An Assessment of the Expected Impacts of City-Level Parking Cash-Out and Commuter Benefits Ordinances

March 28, 2023

U.S. Department of Transportation
Federal Highway Administration

Notice

This document is disseminated under the sponsorship of the U.S. Department of Transportation (USDOT) in the interest of information exchange. The U.S. Government assumes no liability for the use of the information contained in this document. This document does not constitute a standard, specification, or regulation. It is guidance only and does not create any requirements other than those stipulated in statute and regulation.

The U.S. Government does not endorse products, manufacturers, or outside entities. Trademarks, names, or logos appear in this report only because they are considered essential to the objective of the document. They are included for informational purposes only and are not intended to reflect a preference, approval, or endorsement of any one product or entity.

Non-Binding Contents

Except for the statutes and regulations cited, the contents of this document do not have the force and effect of law and are not meant to bind the public in any way. This document is intended only to provide clarity to the public regarding existing requirements under the law or agency policies. While this document contains nonbinding technical information, you must comply with the applicable statutes and regulations.

Quality Assurance Statement

The Federal Highway Administration (FHWA) provides high-quality information to serve Government, industry, and the public in a manner that promotes public understanding. Standards and policies are used to ensure and maximize the quality, objectivity, utility, and integrity of its information. FHWA periodically reviews quality issues and adjusts its programs and processes to ensure continuous quality improvement.

Technical Report Documentation Page

1. Report No. FHWA-HOP-23-023	**2. Government Accession No.**	**3. Recipient's Catalog No.**	
4. Title and Subtitle An Assessment of the Expected Impacts of City-Level Parking Cash-Out and Commuter Benefits Ordinances		**5. Report Date** March 28, 2023	
		6. Performing Organization Code	
7. Authors Gabriella Abou-Zeid, Michael Grant, Susan Heinrich, Deep Shah		**8. Performing Organization Report No.**	
9. Performing Organization Name and Address ICF 9300 Lee Highway Fairfax, VA 22031		**10. Work Unit No. (TRAIS)**	
		11. Contract or Grant No. DTFH61-16-D-00052, Task 693JJ321F000246	
12. Sponsoring Agency Name and Address U.S. Department of Transportation Federal Highway Administration 1200 New Jersey Avenue, SE Washington, DC 20590		**13. Type of Report and Period Covered**	
		14. Sponsoring Agency Code HOTM	
15. Supplementary Notes Allen Greenberg, FHWA Office of Operations			
16. Abstract This project sought to analyze and evaluate the impact city-level parking cash-out ordinances could have on vehicle travel, congestion, greenhouse gas emissions, crashes, and equity externalities for a sample of nine cities and five distinct scenarios, to serve as a resource for municipalities considering enacting parking cash-out ordinances or related policies that would encourage parking cash-out. This report describes, in the main body and included appendices: the scenarios studied; the analysis approach, including inputs, outputs, methodology, limitations, and assumptions; data sources; and results for the sample of cities.			
17. Key Words Parking pricing, parking cash-out, congestion pricing		**18. Distribution Statement** No restrictions.	
19. Security Classif. (of this report) Unclassified	**20. Security Classif. (of this page)** Unclassified	**21. No of Pages** 151	**22. Price** N/A

Form DOT F 1700.7 (8-72) **Reproduction of completed page authorized**.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF EQUATIONS

LIST OF ACRONYMS

ACS	American Community Survey
BLS	Bureau of Labor Statistics
CBD	central business district
CMAP	Chicago Metropolitan Agency for Planning
CO_2	carbon dioxide
CO_2e	carbon dioxide equivalents
CTA	Chicago Transit Authority
CUTR	Center for Urban Transportation Research
DDOT	District Department of Transportation
DVRPC	Delaware Valley Regional Planning Commission
EPA	Environmental Protection Agency
FHWA	Federal Highway Administration
GHG	greenhouse gas
H-GAC	Houston-Galveston Area Council
HTS	household travel survey
MBTA	Massachusetts Bay Transportation Authority
MPO	Metropolitan Planning Organization
MTA	New York Metropolitan Transportation Authority
MWCOG	Metropolitan Washington Council of Governments
NAICS	North American Industry Classification System
NCS	National Compensation Survey
NHTS	National Household Travel Survey
NO_x	oxides of nitrogen
NYMTC	New York Metropolitan Transportation Council
PM-2.5	fine particulate matter
PUMS	Public Use Microdata Sample

RTA	Chicago Regional Transportation Authority
SANDAG	San Diego Association of Governments
SOV	single occupancy vehicle
SUSB	Census Statistics of U.S. Businesses
TDM	transportation demand management
TRIMMS	Trip Reduction Impacts for Mobility Management Strategies
TTI	Texas A&M Transportation Institute
USDOT	U.S. Department of Transportation
VMT	vehicle miles traveled
VRE	Virginia Railway Express
WMATA	Washington Metropolitan Area Transit Authority

EXECUTIVE SUMMARY

For many workers, the decision to drive to work is an economically rational one that minimizes their commute costs. Shoup (1997) estimated that nationwide, 95 percent of commuters receive free parking at work.[1] Compare this to data from the U.S. Bureau of Labor Statistics (BLS) (2021a) that only 9 percent of private industry employees, on average, have access to subsidies to help them pay transit, vanpool, or bicycle commute costs. In many cases, the value of free parking can be substantial; for example, in New York City, the cost of a monthly parking pass in the central business district (CBD) is $655, while even in a mid-sized city such as San Diego, California, the cost is $138 per month (Parkopedia 2020). In most cases, the value of free parking is greater than the cost of riding transit. In effect, employers are incentivizing a behavior that increases roadway congestion, reduces physical activity, and increases emissions. Moreover, since lower-income households are less likely to own and have access to a private vehicle than moderate and higher-income households (FHWA 2020), free parking is a financial benefit that many lower-income employees cannot access. Data from the U.S. BLS (2021b) shows that only 3 percent of employees earning the lowest 10 percent of wages have access to subsidized commuting benefits, compared to 20 percent of employees earning in the highest 10 percent of wages.

Multiple strategies exist to level the playing field among travel modes, provide more equitable benefits, and support more environmentally friendly options. The USDOT's FHWA developed this report to understand the congestion, emissions, crashes (i.e., safety), and equity impacts that may result from parking cash-out, pre-tax commuter benefits, and related policies. The report is part of the agency's ongoing efforts to increase awareness of solutions to address the transportation issues affecting communities in the United States. It was created in coordination with a peer review group made up of representatives from academic institutions and the public sector who provided guidance throughout the study process.

Background

Parking Cash-Out

Parking cash-out is an option that provides employees with a more balanced set of benefits across all modes of transportation. With parking cash-out, employers that provide free or subsidized parking at work also offer employees the option to take an equivalent cash payment, tax-free transit benefit, or tax-free vanpool benefit instead of the parking subsidy. As discussed in the report, this strategy can be (but is not always) revenue neutral for employers while allowing employees to make travel choices that are the most sensible for them.

[1] More recent data from the Society for Human Resource Management (SHRM) estimates that 87% of employers offer free on-site parking for their employees (SHRM 2022). While this figure may be slightly different from the number of employees offered free on-site parking, this demonstrates that the vast majority of employees are likely still offered free on-site parking since Shoup's 1997 study.

Shoup (1997) studied eight firms in southern California and found that the implementation of parking cash-out policies resulted in a 13 percent reduction in drive-alone commute trips and a 12 percent reduction in commute vehicle-miles traveled (VMT). In a study similar to Shoup's, Van Hattum (2009) examined seven employers that implemented parking cash-out programs in the Minneapolis-St. Paul area and found a 12 percent reduction in single occupancy vehicle (SOV) travel. Likewise, Glascock, Cooper & Keller (2003) found a 10 percent reduction in employee parking demand resulting from parking cash-out in Seattle. Outside the U.S., De Borger and Wuyts (2009) found parking cash-out to be associated with a nearly 9 percent reduction in driving commutes and a 17 percent increase in transit use based modeled Belgian data.

Due to its potential to affect travel behavior, multiple government agencies have adopted legislation that encourages or requires employers to offer cash-out to their employees. California, Rhode Island, and Washington, D.C., have laws that require some employers to offer parking cash-out. Other States, including Maryland, Colorado, Delaware, Connecticut, Oregon, and New Jersey use their tax codes to encourage employers to implement parking cash-out programs (MDOT, 2021; Liston et al., 2022; U.S. Environmental Protection Agency (EPA), 2005).

Employer-Paid Commuter Benefits

As a qualified transportation fringe benefit under the Tax Cuts and Jobs Act, Pub. L. No. 115-97, employers may pay up to $280 per month (as of 2022) for their employees' transit or vanpool commuting (as is also the case for employee parking expenses[2]) without any payroll tax or employee income tax obligation being incurred.[3] Employer-provided transit benefits have been demonstrated to result in an increase in the number of employees using transit. A 2005 Transit Cooperative Research Program analysis of 21 surveys conducted in 12 regions from 1989 to 2004 found that employer-paid transit passes generally increase transit ridership 10 percent or more at participating worksites (ICF and Center for Urban Transportation Research (CUTR), 2005).

Pre-Tax Commuter Benefits

Rather than pay for employee commute expenses, an employer can allow employees to set aside their own income on a pre-tax basis to pay for qualified transit or vanpool expenses. As with employer-paid commuter benefits, the pre-tax benefit is also limited to $280 (as of 2022) per month for transit and vanpool costs. Employees save money by reducing their transit and vanpool costs by an amount equal to their marginal tax rate, often 15 percent to 35 percent when accounting for State and Federal income taxes and Social Security and Medicare taxes.

In California, the cities of San Francisco, Richmond, and Berkeley have laws that require employers to offer employees the option to set aside pre-tax dollars for the purchase of transit

[2]Federal law allows these benefits to be combined if, for example, an employee would incur costs to park at a transit station and also to use transit.

[3]Federal tax laws underwent some changes in tax year 2018 as a result of the December 2017 enactment of Pub. L. No.115-97. Prior to 2018, an employer could also deduct the expense of providing these benefits from its taxes.

passes or to pay vanpool expenses (San Francisco Department of the Environment, 2022; City of Richmond 2022; City of Berkeley 2022). Employers that implement these programs save costs on payroll taxes. By reducing out-of-pocket costs for riding transit or vanpools to work, pre-tax commuter benefits can increase the use of these travel modes. Additionally, employers and employees may benefit from transit- or vanpool-based commuting compared to solo driving, as employees are able to use commute time riding these modes more productively. Results from the Metropolitan Washington Council of Governments' (MWCOGs') State of the Commute survey (2020) showed that more than half of commuters surveyed who traveled to work via carpool/vanpool or transit (bus and train) performed work-related tasks during their commute. The rate was highest for transit commuters (58 percent) compared to carpoolers/vanpoolers (38 percent). As suggested in the MWCOG survey, employers may benefit from additional productive time employees are able to spend during a transit commute, while employees may benefit from having additional time to catch up on work tasks, making actual time spent at the workplace less stressful.

Scenarios

This report analyzes the vehicle travel, congestion, emissions, crashes, and equity impacts that city-level parking cash-out, commuter benefit, and related ordinances[4] can have. Cities were selected based on criteria that prioritized those where substantial impacts were expected (i.e., large drive-alone employee populations, higher-priced parking, or high propensity to use transit) and the availability of data to support the analysis. The analyzed cities are as follows:

- Boston/Cambridge, MA
- Chicago, IL
- Houston, TX
- Indianapolis, IN
- Los Angeles, CA
- New York, NY
- Philadelphia, PA
- San Diego, CA
- Washington, DC

Five core policy scenarios were analyzed for nine cities, with the goal of providing a resource for municipalities considering enacting parking cash-out and related policies. The scenarios are meant to provide an overview of potential policy options cities can pursue with regard to cash-out and commuter benefits. The core scenarios analyzed include:

1. **Monthly Parking Cash-Out:** This is an ordinance that requires employers that offer free/subsidized parking to offer employees the option to cash-out their parking on a monthly basis.
2. **Monthly Commuter Benefit (Employer-Paid Transit/Vanpool Benefit):** This is an ordinance that requires employers providing free/subsidized parking to offer employees a transit or vanpool benefit paid by the employer, but not in excess of the value of the parking benefit. These benefits are exempt from payroll taxes and employee income

[4] FHWA has no position on any ordinance discussed or whether an ordinance should be adopted.

taxes, including transit and vanpool benefits up to the maximum allowed by law for each commuter.

3. **Monthly Parking Cash-Out and Pre-Tax Transit Benefit for Employees Without Subsidized Parking:** In addition to requiring that employers that subsidize parking offer a monthly parking cash-out option (same as Scenario 1), all other employers must make pre-tax transit[5] benefits available to all of their employees. This scenario applies a requirement to all worksites—those that provide free or subsidized parking and those that currently do not.
4. **Daily Parking Cash-Out and Pre-Tax Transit Benefit for Employees Without Subsidized Parking:** This scenario is the same as Scenario 3 with the difference that the parking cash-out must be offered as a *daily* cash-out option, rather than monthly. In addition to requiring that employers that subsidize parking offer a daily parking cash-out option, all other employers must make pre-tax transit[5] benefits available to all of their employees. This scenario applies a requirement to all worksites—those that provide free or subsidized parking and those that currently do not.
5. **Requirement to Eliminate Subsidized Parking Benefit + Provide Universal $5 Per Day Employer-Paid Non-SOV Commute Benefit:** An ordinance that requires employers that are offering their employees free/subsidized parking to cease offering it and for all employers to offer an employer-paid non-SOV commute benefit of $5 per commute day. The non-SOV commute benefit would be exempt from taxes to the extent allowed by law for eligible modes (e.g., for transit and vanpool expenses).

Analysis

The scenarios were analyzed independently using unique methodologies that included some shared assumptions and methods. Scenario 1 served as a baseline for much of the analysis. Impacts associated with Scenario 1 were estimated two ways. First, impacts were estimated using the Trip Reduction Impacts for Mobility Management Strategies (TRIMMS) model, which was developed by the University of South Florida (CUTR, 2018). This methodology applies estimated changes in the costs of parking to estimate mode shifts. In cities with low initial drive-alone rates, the shift to non-drive-alone modes seemed unreasonably high, likely due to an internal calculation within the TRIMMS model that accounts for initial mode share. To overcome this issue, a second methodology was used to calculate resulting mode shares for Scenario 1 impacts. The second methodology calculated travel behavior change directly using a demand elasticity of -0.30. The elasticity value was selected after significant literature review and in coordination with the peer review group. The mode share results derived from the two

---

[5]Note that pre-tax transit laws typically allow employees to pay for both vanpools and transit service in a pre-tax manner. In estimating the impact of pre-tax transit benefits for employees *without* subsidized workplace parking, Scenarios 3 and 4 relied on a transit elasticity reflecting changes in transit ridership specifically with respect to transit costs. Given this was a transit-specific measure, it was applied only to estimate changes in transit ridership (vs. transit/vanpool ridership) for this population under this policy. The research team expected such results to be reasonable, even with vanpool impacts unaccounted for, given low (<1%) starting vanpool mode shares for this population. Additional information on methodologies can be found in this report's main body, as well as in Appendix C. Data and Analysis Methodology.

methodologies were averaged to arrive at a single value. Then, VMT reductions were estimated using the average mode shares along with vehicle trip length, occupancy, and employee population data.

The impacts of Scenarios 2 through 5 were estimated using results or methodologies from Scenario 1. The impacts of daily cash-out were estimated to facilitate an additional 16 percent shift away from driving alone compared to monthly cash-out based on results from a study of a form of daily cash-out in Minneapolis (Lari et al., 2014). The impacts of pre-tax commuter benefits were estimated manually using a transit elasticity of -0.15 (reflecting the response of transit use in relation to a change in transit price), which was similarly selected after significant literature review and in coordination with the peer review group.

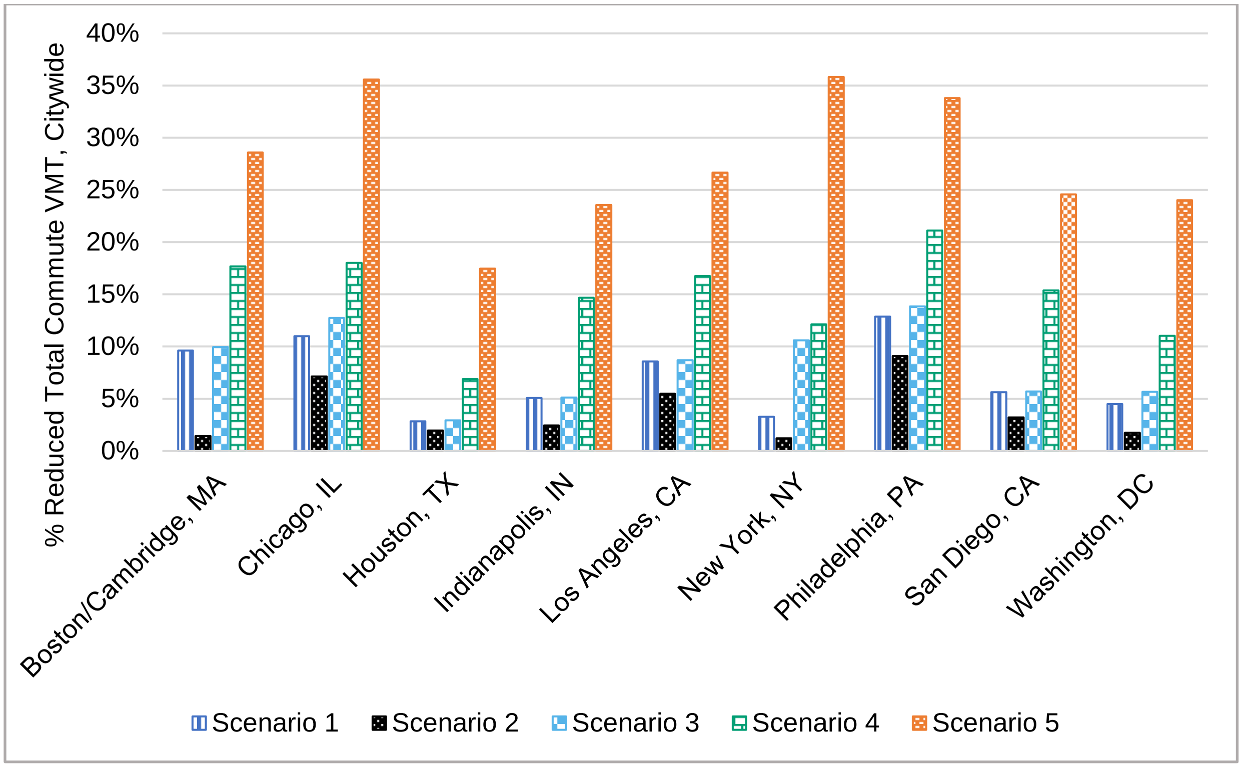
The methods applied in this report assume that employers will fully adopt and comply with hypothetical ordinances and that no transit capacity restrictions interfering with mode shifts to transit will occur. Baseline data were collected for each city and included work-trip mode split, average auto commute trip length, monthly parking prices, and the percentage of employees with access to free parking. The analysis assumed expected near-term conditions associated with commuting patterns accounting for post-COVID-19 pandemic telework expectations (i.e., assumes a higher level of telework than data showed for cities pre-COVID).

Results

Table 1 and figure 1 show the reductions in daily commute-related VMT that were estimated for each scenario and each city. Results are shown with respect to citywide commute-related VMT, not just for affected commuters.

Table 1. Percent reductions in daily citywide commute VMT by scenario and city.

City	S1: Monthly Cash-Out	S2: Monthly Commuter Benefit	S3: Monthly Cash-Out + Pre-Tax Transit Benefit	S4: Daily Cash-Out + Pre-Tax Transit Benefit	S5: Eliminate Parking Subsidies + $5 Non- single occupancy vehicle (SOV) Subsidy
Boston/Cambridge, MA	10%	1%	10%	18%	29%
Chicago, IL	11%	7%	13%	18%	36%
Houston, TX	3%	2%	3%	7%	17%
Indianapolis, IN	5%	2%	5%	15%	24%
Los Angeles, CA	9%	5%	9%	17%	27%
New York, NY	3%	1%	11%	12%	36%
Philadelphia, PA	13%	9%	14%	21%	34%
San Diego, CA	6%	3%	6%	15%	25%
Washington, DC	4%	2%	6%	11%	24%



Source: FHWA.

Figure 1. Graph. Percent Reductions in daily citywide commute VMT by scenario and city.

The impacts vary by scenario and city based on a range of factors, including parking prices, transit fares, and the share of employees receiving free/subsidized parking and transit benefits.

- The two monthly cash-out scenarios—Scenario 1 (monthly parking cash-out) and Scenario 3 (a requirement that employers that do not provide free parking offer a pre-tax transit benefit in addition to monthly parking cash-out for those offering free parking)—show significant potential for reducing daily VMT. Scenario 3 builds on Scenario 1 and applies an additional requirement for employers that do not currently offer free parking to offer pre-tax benefits. As such, reduction potential of Scenario 3 is slightly higher than that in Scenario 1. While the effects of offering pre-tax benefits, where employees set aside their own money for transit, is likely to be small compared to an employer-paid benefit, this policy is assumed to apply to a large population of employees in many cities who do not currently receive free parking.
- Scenario 2 (the option of an employer-paid monthly transit/vanpool benefit in lieu of free parking) shows more modest reductions than the monthly cash-out scenarios. Instead of offering cash, employers in this scenario are required to pay for tax exempt transit or vanpool commute modes in lieu of parking. Even in cities where the assumed average transit fare is high, driving reductions were smaller than those in Scenario 1; fewer employees are likely to take a transit-only benefit as compared to a typically higher cash offer (with a tax-free transit benefit option), since some of those employees may choose to take the cash-out and carpool, bicycle, or walk.

- Scenario 4 (a requirement that employers that do not provide free parking offer a pre-tax transit benefit in addition to *daily* parking cash-out for those offering free parking) shows greater reduction potential than Scenario 3 because it assumes that if employees are offered a daily cash-out, which is more flexible than a monthly option, more employees will take the offer and reduce their driving. The difference between the results for Scenarios 3 and 4 is less pronounced in cities where a lower proportion of employees are offered the cash-out opportunity since free/subsidized parking is less prevalent (e.g., New York City).
- Under Scenario 5 (a requirement that all employers eliminate subsidized parking and provide a universal $5 daily non-SOV commute benefit), employees who drive to work alone would suddenly face a new cost to their driving (parking). This scenario offers the greatest reduction potential in all cities, likely because it eliminates parking subsidies entirely, offers equal non-SOV commute benefits for all non-SOV modes regardless if employees previously received free/subsidized workplace parking or not, and it would yield the additional shift away from driving alone shown in Scenario 4 due to the provision of a daily benefit.

Across all scenarios, it is clear that strategies designed either to make employer-provided commute incentives mode neutral or to specifically disadvantage drive-alone commute trips could have a significant impact on vehicle travel associated with employee commute trips. Scenario 1, the basic monthly cash-out requirement, reduces commute-related VMT by an average of over 7 percent across all analyzed cities, with wide variation among the cities—from about a 3 percent reduction in New York City, where few employees currently receive free parking, to a 13 percent reduction in Philadelphia. Daily versus monthly cash-out policies may yield greater impacts. Given that most of this reduction would occur during peak commute hours, the potential of parking cash-out to reduce congestion and minimize other negative externalities associated with vehicle travel is significant.

Impacts on other driving-related externalities (i.e., congestion, emissions, and crashes) generally reflect the observed patterns of VMT reduction when comparing scenarios within each city. Namely, Scenario 5 achieves the greatest impacts to reduce congestion, emissions, and crashes given its high VMT reduction potential relative to other scenarios. In addition to maximizing VMT reduction potential, Scenario 5 is also thought to maximize the benefits offerings across the analyzed scenarios, given the equal distribution of non-SOV benefits between employees receiving and not receiving free parking (especially where the lowest-income commuters may be less frequently offered free parking as a commuter benefit). These other impacts are discussed in greater detail in Chapter 4 of the main report.

CHAPTER 1. BACKGROUND

The USDOT recognizes the importance of parking pricing and commuter benefits to achieving congestion reduction goals and helping localities to meet driver expectations about parking availability. As part of its effort to reduce congestion and other driving-related externalities, the USDOT FHWA developed *Contemporary Approaches to Parking Pricing: A Primer,* which discussed innovative parking pricing programs.[6] The agency subsequently held 11 regional parking pricing and management workshops throughout the country to document and share lessons learned from a number of innovative parking pricing initiatives it had funded. As part of these broader efforts, parking cash-out was identified as a key strategy with the potential to relieve peak-period congestion and reduce parking demand through the reduction of employee vehicle trips. This study analyzes how citywide cash-out and related policies could impact travel behavior and transportation systems.

Parking Cash-Out

Parking cash-out is an option that provides employees with a more balanced set of benefits across all modes of transportation. Employees who choose to give up their employer-provided or employer-subsidized parking benefit are offered a payment that can be used to purchase transit or vanpool services or be kept as taxable cash. Cash-out programs can be offered on a monthly basis, in which employees decide to give up parking for the month, or on a daily basis, in which employees receive a set amount of money for each day that they choose to not drive to work.

The vast majority of employers nationwide provide their employees free parking at work, while only 9 percent of private sector employees are offered other transportation commute benefits (U.S. BLS 2021a). Parking cash-out holds promise to substantially reduce congestion because it applies a value to a commodity that is often perceived as free. Furthermore, both employers and employees can benefit from parking cash-out. Employees who accept a cash-out offer and utilize lower-cost travel modes, such as carpooling, transit, bicycling, or walking, can save the additional cash income or use it for non-travel purposes. Employers can benefit by reducing the expense of purchasing, maintaining, or expanding parking, and parking cash-out can be seen as an employee benefit that supports employee recruitment and retention.

Because, as noted above, employers reduce their parking expenses when their employees who had been driving accept a parking cash-out offer, the policy would on its face appear to be revenue neutral to employers. Changes in benefits, though, can add to employer costs. In the case of parking cash-out, parking benefits taken as a wage increase impose a small payroll tax burden on employers (and employees). Similarly, some employees accepting a cash-out offer may have previously declined a parking benefit prior to cash-out having been offered. In such instances, employers could not use parking cost savings to fund the cash-out payments. However, as employers retain complete control over the level of commuter benefits that they offer, and can change such level at any time of their choosing, they can thus make changes to their programs

[6] See *Contemporary Approaches to Parking Pricing: A Primer:* https://ops.fhwa.dot.gov/publications/fhwahop12026/

after a parking cash-out requirement is imposed—such as by levying a very small charge on employee parking—to ensure that their commuter benefits related expenditures do not rise.

California, Rhode Island, and Washington, D.C., have laws that require some employers to offer parking cash-out. In California and Rhode Island, the laws apply to employers with 50 or more employees that subsidize parking and are able to reduce, without penalty, the number of paid parking spaces they maintain. California's law applies to employers in an air basin designated nonattainment for any State air quality standard (California EPA Air Resources Board, 2021). Rhode Island's law applies only to employers that are located within one-quarter mile of a Rhode Island public transit service. Unlike California, Rhode Island employers are not required to provide a cash payment, but must instead provide monthly transit passes (Rhode Island, 2014). The District of Columbia's law applies to employers with 20 or more employees in Washington, D.C., but excludes most companies that own versus lease their parking. Companies that opt not to offer the benefit (in an amount equal to or greater than the monthly market value of the parking benefit) can instead pay a Clean Air Compliance fee of $100 a month for each eligible employee to the District Department of Transportation (DDOT) or create and implement a transportation demand management (TDM) plan certified by DDOT as likely to achieve or speedily move toward achieving an employee drive-alone mode split of 25 percent or less[7] (Wilson 2022).

Other States use their tax codes to encourage employers to implement parking cash-out programs. Maryland offers a 50 percent tax credit, up to $100 per individual employee per month, to employers that implement parking cash-out programs (MDOT, 2021). The credit covers costs associated with providing the cash-out. In 2022, Colorado's State legislature passed HB22-1026, the Alternative Transportation Options Tax Credit, which offers a 50 percent refundable income tax credit for employers for expenses incurred when providing alternative transportation options to employees.[8] The bill defines alternative transportation options as "free or partially subsidized, generally accepted TDM strategies, including but not limited to ridesharing arrangements, provision of ridesharing vans or low-speed conveyances such as human-powered or electric bicycles, shared micromobility options such as bikesharing and electric scooter sharing programs, carsharing programs, and guaranteed ride home programs" (Liston et al., 2022). Delaware, Connecticut, Oregon, and New Jersey offer tax credits to companies that implement TDM programs, which can include parking cash-out (U.S. EPA, 2005).

Employer-Paid Commuter Benefits

As a qualified transportation fringe benefit under the Tax Cuts and Jobs Act, Pub. L. No. 115-97, employers may pay up to $280 per month (as of 2022) for their employees' transit or vanpool

---

[7]As of 2019, the drive-alone mode share in Washington, D.C., is estimated at 42%, based on American Community Survey (ACS) 2019 5-Year Estimates, Modeshare by Workplace City (Place Geography) Table B08601: Means of Transportation to Work by Workplace Geography.

[8] See more information on HB22-1026 here: https://leg.colorado.gov/bills/hb22-1026

commuting (as is also the case for employee parking expenses[9]) without any payroll tax or employee income tax obligation being incurred[10]. Employer-provided transit benefits have been demonstrated to result in an increase in the number of employees using transit. A 2005 Transit Cooperative Research Program analysis of 21 surveys conducted in 12 regions from 1989 to 2004 found that employer-paid transit passes generally increase transit ridership 10 percent or more at participating worksites (ICF and CUTR 2005).

Pre-Tax Commuter Benefits

Rather than pay for employee commute expenses, an employer can allow employees to set aside their own income on a pre-tax basis to pay for qualified transit or vanpool expenses. As with employer-paid commuter benefits, the pre-tax benefit is also limited to $280 (as of 2022) per month for transit and vanpool costs. Employees save money by reducing their transit and vanpool costs by an amount equal to their marginal tax rate, often 15 percent to 35 percent when accounting for State and Federal income taxes and payroll taxes.

Employers that implement these programs save costs on payroll taxes. By reducing out-of-pocket costs for riding transit or vanpools to work, pre-tax commuter benefits can increase the use of these travel modes. Additionally, employers and employees may benefit from transit- or vanpool-based commuting compared to solo driving, as employees are able to use commute time riding these modes more productively. Results from the MWCOGs' State of the Commute survey (2020) showed that more than half of commuters surveyed who traveled to work via carpool/vanpool or transit (bus and train) performed work-related tasks during their commute. The rate was highest for transit commuters (58 percent) compared to carpoolers/vanpoolers (38 percent). As suggested in the MWCOG report, employers may benefit from additional productive time employees are able to spend during a transit commute, while employees may benefit from having additional time to catch up on work tasks, making actual time spent at the workplace less stressful.

In California, the cities of San Francisco, Richmond, and Berkeley have laws that require employers to offer employees the option to set aside pre-tax dollars for the purchase of transit passes or to pay vanpool expenses. The San Francisco law impacts all businesses, including nonprofit organizations. Employers must offer their employees one of the following: 1) a pre-tax benefit up to $280 per month to pay transit or vanpool expenses, 2) a monthly subsidy for transit or vanpool expenses equivalent to the price of a San Francisco Muni Fast Pass, 3) a company-funded bus or van service to and from the workplace, or 4) any combination of the previous items (San Francisco Department of the Environment, 2022). The Berkeley and Richmond laws apply to employers with 10 or more employees (City of Richmond 2022; City of Berkeley 2022). Further, businesses in the Bay Area with 50 or more employees must offer employees one option between pre-tax transit benefits, subsidized transit or vanpool costs, provision of low-cost transit service, or an alternative benefit suited for reducing SOV commuting (MTC 2021). New York

[9] Federal law allows these benefits to be combined if, for example, an employee would incur costs to park at a transit station and also to use transit.

[10] Federal tax laws underwent some changes in tax year 2018 as a result of the December 2017 enactment of Pub. L. No.115-97. Prior to 2018, an employer could also deduct the expense of providing these benefits from its taxes.

and Washington, D.C., also have pre-tax transit benefit laws, and both apply to employers with 20 or more employees (Huff 2020; NYC Consumer and Worker Protection 2020).

Policy Scenarios Introduction

This report analyzes the impact that city-level parking cash-out, commuter benefit, and related ordinances can have on vehicle travel, as well as congestion, emissions, crashes, and equity. Five core policy scenarios were analyzed for nine cities, with the goal of providing a resource for municipalities considering enacting parking cash-out and related policies. This report provides information that can guide the creation of policies that encourage changes in travel behavior that decrease the incidence of solo driving in urban areas and provides methodologies to help policy makers estimate the likely impact of the congestion reduction strategies that are examined.

The report includes a literature review, which summarizes study results that were used to analyze the five core policy scenarios. This is followed by a discussion of the various scenarios, a description of the methodology used to analyze the scenarios, and a summary of the analysis results.

A Note on Implementation

The analysis presented in this document is, as mentioned, focused on impacts of city-level parking cash-out, commuter benefits, and related ordinances impacting vehicle travel, congestion, emissions, crashes, and equity. This report does not provide strategies for implementation and enforcement related to the modeled scenarios. In recognition of the importance these topics will carry for parties considering implementation, however, APPENDIX A. IMPLEMENTATION RESOURCES, summarizes some external resources on this topic that may be of interest to some readers.

Peer Review Group

A peer review group consisting of parking practitioners and researchers from government and academic institutions assisted FHWA in developing this study. Individuals were recruited to participate in the group based on their background related to cash-out, their organization's experience or interest in testing and studying cash-out policies, and their knowledge of data and research applicable to the study. Five meetings were held with the group at key points during the study process in order to obtain input on matters such as what cities to include in the analysis, policy scenarios to analyze, best practices information, data sources, analysis methodology, and the presentation of results. The peer review group included:

- John Attanucci, Massachusetts Institute of Technology
- Lindsay Bayley, Chicago Metropolitan Agency for Planning (CMAP)
- Chris Hagelin, City of Boulder
- Andrea Hamre, Western Transportation Institute
- Donald Shoup, University of California, Los Angeles
- Colleen Stoll, City of Santa Monica
- Don Pickrell, Volpe National Transportation Systems Center

- Todd Litman, Victoria Transport Policy Institute
- Rachel Weinberger, Regional Plan Association
- Adam Millard-Ball, University of California, Los Angeles
- Brett Wood, Wood Solutions Group
- Phil Winters, CUTR
- James Choe, Metropolitan Transportation Commission

These individuals were instrumental to this study; however, FHWA staff was responsible for all final decisions regarding the analysis and the presentation of results. The participation of individuals in the peer review group should not be construed as an endorsement of the study results by those individuals nor their agencies or organizations.

CHAPTER 2. LITERATURE REVIEW

The project team reviewed available research on the effects of cash-out and changes to the price of transit and parking. While a handful of studies have been conducted to estimate the impact of cash-out policies and changes in parking and transit prices on commute mode choice, no city level policy studies were found.

Parking Elasticities

In a comprehensive analysis of eight parking cash-out programs in Southern California, Shoup (1997) found such programs were associated with a 13 percent reduction in single-occupant driving, an 11 percent reduction in vehicle trips per commuter per day, and a 12 percent reduction in vehicle miles traveled (VMT). The average price elasticity of demand for parking at the eight employer sites was -0.15. Van Hattum (2009) conducted a similar study of seven employer sites in Minneapolis-St. Paul where parking cash-out programs were implemented and found a 12 percent reduction in SOV travel. Likewise, Glascock, Cooper & Keller (2003) found a 10 percent reduction in employee parking demand resulting from parking cash-out in Seattle. Outside the U.S., De Borger and Wuyts (2009) found parking cash-out to be associated with a nearly 9 percent reduction in driving commutes and a 17 percent increase in transit use based modeled Belgian data.

Shoup (2005) reviewed seven studies conducted between 1969 and 1991 that analyzed the effect of employer-paid parking on SOV commute rates. The review found that when employers paid for parking in analyzed areas, on average, 67 percent of employees drove alone. When employees paid for parking in the same areas, the average drive-alone rate dropped to 42 percent. Price elasticity of demand for parking at the various employment sites ranged from -0.08 to -0.23, and the mean was -0.15.

Concas and Nayak (2012) conducted a meta-analysis of parking price elasticity of demand in which they reviewed 25 related articles that included 169 elasticity variables. The studies covered multiple countries, and elasticity values ranged from -6.22 to zero, with a mean value of -0.482. The authors developed a model to explain the variation in elasticity estimates based on factors such as geographic location, estimation method, and data type. Their model, applied to estimate an elasticity for the United States (using econometric techniques), yielded a parking price elasticity of -0.39.

Litman (2022a) conducted an extensive literature review of transportation price elasticities and generally found that the demand for vehicle trips with respect to parking price ranges from -0.1 to -0.3, with significant variations due to demographic, geographic, and trip characteristics. While short-run and long-run elasticities are not explored for parking pricing, Litman (2022a) summarizes other short-run and long-run price elasticities related to travel demand, where long-run values are typically two to three times short-run values. In general, commuters may be more responsive to changes in pricing over a long-time horizon, given additional time to adjust behaviour, compared to over a short-term horizon.

In a study conducted for the San Francisco County Transportation Authority (2016), researchers modeled travel demand for five parking policy scenarios, including a cash-out scenario in which drivers paid 75 percent of the parking cost. Model results showed the proportion of vehicle commuting trips fell in the Northeast Cordon (downtown business district) and citywide by 9 percent and 6 percent, respectively. Further analysis showed parking arc elasticities associated with cash-out are -0.45 for destinations within the Northeast Cordon and -0.06 elsewhere in San Francisco, which may be a result of fewer alternative mode options outside of the downtown business area.

A study conducted by Knittel and Tanaka (2019) provides new insights on price elasticities and vehicle travel, although the data used is based on drivers located in Japan. Using mobile phone data for more than 90,000 drivers, the authors found the price elasticity for vehicle kilometers traveled to be -0.30.

Shin (2020) utilized the Puget Sound Regional Travel survey to evaluate how commuting behaviors are related to commuter incentive programs. The Puget Sound region is subject to Washington State's Commute Trip Reduction Law, which requires certain employers to have TDM programs.[11] Shin first examines the relationship between various benefits and commuter mode choice. Results show that transit-related benefits (i.e., free or subsidized transit passes) are associated with higher probabilities of commuting via public transport, non-motorized transport, and carpooling relative to driving alone. In contrast, employer-subsidized parking reduces the likelihood of commuting by these modes compared to driving alone.

Additionally, Shin (2020) finds that transit benefits are not only associated with lower worker commute trip VMT, but also with lower non-work trip VMT. On average, workers with transit benefits are expected to drive 3.16 miles and 1.15 miles fewer for commute and non-work trips daily, respectively. In contrast, workers with free workplace parking drive 3.13 miles and 0.99 miles more for commute and non-commute trips daily on average, respectively. When controlling for workplace transit accessibility and employment density in addition to residential built environment characteristics, Shin finds workers with transit benefits drive 2.19 *fewer* miles for work trips and drive 0.83 *fewer* miles for non-work trips on average compared to workers without transit benefits. In contrast, workers with free workplace parking are expected to drive 2.48 *more* miles for work trips and 0.78 *more* miles for non-work trips on average compared to workers without free workplace parking.

Shin found that the availability of free workplace parking benefits for a given worker significantly impacted the VMT of the other members in the workers' household differently than their own. Namely, other members of the same households were expected to have *lower* work and non-work VMT (such a reverse relationship was not discovered for transit benefits). The differing impacts on free workplace parking make intuitive sense as workers with parking may add additional VMT by adding stops to their commute trips while other household members would then have fewer trips they would need to make for the household. Shin also notes one possible explanation is related to residential choice: "[w]orkers, on average, are found to live closer to their workplaces if their household members (except for themselves) are offered

[11] See more about Washington State's Commute Trip Reduction Law here: https://wsdot.wa.gov/business-wsdot/commute-trip-reduction-program

employer-sponsored parking benefits; however, average commute distance is statistically significantly longer for workers who have their own parking benefits than for those without" (p. 15). Overall, Shin's work demonstrates spillover effects of various commuter benefits, into both non-work VMT for a given worker, as well as total VMT for others in their household. The differing directional relationships introduce ambiguity into the aggregate effect on VMT and thus no adjustments are made to the analysis here due to Shin's research.

As such, policies implementing employer-subsidized transit benefits may offer additional VMT reductions (along with subsequent congestion, crash, and emissions reductions). The extent of these reductions is dependent on many factors, including how transit benefits are offered to employees (e.g., as a monthly pass or not). For example, a member of the peer review group convened for this study noted her employer in Los Angeles paid a per-trip fee associated with employee transit passes. As such, employees had to log their trips and were asked to only use their employer-paid benefits for work trips. Conversely, another member noted that in Boulder, CO, there is evidence that employees with access to free transit passes are more likely to use transit for non-work trips and are also more likely to bike to work more.

In a study of German commuters, Evangelinos et al. (2018) found parking cash-out offerings significantly reduce the probability of commuting by car, even when restricting the sample to vehicle-only commuters. For these commuters, parking cash-out values offered were equivalent to the cost of a transit pass rather than the cash value associated with the parking space.

Brueckner and Franco (2018) develop a theoretical model based on a simplified version of a city divided between a suburban and central zone, connected by a roadway and transit line. Assuming the optimal allocation of resources, the authors' theoretical model results reveal the percentage of commuters traveling by car goes from above 80 percent to around 50 percent as the share of parking costs covered by employers goes from zero to 100 percent. Using data from a stated choice experiment of commuters in Nanjing, China, Ding and Yang (2020) found a 25 percent increase in parking cost was associated with an 8.7 percentage point reduction in auto mode share, while 50 percent, 75 percent, and 100 percent increases in parking costs were associated with 14.3, 19.1, and 19.9 percentage point reductions in auto mode share, respectively. It should be noted, however, that commute locations were to Nanjing's CBD and starting mode choice probability for commuting by car was only 26.2 percent, compared to 24.6 percent for bus and 49.2 percent for rail.

In a study using the 2012 California Household Travel Survey, Khordagui (2019) modeled the decision to drive in a hypothetical scenario where all commuters pay for parking or take an equivalent parking cash-out incentive based on the average paid parking price in the workplace zip code. Model results show a 10 percent increase in the price of parking (and subsequently the cash-out value) is associated with a reduction in the probability of driving alone to work of one to two percentage points, with the lower end result related to the "parking opportunity cost scenario," which attempted to explore the opportunity cost of free parking based on the prevalent parking price in each geography. The marginal effects vary with prices and the relationship is not linear, but the study notes these findings correspond to a parking price elasticity range of -0.13 to -0.26. It suggests that this result is generally in line with, and at the lower end of, some prior studies, such as a study by Su and Zhou (2012) reporting an elasticity of -0.23 and Washbrook et al. (2006) who report an elasticity of -0.30.

Travel and Transit Elasticities

Beyond elasticities associated with parking price, travel behavior may also be examined through transit price elasticities (reflecting expected changes in transit use in response to transit price). Here, elasticities range widely depending on a number of factors, including the type and level of transit service, user type, and time of use. Litman (2015) suggests the ranges for peak commute transit elasticities with respect to prices should be -0.15 to -0.30 in the short term, and -0.40 to -0.60 in the long term. However, Litman (2015) notes the elasticities could be as high as -0.8 to -1.0 for suburban commuters, which could make up a significant portion of the employee population taking a transit benefit. A study by Gillen (1994) provided disaggregated transit elasticities and identified an elasticity range of -0.10 to -0.19, which is specific to work trips.

There is also rich literature on short-run and long-run price elasticities of demand for gasoline consumption. Litman (2022a) compiles several such studies placing the short-run price elasticity of demand ranging between -0.11 and -0.27 compared to between -0.58 and -0.71 in the long-run. This aligns with earlier findings from Espey (1996), who found a short-run elasticity of -0.26 and a long-run elasticity of -0.58.

Greenberg and Evans (2015) conducted a review of travel price elasticity data as part of an effort to estimate the impact of cash-out, pay-as-you-drive car insurance, and the conversion of State and local sales taxes on newly purchased vehicles to mileage taxes. The base of the analysis is the overall variable driving cost, which focuses on per-mile fuel costs. With an initial parking price of zero, the percentage increase in the price of driving is derived by summing the new parking price (which could be presented through cash-out as an "opportunity cost") and the pre-existing fuel price and comparing it with the pre-existing fuel price on its own. According to Greenberg and Evans, converting results from studies of the elasticity of demand for VMT with respect to fuel price to an elasticity of VMT with respect to the per-mile price of driving yields elasticities ranging from -0.22 to less than -0.50. Such a conversion is performed by first recognizing that because part of the response to higher fuel prices is mileage shifting to more efficient vehicles and more fuel-efficient driving, the per mile price of driving experienced by drivers rises, on average, by a lower percentage than the fuel price. Citing the compendium of studies in Litman (2022a), Greenberg and Evans justify attributing fuel savings from higher fuel prices evenly between reduced mileage and better fuel economy. The change in the per mile cost of driving, then, is essentially assumed to be half of the change in the cost of fuel when calculating the price elasticity of demand for VMT. Greenberg and Evans settle on an elasticity of demand for VMT with respect to the per mile price of travel as -0.30 and also note that three other major studies use this same value.

Considerations in Applying Elasticities

The use of parking price and per-mile travel cost elasticities to estimate the impacts of parking cash-out policies could raise some concerns for analyses covering relatively short time periods.

This is because the manner in which commuters respond to cash-out payments tied to the loss of a parking space may be different than how they respond to increases or decreases in direct parking charges or per-mile travel costs.

Research from Thaler (1980) notes an “endowment effect,” which could apply here by considering that the aggravation that some consumers may experience from giving up a parking space they had already begun to use could exceed the pleasure they would receive from accepting a cash-out. Thaler concluded that “[t]he aggravation that one experiences in losing a sum of money appears to be greater than the pleasure associated with gaining the same amount” (p. 43). He also discussed a well-known economic theory called the “endowment effect,” noting that it causes “a certain degree of inertia [to be] introduced into the consumer choice process since goods that are included in the individual’s endowment will be more highly valued than those not held in the endowment” (p. 44).

While loss aversion may affect current holders of parking spaces, it would not affect new employees. However, discussions with the peer review group for this study highlighted that the endowment effect would not be in play for new employees, who would not have experienced free parking prior to choosing between parking and cash. This statement is supported by Thaler who, as noted above, said that the endowment effect applies to items that are “held” by the individual. This means that if the endowment effect does impact behavior as it relates to parking cash-out, that effect is likely to decrease over time as employees turn over. For this reason, the project team determined that it is acceptable to model cash-out related behavior change using travel and parking cost elasticity data.

Considerations for Monthly and Daily Parking Cash-Out

The above studies primarily focused on the impact of monthly cash-out policies, but responses to cash-out offers may vary depending on how a program is implemented. Two survey-based studies were conducted in Dublin to determine employee preferences for different cash-out program parameters. Commuter surveys administered by both Farrell et al. (2005) and Watters et al. (2006) found that, when presented with scenarios under which commuters would have to give up their parking space, surveyed participants overwhelmingly opted for daily cash-out options over annual, monthly, or one-time payouts. This was true even in the absence of monetary values associated with cash-out options in the Farrell et al. (2005) survey and even when daily cash-out resulted in the lowest potential monetary gain in the Watters et al. (2006) study.

In Minneapolis, researchers worked with FHWA, the Minnesota Department of Transportation, Metro Transit, and the City of Minneapolis to target monthly contract holders in city-owned parking lots, offering a variety of cash-out offerings, including daily cash-out where monthly parkers received some financial renumeration when not parking (Lari et al., 2014). In one phase of the study, the effects of two different daily-parking cash-out offerings were evaluated. For users who opted for a free daily transit pass and $2 rebate on days where transit was taken instead of driving, the lowest average monthly SOV rate across the nine months of the study was 68 percent, compared to 75 percent at the end of the study and 83 percent prior to the study. Users who opted for the same transit rebate scheme plus a $7 daily rebate when neither parking nor transit was used exhibited a 72 percent SOV rate prior to the study and 60 percent SOV rate at the end of the study. This offering is very analogous to parking cash-out.

Equity

Lower-income households are less likely to own and have access to a private vehicle than moderate and higher-income households (FHWA, 2020). Additionally, low-income households are increasingly dependent on walking, biking, and transit for their travel. As such, free parking is a financial benefit that many lower-income employees cannot access. This challenge is expected to increase as a result of especially high vehicle prices, topping $47,000 for the average new vehicles (Cox Automotive, 2022a) and $28,000 for the average used vehicles (Cox Automotive, 2022b) in mid-2022. It follows that parking cash-out and related commuter benefits policies can enhance equity by providing cash or an alternative benefit for employees who may not be able to use free/subsidized parking.

This consideration is certainly nuanced, as low-income households who *do* primarily rely on vehicle travel may have less of an ability to shift to other, non-vehicle modes, particularly if they are not located near high-quality transit or supportive active transportation infrastructure. Dong et al. (2012) make a strong point regarding cost responsiveness to auto use by income. Namely, the authors note that higher income households might be expected "to be less price sensitive than lower income ones, but … realize that poorer people spend a good deal more of their travel budgets on necessary trips, such as commuting. So they may have little choice but to pay the extra travel cost imposed: or they may have to stay home if the trip is of a more discretionary nature. Either way, they are often dependent on their current travel option. Higher and middle-income households, in contrast, may find it easier to drop some discretionary trips if fuel or other prices rise sharply. Over the longer run they also have more opportunities to adapt their lifestyle to absorb additional travel expenditures" (p. 11).

The team looked at whether price elasticity for car travel among lower-income workers, and specifically for car commuting where such data may be available, is different than for higher-income workers. This is an equity issue because if price elasticity were to be higher for low-income workers then they would be more likely to shift behavior and subsequently benefit financially more than others. So far, the data seems inconclusive, indicating that while fewer low-income workers drive to work in the first place, they do not seem to alter their behavior noticeably more than others when the price of driving does change. One recent Swedish study of app-based travel incentives supports this; in addition to income level, homogenous responses to pricing were found across age and education levels, although there were differences observed by gender (Axhausen et al., 2021). A report published by the Victoria Transport Policy Institute identifies patterns found in pricing and transport research, including that higher-income travelers are less sensitive to pricing than lower-income travelers (Litman, 2022c).

In contrast, a study by Gillingham (2013) finds heterogeneity across income groups in their VMT response to (gasoline) prices; however, results from this work indicate higher income households tend to be more responsive to pricing than lower income households. Gillingham suggests some potential explanations for this, including more observed discretionary driving trips, higher levels of vehicle ownership and within-household vehicle switching, and potential to shift from driving to flying for some trips in wealthier households. Gillingham notes this finding is in contrast to other work in this area. West (2004) and West and Williams (2004) find that lower-income households are more responsive to gas price changes. Inconsistent findings related to price responsiveness here may be due to differences in commuting and work-based travel experienced across income and industries. It is difficult to make a clear inference from these results, not only due to their somewhat contradictory results, but also because gas price responsiveness may not be fully aligned with responses to parking pricing.

Literature examining responsiveness to parking pricing by income is sparser than that looking at responsiveness to fuel costs. A Transit Cooperative Research Program report (Vaca and Kuzmyak, 2005) notes that "model-derived analyses…suggest that parking pricing impacts, as measured by SOV trip reduction, may be as much as eight times greater for trip makers in the lowest income quintile as for travelers in the highest quintile" (p. 13-6). These analyses, however, rely on simulated (versus empirical) data based on the 1995 Census Public Use Microdata Sample (PUMS) for Sacramento and Los Angeles. Further, they examine price influences on the proportion of work trips taken by SOV, not VMT.

Despite limitations in clear available data on parking price responsiveness by income level, equity of the current analysis can be evaluated through comparison to other data sources looking at auto ownership levels and the provision of benefits across income levels. A later section of this report presents such an evaluation.

CHAPTER 3. CITY AND SCENARIO SELECTION

Several cities and scenarios were considered for inclusion in the analysis. This section describes the process (including the factors considered) for selection of the five core scenarios (with a few extensions) and nine cities analyzed.

Scenarios

The research team developed a range of potential policy scenarios to consider and used this initial list to select five policy scenarios for the final analyses. Appendix B. Additional Scenarios Considered for Analysis provides a discussion of the initial long list of potential policy scenarios, which may be of value to cities considering various policy options to reduce congestion, parking demand, and related externalities.

The following were the five scenarios selected for analysis:

1. Monthly parking cash-out
2. Monthly commuter benefit (employer-paid transit/vanpool benefit for employees with subsidized parking)
3. Monthly parking cash-out and pre-tax transit benefit for employees without subsidized parking
4. Daily parking cash-out and pre-tax transit benefit for employees without subsidized parking
5. Requirement to eliminate subsidized parking benefit and provide universal $5 per day employer-paid non-SOV commute benefit

Scenario 1: Monthly Parking Cash-Out

This is an ordinance that requires employers offer employees the option to cash-out their parking on a monthly basis. Employees must commit in advance to not use their parking space for the entire month. The cash-out value is equal to the monthly parking market rate, adjusted to account for the fact that some employees would accept the full cash-out value as taxable cash, and others would accept a tax-free transit benefit for a portion of the value with the remainder as taxable cash.

Scenario 2: Monthly Commuter Benefit (Employer-Paid Transit/Vanpool Benefit)

This is an ordinance that requires employers providing free/subsidized parking to offer employees a transit or vanpool benefit paid by the employer. These benefits are exempt from payroll taxes and employee income taxes, including transit and vanpool benefits up to the maximum allowed by law for each commuter, but not in excess of the value of the parking benefit.

Scenario 3: Monthly Parking Cash-Out and Pre-Tax Transit Benefit for Employees Without Subsidized Parking

In addition to requiring that employers that subsidize parking offer a monthly parking cash-out option (same as Scenario 1), all other employers must make pre-tax transit benefits available to all of their employees. That is, employers must allow their employees to set aside their own income on a pre-tax basis for transit[12] costs. This scenario applies a requirement to all worksites—those that provide free or subsidized parking and those that currently do not. Both employers and employees save money on taxes when the employee sets aside income on a pre-tax basis.

Scenario 4: Daily Parking Cash-Out and Pre-Tax Transit Benefit for Employees Without Subsidized Parking

This scenario is the same as Scenario 3 with the difference that the parking cash-out must be offered as a *daily* cash-out option, rather than monthly. In addition to requiring that employers that subsidize parking offer a daily parking cash-out option, all other employers must make pre-tax transit benefits available to all of their employees. That is, employers must allow their employees to set aside their own income on a pre-tax basis for transit[12] costs. This scenario applies a requirement to all worksites—those that provide free or subsidized parking and those that currently do not. Both employers and employees save money on taxes when the employee sets aside income on a pre-tax basis.

Scenario 5: Requirement to Eliminate Subsidized Parking Benefit + Provide Universal $5 Per Day Employer-Paid Non-SOV Commute Benefit

This is an ordinance that requires employers that are offering their employees subsidized parking to cease offering it and for all employers to offer employer-paid non-SOV commute benefits of $5 per commute day. This could come in the form of a "transportation wallet" to pay for non-SOV commute trips that incur discrete charges (including transit, vanpool, and pay-per-use bikeshare and e-scooter trips). Cash compensation would also be provided so that the total benefit for non-SOV travel is $5 per commute day (if the "transportation wallet" expense would otherwise be less), and the full $5 would be paid for non-SOV trips that do not incur discrete per-use charges (e.g., cycling using a personal bicycle or annual bikeshare membership, walking, and carpool commutes). Non-SOV trips would need to be verified, such as through a smartphone application or by providing other evidence (e.g., the employee sharing with the employer bikeshare trip data that is available online, parking a personal bicycle at a worksite which the employer could see, or providing evidence of a home address within a walkable 1.25 miles of

---

[12]Note that pre-tax transit laws typically allow employees to pay for both vanpools and transit service in a pre-tax manner. In estimating the impact of pre-tax transit benefits for employees *without* subsidized workplace parking, Scenarios 3 and 4 relied on a transit elasticity reflecting changes in transit ridership specifically with respect to transit costs. Given this was a transit-specific measure, it was applied only to estimate changes in transit ridership (vs. transit/vanpool ridership) for this population under this policy. The research team expected such results to be reasonable, even with vanpool impacts unaccounted for, given low (<1%) starting vanpool mode shares for this population. Additional information on methodologies can be found in Appendix C. Data and Analysis Methodology.

work and signing a declaration of having walked to work). The non-SOV commute benefits would be exempt from taxes to the extent allowed by law for eligible (transit and vanpool) modes.

Scenario Extensions and Adjustments

The research team also examined the following extensions and adjustments of core scenarios:

- **VMT for Affected Commuters:** Scenarios 1 and 2 apply only to a subset of all commuters. As such, the changes in affected commuter VMT will be more prominent than those in citywide VMT.
- **Scenarios 1A and 3A:** These scenarios entail re-runs of Scenarios 1 and 3, respectively, but are limited to employers with fewer than 20 employees.
- **Partial Subsidy Impacts:** The research team conducted a sample analysis to examine the VMT impacts of partial parking subsidies.
- **Telecommuting Impacts for All Scenarios:** The research team scaled impacts on congestion and emissions to reflect expectations in teleworking after the COVID-19 pandemic.

Cities

Criteria were established to guide city selection. The study team was searching for cities with large employment bases and a large number of drive-alone commuters where cash-out policies would have the highest potential impacts. In addition, data quality and geographical diversity were considered in city selection. Site selection criteria included:

- **Size of drive-alone employee population:** Larger drive-alone employee populations will yield higher absolute results; cities with larger commute driving populations were preferred for the analysis.
- **Price of parking:** Higher priced parking is an incentive for employees to cash-out their parking; cities with higher market rate parking were preferred for the analysis.
- **Mode share indicators:** The potential for employees to switch to transit as an alternative to driving alone is helpful to the decision to cash-out parking. Cities with high transit mode shares indicate that transit is a viable alternative.
- **Data to support:** Availability of city-specific data is essential for the analysis.

Drive-alone employee population and monthly parking rates were prioritized when selecting cities. Table 2 shows the 26 cities considered for analysis in order of their drive-alone population size. Cities that have better data availability are noted with a check mark.

Table 2. Employee populations, mode shares, and parking rates by city.

Cities	Employee Population*	Percent Drive Alone*	Drive-Alone Employee Population*	Percent Public Transit*	Daily Parking Rates**	Monthly Parking Rates**	Data Availability
Houston, TX	1,873,491	81%	1,525,543	3%	$19	$118	✓
Los Angeles, CA	2,154,978	71%	1,521,020	9%	$24	$137	
New York, NY	4,733,695	23%	1,080,909	58%	$47	$655	✓
Chicago, IL	1,530,905	47%	717,309	33%	$31	$242	
San Diego, CA	926,419	77%	713,003	4%	$20	$138	✓
Dallas, TX	893,716	80%	712,217	4%	$15	$122	
San Antonio, TX	876,905	80%	701,772	3%	-	-	
Phoenix, AZ	898,950	77%	691,544	3%	-	-	
Charlotte, NC	606,473	80%	486,238	3%	$17	-	
Austin, TX	615,370	77%	473,835	3%	$20	$153	
Miami, FL	543,145	86%	465,121	6%	$24	-	
Indianapolis, IN	547,906	85%	464,911	1%	$19	-	✓
Atlanta, GA	606,657	74%	450,884	9%	-	-	✓
Columbus, OH	527,281	82%	433,622	3%	-	-	
Jacksonville, FL	519,393	83%	428,888	2%	-	-	
Fort Worth, TX	498,101	83%	412,923	1%	-	$125	
Philadelphia, PA	784,744	51%	399,384	27%	$25	$258	✓
Denver, CO	569,707	69%	392,562	10%	$20	$173	
Memphis, TN	419,731	85%	358,112	0%	-	-	
Washington, DC	840,050	42%	351,616	37%	$23	$273	✓
San Jose, CA	446,527	76%	341,524	4%	$24	-	
Boston, MA	827,852	41%	340,247	38%	$34	$337	✓
Portland, OR	504,277	62%	312,370	13%	$15	$192	
Seattle, WA	663,761	46%	307,169	28%	$23	$231	✓
Baltimore, MD	392,680	71%	277,741	11%	$17	$152	
San Francisco, CA	794,514	30%	235,789	44%	$27	$297	

*Source for employee population and mode shares is American Community Survey (ACS) 2019 5-Year Estimates, Modeshare by Workplace City (Place Geography) Table B08601: Means of Transportation to Work by Workplace Geography

**Source for city parking costs is Parkopedia's 2019 North America Parking Index (Parkopedia 2020)

While not originally considered, cities with the most expensive parking and robust transit systems, which were prioritized for analysis, typically had lower rates of employers subsidizing parking than other cities. This limited the potential benefits, as most of the policies explored were triggered by employers subsidizing employee parking. The rationale for attempting to choose cities where impacts would be greatest is the same as for attempting to choose policies where the impacts would be substantial. Namely, city leaders are most likely interested in policies that yield the biggest impacts in their cities. Nevertheless, there was diversity in the types of cities selected for analysis, allowing many cities that were not analyzed to get a sense of what impacts the policies would have in their cities by looking at the results from one or more similar cities. Even better, the spreadsheet model developed for this analysis could be populated with data from cities that were not originally analyzed to produce such analysis; potential development of such a model was identified as a key future work activity.

Upon review of the criteria and in coordination with the peer review group, the following cities were selected for analysis:

- Boston/Cambridge, MA
- Chicago, IL
- Houston, TX
- Indianapolis, IN
- Los Angeles, CA
- New York, NY
- Philadelphia, PA
- San Diego, CA
- Washington, DC

Data and Methods Summary

For each scenario described above, the research team developed and tested various approaches to calculate their impacts on vehicle commute travel. Because of the availability of varying research and analysis approaches, each with distinct advantages and disadvantages, that could be applied to each scenario, in most cases the research team used the two best calculation approaches and then developed a midpoint estimate of results for a given policy.

Outputs. The primary direct output of the analysis is the estimated reduction in VMT. The reduction in VMT was then used to estimate reduction in driving-related externalities by applying per-mile factors to the vehicle travel metrics. The analysis focused on traffic congestion, emissions, and safety, as these impacts are of concern to State, regional, and local governments. Key outputs included:

- Reduction in vehicle travel
  - Reduction in average daily commute VMT, determined using reduction in vehicle trips, trip lengths, and vehicle occupancies
- Reduction in driving-related externalities
  - Reduction in congestion, in terms of average delay

    - Reduction in criteria air pollutant emissions
    - Reduction in greenhouse gas (GHG) emissions
- Reduction in crashes

Inputs. Key inputs were generally unique to each city, to the extent local data were available, and include:

- Employee populations
    - Total number of employees working in the city
    - Share of employees with access to free or subsidized parking from their employer (used to estimate the number of employees subject to a cash-out ordinance)
    - Share of employees with access to subsidized transit commuter benefits
- Employee commute characteristics
    - Citywide mode share
    - Mode share of employees with access to free or subsidized parking from their employers (used to estimate number of drivers eligible for cash-out)
    - Average commute distance for automobile commuters in/into the analysis city
- Travel cost factors
    - Average monthly market cost of parking in the analysis city, converted to daily rates
    - Average monthly cost of a transit pass in the analysis city, converted to daily rates
- Driver responses
    - Elasticity of VMT with respect to parking costs
    - Elasticity of transit ridership with respect to transit costs

VMT reduction estimates were primarily derived using two analysis strategies for each scenario. Citywide mode shares were estimated, averaged between the two strategies, and then applied to total employee, trip distance, and vehicle occupancy data to estimate VMT reductions. The two strategies were:

1. Using TRIMMS, a sketch planning tool for analyzing many types of strategies at a regional or sub-area scale, the first-round outputs were calculated. The tool is Microsoft® Excel-based, and preloaded with metropolitan-specific data, including employment and travel data, and travel elasticities and cross elasticities derived from national research. The user can adjust the parameter values and price elasticities. Default parameters were adjusted for starting commuter mode shares (to reflect the population receiving fully subsidized parking).
2. The second-round outputs were garnered by directly applying a travel price elasticity of -0.30 for the change in vehicle travel in relation to the driving costs as derived from the research team's literature review and conversations with the study's peer review group.

Outputs from these two strategies were averaged, and the averages are reported as the results in this study. This analysis relied on several data sources for input data, including data from the U.S. Census Bureau, local employer or employee surveys, and input from the peer review group convened for this analysis. Based on data availability, the analysis uses the most recent (pre-pandemic) available data for employment, driving patterns, emissions rates, and parking cost characteristics wherever available, rather than attempting to forecast these figures to a specific future year. With respect to Scenario 4, the impacts of daily cash-out were estimated to facilitate an additional 16 percent shift away from driving alone compared to monthly cash-out based on results from a study of daily cash-out in Minneapolis (Lari et al. 2014). A transit elasticity reflecting changes in ridership with respect to transit costs of -0.15 was used in applicable scenarios based on the research team's literature review and conversations with the study's peer review group.

Raw VMT reductions were scaled to account for telework expectations (between 1.4x and 3.2x pre-pandemic conditions, with the "most likely" scenario being 2x pre-pandemic conditions [13]) in a post-pandemic near-future time. Citywide VMT reduction estimates were reported for the "most likely" telework scenario, or 2x pre-pandemic rates. Reported reductions in this analysis reflect reductions in commute VMT resulting from the modeled scenarios. Teleworkers are essentially, then, excluded from the analysis as "non-commuters." Because of this, where raw VMT reduction results are reported as a range based on various telework expectations, larger reductions in commute VMT are expected with lower rates of telework, given a larger starting number of commuters impacted. Although not the focus of this analysis, it is important to note that teleworking also has positive benefits for reductions in VMT, congestion, emissions, and crashes.[14]

Impacts on congestion, emissions, and crash reduction estimates were calculated using factors relating these metrics to VMT, where the raw VMT reductions accounted for the "most likely" telework scenario. With respect to congestion, the research team evaluated three possible methods for estimating delay impacts resulting from the policy scenarios. One approach used baseline delay measures specific to each city to estimate congestion impacts from VMT linearly. Another approach applied an area-size (but non-city) specific elasticity that assessed delay in a more sophisticated and logical (i.e., non-linear) manner. Ultimately, the chosen approach used both the city-specific baseline and area-size-based elasticity to estimate changes in delay for the modeled scenarios. Presented changes in delay are relative to all peak-time VMT (not just commute VMT). Additional details on data and methodologies, including related to the selected congestion estimation process, are provided in Appendix C. Data and Analysis Methodology.

General Assumptions

The analysis of the five scenarios includes a number of assumptions that reflect, among other things, limited data and experience with voluntary and mandatory parking cash-out and a desire to serve the study objective to produce useful and comparable results across scenarios and cities. These general assumptions are described below.

---

[13] Estimates derived from Mokhtarian et al. (2022) as discussed further in Appendix C. Data and Analysis Methodology. Estimates are subject to uncertainty, as discussed under General Assumptions in the same appendix.

[14] While not considered in this analysis, parking pricing structures and prices may influence telework rates. For example, for employees who have more flexibility over remote working, a daily parking charge may likely lead to more telecommuting. In full, a suite of strategies relying both on parking cash-out laws, parking pricing strategies, and telework flexibility may have the combined potential to more substantially reduce commute VMT and subsequent congestion, emissions, and crashes.

Full Adoption and Compliance. The approach calculates impacts at the point of full adoption and compliance by all affected employers. The analysis does not account for changes in the adoption of parking cash-out policies that may occur over time (e.g., time for roll-out of the ordinance requirements) but presents results assuming full compliance. This document does not provide strategies for implementation and enforcement. However, Appendix A. Implementation Resources provides a brief discussion and example resources.

Free Versus Partially Subsidized Parking. Due to data limitations and sometimes vague descriptions of parking subsidies in the referenced sources, the analysis primarily considers employees with free parking as eligible for parking cash-out. Evaluating impacts of partial subsidies would require information about the percentage of employees in each city receiving partial parking subsidies of different amounts, so that cost estimates could be plugged into TRIMMS and elasticity analysis methods appropriately. Because of the focus on free parking, actual results may vary depending on the extent of partial subsidies in a given location. Additional discussion is provided in Appendix D. Additional Results, including about estimating impacts of partial subsidies for two different scenarios in the two cities where there is sufficient data to support such analysis.

Near-Term Conditions. Based on data availability, the analysis uses the most recent (pre-pandemic) available data for employment, driving patterns, emissions rates, and parking cost characteristics wherever available, rather than attempting to forecast these figures to a specific future year. As discussed, raw VMT reduction, congestion, emissions, and crash reduction estimates were scaled to account for telework expectations in a post-pandemic near-future time. However, even the near-future rates of telework are difficult to predict as the pandemic recovery evolves.

Some factors are expected to change in future years; specifically, pollutant emission rates will decrease as the current vehicle fleet is gradually replaced by cleaner vehicles, so it is important to recognize that per-vehicle emissions benefits 5 or 10 years in the future may be lower than estimated in this analysis (although other factors, such as rising employment population, would partially offset this). Other benefits, such as those related to reduced travel delays, may be higher since traffic congestion would otherwise continue to grow over time, and the greater the level of congestion, the greater the benefit of VMT reductions on congestion.

Market Parking Rates. The market parking rates used in the analysis reflect an estimate based on available parking data in the CBD. CBD parking rates were taken from the Parkopedia's North American Parking Index (Parkopedia, 2020), which provides rates for "all publicly available paid off-street and on-street parking locations in a city center." Because the index is focused on parking in CBDs, these prices are likely on the high end of the range for a city, especially for expansive cities such as Los Angeles and Houston, where there may be areas with low or even no parking costs. In low-cost non-CBD areas, the parking costs and corresponding cash-out amount would be lower. Cities could, as was modeled, require that cash-out values in non-CBD areas equal the average daily price of transit. In some cities, monthly CBD parking rates are high (e.g., $655 in New York City, equivalent to $34.48 per day); and assuming a non-CBD parking rate equal to a round-trip average transit cost results in a much lower parking rate or cash-out value figure for the non-CBD area (in this case, an average of $7.05 in New York). The actual non-CBD market parking rate, for which the study team did not have reliable data, could be lower or higher (parking outside the CBD in New York could still be quite expensive, for example). An average city-wide parking rate was then calculated for each city based on the weighted average of the rates reflective of the share of employment in the city in the CBD and non-CBD areas.

CBD Parking Benefits Offered at Full Market Value. The analysis assumes that employers subsidizing parking are doing so at the full market value of the parking, even though for many cities, the average CBD market value is significantly higher than the $280 per month that is allowed as exempt from payroll taxes and employee income taxes. Survey data support this assumption, as full-value employer parking subsidies were found to be much more common than partial subsidies.

No Transit Capacity Restrictions. The analysis does not account for capacity or operational restrictions that may, for example, challenge transit to accommodate significant new demand. Some regional transit systems would probably not be able to accommodate some of the increases in ridership predicted by the analysis results in this study, except if they instigated peak-shoulder travel incentives, such as those being tested by the Bay Area Rapid Transit System, to spread out peak travel. Carpooling, though, would not require special accommodations, although high-occupancy vehicle and high-occupancy toll lanes could help. It is not clear whether roadway or transit capacity constraints will be more of a limitation in the future and how that might impact mode choice.

Responsiveness to Pricing. As described in Chapter 2. Literature Review, there is a wide range of travel behavior responses to changes in trip and parking costs. Because most of the scenarios envision “all or nothing” price changes with respect to parking, and it is not possible to calculate or use elasticity if one of the prices is zero, this analysis focused on finding the price elasticity of travel, incorporating parking costs within travel costs, instead of price elasticity of parking. After reviewing many studies, the team selected an elasticity of -0.3 as the value best supported in the literature. The elasticity value and other decisions made for this study were in part validated for Scenario 1 as the results were in the range of those found in parking studies conducted in Los Angeles by Donald Shoup.

The peer review group expressed some concern that the driving reductions would not be as large as the analysis forecasts because of an “endowment effect.” This effect, shown to exist in the literature, results in people placing a higher value (and requiring a higher payment) to give up that which they possess than they would be willing to pay for the same thing in the first place. Initially, employees may not respond to a new cash-out offer the same as they would if they were forced to pay cash for parking because of the endowment effect; however, in the long term, more people will face making a decision to take a cash-out offer or parking when they are newly employed, prior to actually “possessing” the workplace parking. In this instance, forfeiting a higher wage in exchange for parking is more likely to be perceived as an actual cost.

Responsiveness to Daily Cash-Out. There is very limited research on which to base calculations of employee response to a daily cash-out offer. Indeed, the analysis here is based on only a single, small study in Minneapolis that showed a monthly parking pass with a pro-rated rebate for forfeited parking days yielding about a 24 percent reduction in parking days, which in this analysis was assumed to reflect a 16 percent mode shift (with the other 8 percent, or one-third of this reduction, assumed to have resulted from teleworking). A daily cash-out is likely to encourage more participants than a monthly cash-out because of the increased flexibility, but participants are likely to skip driving only once or twice a week. A few employees who otherwise would take the monthly cash-out might choose daily cash-out and then drive more than under the monthly option, although even without this option, those cashing out monthly could still occasionally purchase daily parking on their own.

Responsiveness to Monthly Cash-Out as Related to Daily Parking Costs. The response to a monthly cash-out offer may depend in part on the market rate for daily parking in a city in relation to monthly parking. If the price of daily parking is moderate relative to monthly parking (e.g., about $1/20^{th}$ the cost of monthly parking), then employees may be more drawn to accepting a monthly cash-out offer, as the price of driving on any given day would be modest. If, on the other hand, the cost of daily parking is high relative to monthly parking (e.g., if monthly parking is discounted significantly), then employees may be reluctant to accept a monthly cash-out offer.

Crashes Scale Linearly with VMT. After consulting the peer review group convened for this research, the team believed it reasonable to assume reductions in crashes would scale linearly with reductions in VMT for this sketch-level analysis. Deviations from this standard trend during the COVID-19 pandemic might be attributed to higher levels of speeding during this time (Litman, 2022b), which is expected to dissipate as the causes start to recede (e.g., near-empty roadways and pandemic-inspired antisocial behavior).

For interested readers, Appendix C. Data and Analysis Methodology provides information on compiled data and analysis approaches (including additional discussion on congestion methods considered) for each scenario in detail.

CHAPTER 4. RESULTS

For all cities, the project team estimated the VMT reductions as a percent of total citywide commute VMT. The results are in Table 3 and figure 2 for each city and each scenario. The overall level of VMT reduction is dependent on several factors, including, most notably, the existing mode shares (e.g., how many employees are currently driving alone) and how many employees currently receive free or subsidized parking and are subject to the ordinance.

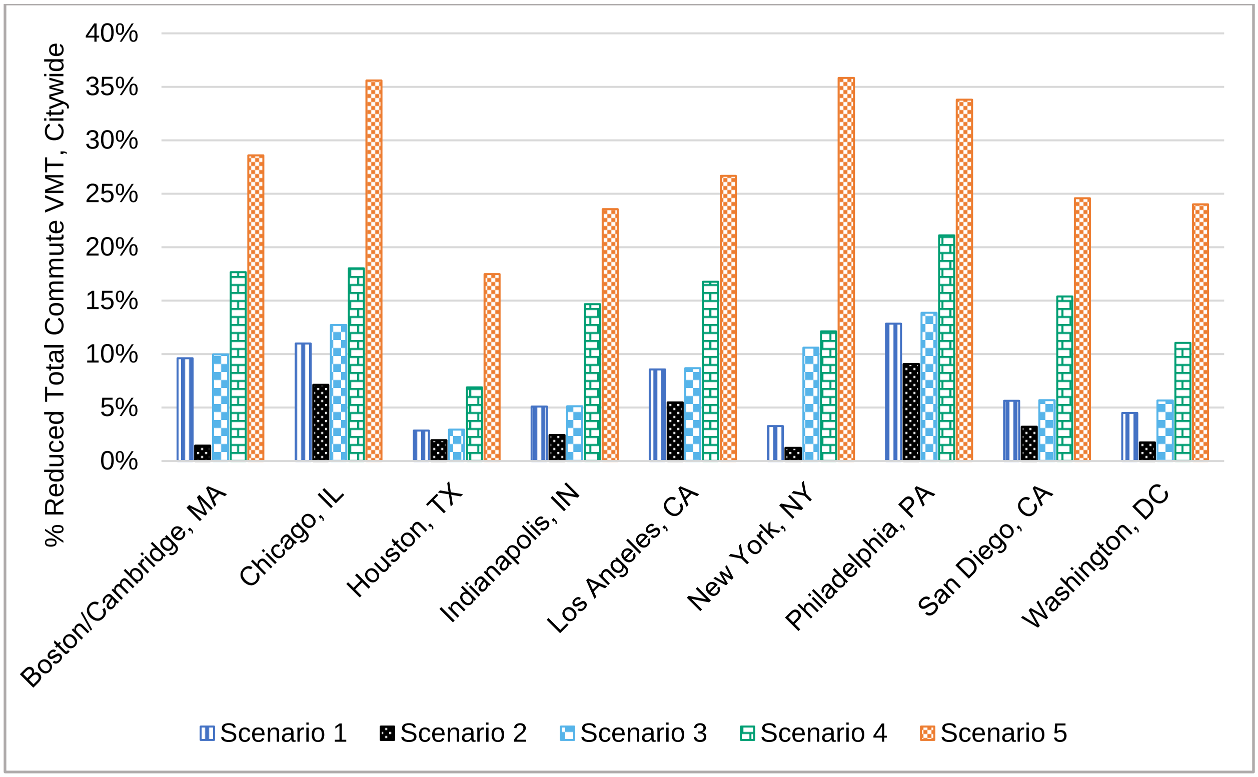
Table 4 and figure 3 show the expected raw VMT reductions for each city and scenario. Table 4 shows the raw VMT reduction expected under a scenario where telework rates are 2x pre-pandemic rates, while figure 3 reflects these values as a range (1.4–3.2x) based on estimates presented by Mokhtarian et al. (2022) on post-pandemic telework expectations. Due to the sketch-level approach of this analysis, all estimated figures (VMT, congestion, emissions, and crash reductions) are subject to uncertainty.[15]

Additional results related to the extensions examining VMT reductions in affected commuters only for Scenarios 1 and 2, exempting small employers (i.e., for Scenarios 1A and 3A, which are otherwise identical to Scenarios 1 and 3 except that the extensions exempt employers with fewer than 20 employees), and investigating impacts of free versus partially subsidized parking impacts are presented in Appendix D. Additional Results. Detailed core results for each city are in Appendix E. Results by City.

Table 3. Percent reductions in daily citywide commute VMT by scenario and city.

City	S1: Monthly Cash-Out	S2: Monthly Commuter Benefit	S3: Monthly Cash-Out + Pre-Tax Transit Benefit	S4: Daily Cash-Out + Pre-Tax Transit Benefit	S5: Eliminate Parking Subsidies + $5 Non- Single Occupancy Vehicle (SOV) Subsidy
Boston/Cambridge, MA	10%	1%	10%	18%	29%
Chicago, IL	11%	7%	13%	18%	36%
Houston, TX	3%	2%	3%	7%	17%
Indianapolis, IN	5%	2%	5%	15%	24%
Los Angeles, CA	9%	5%	9%	17%	27%
New York, NY	3%	1%	11%	12%	36%
Philadelphia, PA	13%	9%	14%	21%	34%
San Diego, CA	6%	3%	6%	15%	25%
Washington, DC	4%	2%	6%	11%	24%

[15]Results have been rounded to reflect this uncertainty; extent of rounding (e.g., to the nearest one-hundred thousand, ten thousand) were chosen based on the range and magnitude of the presented VMT, congestion, emissions, and safety measures only. That is, a figure rounded to, for example, the nearest one-hundred does not reflect more certainty to a figure rounded to the nearest one-hundred thousand.



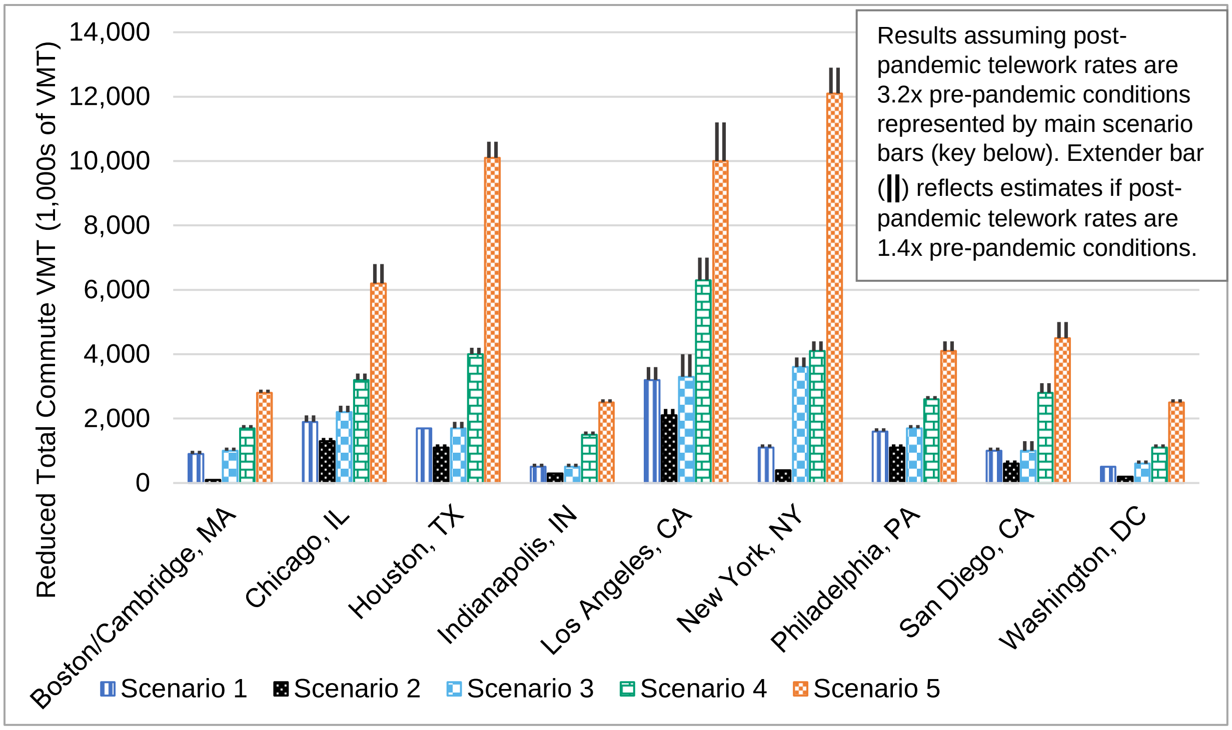
Source: FHWA.

Figure 2. Graph. Percent reductions in daily citywide commute VMT by scenario and city.

Table 4. Estimated raw reductions in daily citywide commute VMT by scenario and city (assuming "most likely" 2x telework scenario and approximated to the nearest one-hundred thousand)

City	S1: Monthly Cash-Out	S2: Monthly Commuter Benefit	S3: Monthly Cash-Out + Pre-Tax Transit Benefit	S4: Daily Cash-Out + Pre-Tax Transit Benefit	S5: Eliminate Parking Subsidies + $5 Non- Single Occupancy Vehicle (SOV) Subsidy
Boston/Cambridge, MA	1.0M	0.1M	1.0M	1.8M	2.8M
Chicago, IL	2.0M	1.3M	2.4M	3.3M	6.6M
Houston, TX	1.7M	1.2M	1.8M	4.1M	10.4M
Indianapolis, IN	0.6M	0.3M	0.6M	1.6M	2.6M
Los Angeles, CA	3.5M	2.2M	3.5M	6.8M	10.8M
New York, NY	1.2M	0.4M	3.7M	4.3M	12.6M
Philadelphia, PA	1.6M	1.2M	1.8M	2.7M	4.3M
San Diego, CA	1.1M	0.6M	1.1M	3.0M	4.8M
Washington, DC	0.5M	0.2M	0.6M	1.2M	2.6M

*M = million



Source: FHWA.

Estimates have been approximated to the nearest one-hundred thousand.

Figure 3. Graph. Estimated raw reductions in daily citywide commute VMT (in thousands of VMT) by scenario and city.

Discussion

Across all of the scenarios, it is clear that local parking cash-out related ordinances could have a significant impact on reducing vehicle travel (along with subsequent congestion, emissions, and crashes) associated with commuting by employees. The impacts vary by scenario and by city based on a range of factors, including parking prices, transit fares, and the share of employees currently receiving free or subsidized parking. This section first discusses results framed around reductions in VMT. Then, results related to equity, congestion, emissions, and crashes are presented.

The two monthly cash-out scenarios—Scenario 1 (monthly parking cash-out) and Scenario 3 (a requirement that employers that don't offer free parking offer a pre-tax transit benefit in addition to monthly parking cash-out for those offering free parking)—show significant potential for reducing daily VMT. Scenario 3 builds on Scenario 1 and applies an additional requirement for employers that do not currently offer free parking to offer pre-tax transit benefits. While the effects of offering pre-tax benefits, where employees set aside their own money for transit, is likely to be small compared to an employer-paid benefit, this policy is assumed to apply to a large population of employees in many cities who do not currently receive free parking. For instance, in San Diego (and most other cities analyzed), the pre-tax benefit requirement on top of the parking cash-out ordinance yields a relatively small incremental effect, since in San Diego it is estimated that 88 percent of employees work at sites with fully subsidized parking and would receive the cash-out offer instead of the pre-tax benefit. On the other hand, in New York City, where only 4 percent of employees work at sites with fully subsidized parking, the pre-tax transit benefit requirement applies to a much larger share of employees and yields a larger incremental benefit. Pre-tax commuter benefits may also exhibit greater reduction potential when paired with campaigns to increase commuter awareness.

Scenario 4 (a requirement that employers that do not offer free parking offer a pre-tax transit benefit in addition to daily parking cash-out for those offering free parking) shows greater reduction potential than Scenario 3 because it assumes that if employees are offered a daily cash-out, which is more flexible than a monthly option, more employees will take the offer and reduce their driving. The Scenario 4 analysis assumes an additional 16 percent shift away from driving alone with daily cash-out compared to monthly cash-out in Scenario 3. This does not translate directly to a linear 16 percent overall VMT reduction between the scenarios. For the population under each scenario eligible for cash-out, while there is a 16 percent decrease in *drive-alone* VMT between the two scenarios, some of this VMT is re-distributed to carpool and vanpool (among other modes), which still count toward total VMT (although less than driving alone, given higher vehicle occupancies). This slightly dilutes the VMT savings (i.e., to between a 10–15 percent decrease). From there, the overall citywide impact varies based on the prevalence of free-parking offerings in each city. That is, the difference between the results in Scenarios 3 and 4 is less pronounced in cities where a lower proportion of employees are offered the cash-out opportunity versus the pre-tax transit benefit (e.g., New York City).

Scenario 2 (the option of an employer-paid monthly transit/vanpool pass in lieu of free parking) shows more modest reductions than the monthly cash-out scenarios. Instead of offering cash, employers in this scenario are required to offer a tax-exempt transit or vanpool benefit in lieu of parking. Even in cities where the assumed average transit fare is high, driving reductions were smaller than in Scenario 1; fewer employees are likely to take a transit-only benefit as compared to a cash offer (with a tax-free transit option) and even most commuters accepting tax-free transit would, with Scenario 1, also be provided an additional taxable cash-out payment due to the market value of parking exceeding transit commute costs. Scenario 2 also applies to a slightly smaller baseline population than Scenario 1—beyond employees who receive free or subsidized parking (excluding those who already receive parking cash-out), it also does not apply to these commuters who already receive transit benefits.

Under Scenario 5 (a requirement that all employers eliminate subsidized parking and provide a universal $5 daily non-SOV commute benefit), employees who drive to work alone would suddenly face a new cost to their driving (parking). This scenario offers the greatest reduction potential in all cities, likely because it incentivizes non-SOV modes not considered in other scenarios (e.g., carpool, walking, biking) in addition to non-SOV modes already considered by other scenarios (transit, vanpool) for a greater number of employees, and it would yield the additional shift away from driving-alone also realized in Scenario 4 due to the provision of a daily benefit.

Under each scenario, the largest cities by number of commuters understandably demonstrate the greatest raw VMT reduction potential (e.g., Houston, Los Angeles, New York City). Cities that start with a high citywide drive-alone share show the smallest reductions relative to citywide commute VMT, especially when using the TRIMMS analysis methodology. If comparing two cities with the same drive-alone mode share, cities where a greater proportion of employees are offered free or subsidized parking (and thus would be eligible for cash-out) are expected to exhibit greater relative reductions under cash-out policies. For example, Houston and Indianapolis currently have drive-alone shares of more than 80 percent. When comparing those two cities, however, Scenarios 1, 3, and 4 have considerably larger impacts in Indianapolis than in Houston. This is because a much larger proportion of employees are offered subsidized parking in Indianapolis. Thus, offers directed toward current drivers receiving subsidized parking have more impact in Indianapolis than in Houston.

Examining the results across scenarios, Houston and Chicago reveal the impact of starting mode share and travel costs. These cities have relatively similar numbers of employee populations. Additionally, approximately 40 percent of employees in each city receive free parking at work, while around 10 percent already receive transit benefits. The estimated drive-alone mode share for employees receiving fully subsidized parking in Houston was 83 percent versus 53 percent for Chicago. While daily transit costs are estimated around six dollars in each city, the daily cost of parking in Chicago is approximately double that of Houston. Despite a number of similarities, the relative VMT reductions across the scenarios in Chicago are more than double those in Houston.

Even though New York City has an employee population more than double the size of the city with the next largest employment population (over four million compared to Los Angeles' two million), relative VMT reduction estimates are relatively small compared to some other cities (i.e., those which also have high parking costs and low drive-alone mode shares, like Chicago) in scenarios applied only to employees receiving fully subsidized parking (which is only around 4 percent in New York City). This is because these scenarios (Scenarios 1 and 2) are applied to a relatively small population, and consequently, the impact is small. By contrast, Scenarios 3, 4, and 5 apply to all employees, boosting the relative VMT reductions comparable to other cities with similar characteristics (high parking costs and low drive-alone mode shares).

Overall, travel impacts vary widely among scenarios and cities. Responses to the different scenarios generally depend on the attractiveness of alternatives to driving and parking and which segment of the employee population is targeted. Among the cities, trip and VMT reductions depend on a variety of parameters, including the size of the affected population, baseline mode shares of the employees, average trip distances, and existing parking and transit costs (see these core attributes in Appendix C. Data and Analysis Methodology, Table 6). Regardless of the exact strategy or city, the projected VMT reductions, along with reductions in driving related externalities, through any of these policy mechanisms are significant.

The presented analysis is based on existing data along with several assumptions and estimations, introduced in Chapter 3. City and Scenario Selection and outlined in more detail in Appendix C. Data and Analysis Methodology. Chapter 2. Literature Review highlights research by Shoup

(1997), which provides results to compare to those modeled from Scenario 1. As previously presented, Shoup (1997) found parking cash-out programs were associated with a 12 percent reduction in VMT in a comprehensive analysis of eight parking programs in Southern California (mainly in and around Los Angeles), and subsequent analysis by researchers in Minneapolis and Seattle found similar results. While the results presented here reflect VMT reduction estimates citywide, additional analyses presented in Appendix D. Additional Results show Scenario 1 results for affected commuters only. The estimated reduction in commute VMT in Los Angeles for affected commuters under Scenario 1, the most similar policy to that studied by Shoup, is 11 percent. Across all the cities studied, the average percent reduction in commute VMT for affected commuters under Scenario 1 is 14 percent. Both figures are relatively close to Shoup's (1997) earlier VMT reduction estimate.

Beyond Scenario 1, the other modeled scenarios lack implementation-based data to which a comparison to modeled results could be drawn. The results of Scenario 5 are striking, in particular, given estimates of VMT reduction between 17 percent and 36 percent; across the analyzed cities, Scenario 5 results reflect an average four-fold increase in estimated VMT reduction compared to Scenario 1, citywide. The results are plausible, though, considering the unique feature of Scenario 5 compared to the other modeled scenarios—the elimination of subsidized parking entirely—plus the addition of a new, daily benefit for not driving alone to work.

An INRIX (2017) study found that one-third of the total costs of vehicle ownership could be attributed to parking. When parking is subsidized, these costs are "hidden" to drivers. Subsequently, when those costs are revealed, such as through the elimination of parking subsidies, drivers may be likely to shift behavior given the cost increase relative to the overall total cost of driving. Additionally, elimination of subsidized parking entirely may make non-driving incentives more attractive. In a study of commuter benefits in the Washington, D.C., region, Hamre and Buehler (2014) found very significant impacts of parking and other subsidies, and their elimination, on commute mode choice. While benefits incentivizing public and active transportation commuting (e.g., transit benefits, showers/lockers, bike parking) were related to a decreased likelihood of driving, the provision of these benefits alongside free workplace parking reduced their effectiveness. For example, Hamre and Buehler's (2014) found that when both free parking and transit benefits were offered together, the estimated drive alone mode share was quite high at approximately 83 percent.

Taken together, the high proportion of driving costs attributable to parking and the increased expected effectiveness of non-SOV incentives in the absence of free parking lend support to the estimated impact of Scenario 5 compared to the other modeled scenarios.

Each scenario has additional implications for equity, congestion, emissions, and safety, as discussed in the following subsections. Additionally, recall that Chapter 1. Background covered some financial impacts and benefits related to parking cash-out and commuter benefits policies. For interested readers, Appendix F. Non-Employee Financial Impacts: Employer Costs and Government Tax Revenues elaborates on some of these impacts, which may be useful for those considering implementation of such programs, or ordinances requiring such programs.

Equity Considerations

The parking cash-out and related commuter benefits policies examined in this analysis have various implications for equity. If free parking is traditionally only offered to specific subsets of commuters (e.g., commuters working in certain industries, at specific income levels, etc.), it would disproportionately benefit certain groups of commuters over others. Policies that include cash-out alone would only be offered to those commuters already receiving free parking at work. Even if parking benefits are not offered equitably, however, cash-out is equity-enhancing as it adds two groups to those receiving a benefit: 1) employees who were offered parking but could not take advantage of it due to not owning a car that is available for their commuting (either due to owning no vehicles or sharing a vehicle with other household members who may need it); and 2) employees living in locations where driving to work is not the most convenient alternative. Policies that include commuter benefits for other modes tend to be offered more broadly than parking (employers controlling a limited parking supply might pick and choose to whom they offer it) and thus are further enhancing of equity.

In this analysis, each scenario would impact the following baseline populations:

- **Scenario 1:** Only commuters who receive free workplace parking
- **Scenario 2:** Only commuters who receive free workplace parking
- **Scenario 3:** All commuters, with different benefits provided to those offered free workplace parking than to others
- **Scenario 4:** All commuters, with different benefits provided to those offered free workplace parking than to others
- **Scenario 5:** All commuters, with equal benefits offerings across non-SOV modes

In Scenarios 1 and 2, the population being impacted are only those employees with free workplace parking. Under both scenarios, those within the eligible baseline population can benefit if they can mode-shift from driving to work. Commuters expected to receive the greatest benefits under Scenario 2 are those who already commute via transit or vanpool, or who are located with access to quality transit for commuting purposes. Although the benefit would technically be offered to other employees in the baseline population, it may not be realized if commuters do not have access to transit or are unable to form a vanpool. In contrast, the full baseline population impacted could benefit from parking cash-out in Scenario 1, provided commuters who currently drive are able to shift their commute mode.

In Scenarios 3 and 4, all commuters would be eligible to receive some type of commute benefits. Those without free workplace parking would be eligible for pre-tax transit[16] benefits, while those

[16] As discussed previously, Federal tax law allows employers to accommodate, through their payroll systems, employees paying for both vanpools and transit service in a pre-tax manner. In estimating the impact of pre-tax transit benefits for employees *without* subsidized workplace parking, Scenarios 3 and 4 relied on a transit elasticity reflecting changes in transit ridership specifically with respect to transit costs. Given this was a transit-specific measure, it was applied only to estimate changes in transit ridership (vs. transit/vanpool ridership) for this population under this policy. The research team expected such results to be reasonable, even with vanpool impacts unaccounted for, given low (<1%) starting vanpool mode shares for this population. Additional information on methodologies can be found in Appendix C. Data and Analysis Methodology.

commuters who receive free workplace parking would be eligible for parking cash-out. Again, for commuters who would only be eligible for transit benefits and are unable (or unwilling) to commute via transit or vanpool, they may not see the benefit realized. However, these two scenarios may be more equitable than Scenarios 1 and 2 if a broader demographic of employees would become eligible for benefits.

In Scenario 5, all non-SOV commuters are eligible for equal benefits, with the same benefit offered to any commuter who travels via a non-SOV mode whether or not free/subsidized workplace parking was in place. This scenario is primarily different from the other core scenarios in that it eliminates parking subsidies entirely. While the commute benefit for Scenarios 3 and 4 for employees who did not receive fully subsidized parking might only be realized for those employees who are reasonably able to commute via transit or vanpool, the commute benefits offered under Scenario 5 could be realized by any employees not driving to work, regardless of if they received workplace parking subsidies or not. That is, although Scenarios 3, 4, and 5 would all technically offer benefits to all employees, the proportion of employees who are actually able to utilize the benefit offered is expected to be greatest under Scenario 5.

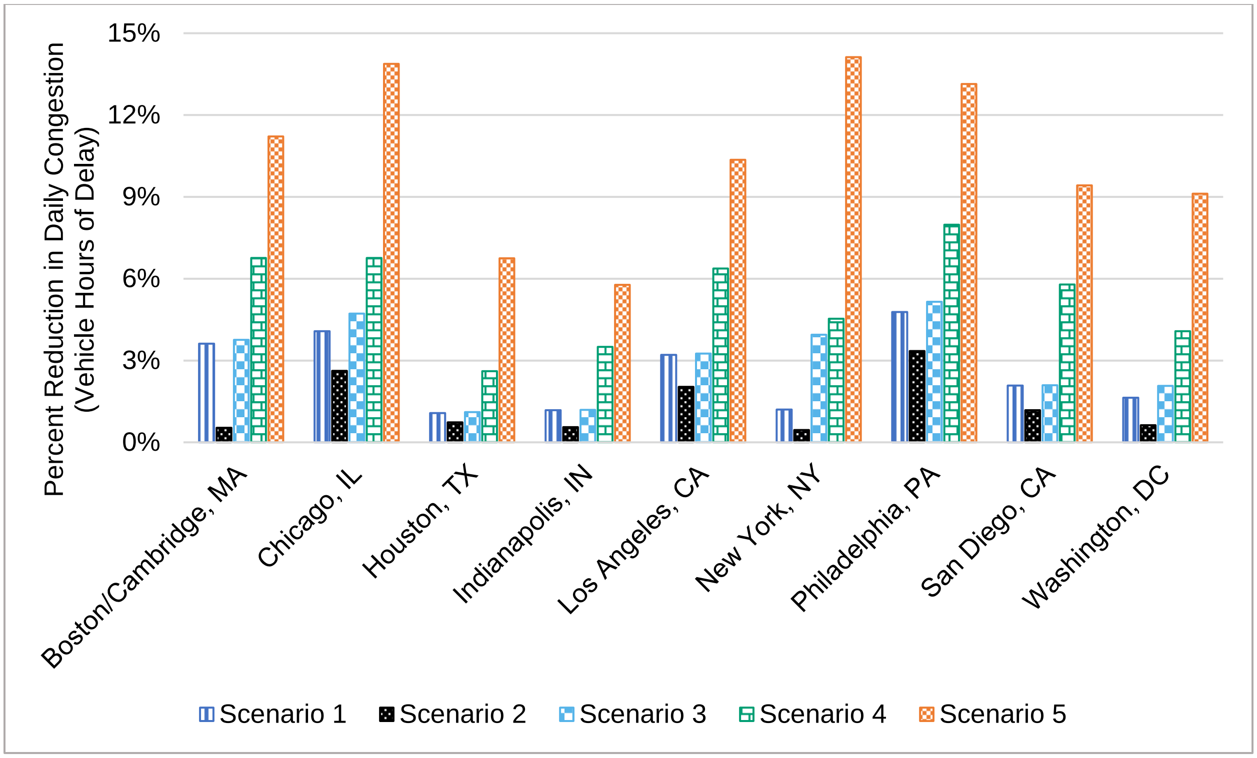
As such, in addition to maximizing VMT reduction potential, Scenario 5 is thought to maximize the benefits offerings across the analyzed scenarios, and reflects the policy expected to distribute benefits most equitably. For example, Census data shows that, in general, the lowest-income households exhibit lower rates of vehicle ownership and higher rates of walking or biking commuting compared to higher income households (see Appendix G. Additional Equity Discussion for more information). If these commuters *cannot* switch from walking or biking to another mode and do not receive workplace parking subsidies (and so are ineligible for cash-out under other scenarios), they would realize the greatest benefit out of Scenario 5 (e.g., while they may be offered transit or vanpool benefits under Scenarios 3 or 4, if they cannot switch modes, then they cannot actually *use* these benefits).

Scenario 5 also advances transportation equity by eliminating the false free cost of parking; free parking acts to subsidize automobile use, and can subsequently increase negative externalities related to congestion, pollution, emissions, and safety. Scenario 5 has the greatest VMT reduction potential, which will act to mitigate these externalities for the greatest number of people. Although this analysis is limited in that it is not designed to map VMT reductions spatially across the cities, reductions in emissions and pollution specifically should have citywide benefits; future work could examine how reductions in congestion and safety improvements could be mapped spatially and overlap with neighborhood demographics for a more robust look into equity impacts. Appendix G. Additional Equity Discussion explores considerations across the analyzed scenarios in more detail.

Congestion Reduction

The estimated reductions in daily congestion (i.e., percent change in peak period time delays experienced) for each scenario are shown in figure 4 (assuming the “most likely” 2x pre-pandemic telework rate scenario). The changes in vehicle hours of delay across scenarios generally follow the VMT patterns exhibited by the scenarios. That is, Scenario 2 exhibits the lowest impacts on delay reduction, while Scenario 5 has the greatest impact.[17]

While the reduction in vehicle travel should translate directly to reduced vehicle congestion, the level of delay reduction is uncertain and influenced by many factors, notably including the current level of congestion along individual corridors within each city. Here, delay reduction potential is more limited than VMT reduction potential. This is, in part, a function of the method applied (which relies on an elasticity showing a less than 1 percent reduction in delay for each 1 percent reduction in VMT). Additionally, recall that changes in delay are relative to all peak-time VMT (of which only 54.9 percent of peak-period VMT is commute related), while VMT reductions presented in figure 2 are presented relative to commute travel only.



Source: FHWA.

Figure 4. Graph. Estimated percent reduction in daily peak period delay by scenario and city.

This relationship of delay relative to VMT being less than one is not an overarching rule-of-thumb. In contrast, some research suggests that a small reduction in vehicle travel can have a disproportionately large impact on delay reduction. For instance, a study conducted for FHWA estimated that "in general a 10 percent to 14 percent decrease in traffic on congested

[17]Recall that several methods for estimating congestion impacts were considered. Interested readers can look to Appendix C. Data and Analysis Methodology: Calculating Resulting Congestion, Environmental, and Safety Impacts for more information on the tested methods.

freeways will reduce delay by approximately 75 percent to 80 percent" based on data from the Washington, D.C., region (The Louis Berger Group 2008).

Despite the more conservative percent changes in congestion compared to VMT in this analysis, however, the impacts are not insignificant. Considering the results from figure 4, the research team scaled the time reduced for Scenario 1 and Scenario 5 to an annual measure (assuming 19 working days each month) for each city. Then, using the 2019 value of time ($/hour) from the Texas A&M Transportation Institute's (TTI's) Urban Mobility Report,[18] dollars saved from delay reductions (rounded to the nearest million) for these two scenarios are presented in Table 5.

Table 5. Estimated annual dollars saved for all commuters due to delay reductions.

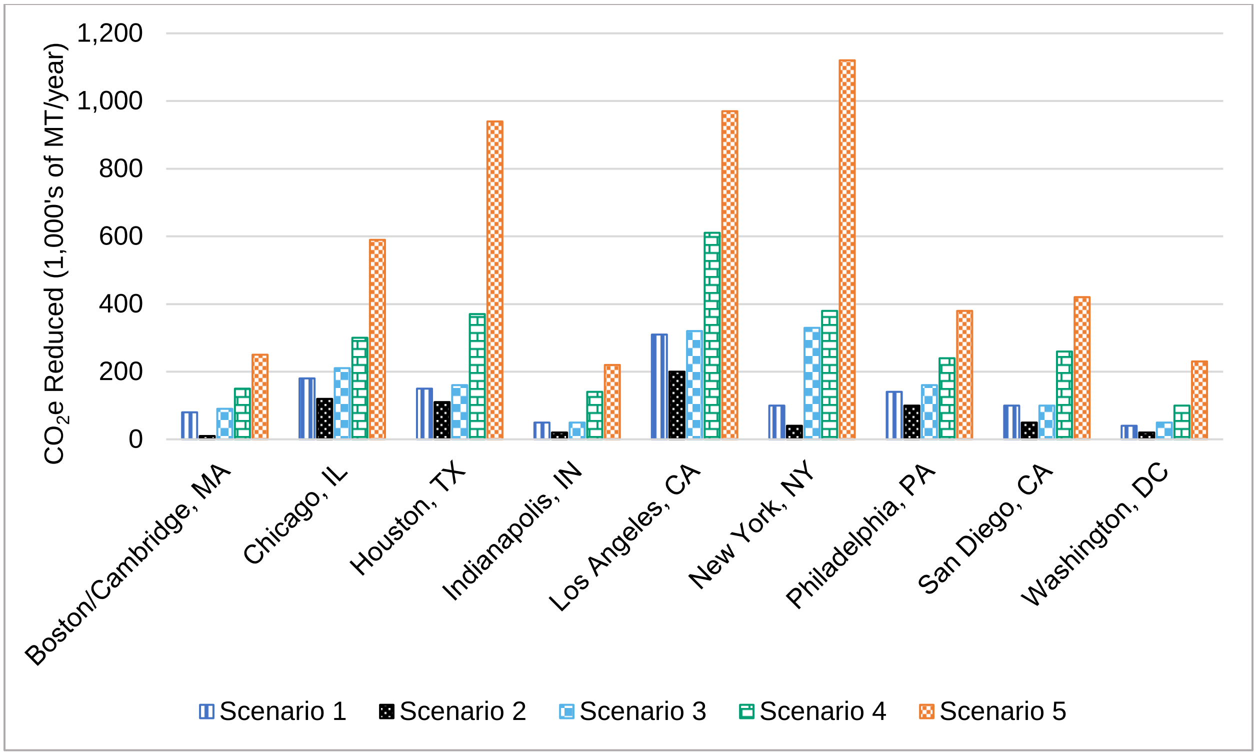
City	Scenario 1	Scenario 5
Boston/Cambridge, MA	$10M	$32M
Chicago, IL	$25M	$85M
Houston, TX	$20M	$128M
Indianapolis, IN	$3M	$14M
Los Angeles, CA	$37M	$121M
New York, NY	$10M	$114M
Philadelphia, PA	$17M	$47M
San Diego, CA	$8M	$34M
Washington, DC	$6M	$35M

Emissions Reduction

Figure 5, figure 6, and figure 7 display estimated annual emissions reductions for each city and scenario (assuming the "most likely" 2x pre pandemic telework rate scenario). The reduction potential trends within each city generally mirror those of VMT reductions, while the magnitude of reduction is greater in cities with greater numbers of commuters in general. These reductions are not insignificant. To put these estimates in perspective, 500,000 metric tons of carbon dioxide equivalents (CO2e) (close to the average reduction across cities for Scenario 5) is equivalent to the energy use of more than 60,000 homes each year, the electricity use of almost 100,000 homes each year, and more than a million barrels of oil consumed.[19] This is the amount of carbon sequestered by roughly 8 million tree seedlings growing over 10 years, or almost 600,000 acres of U.S. forests in one year.

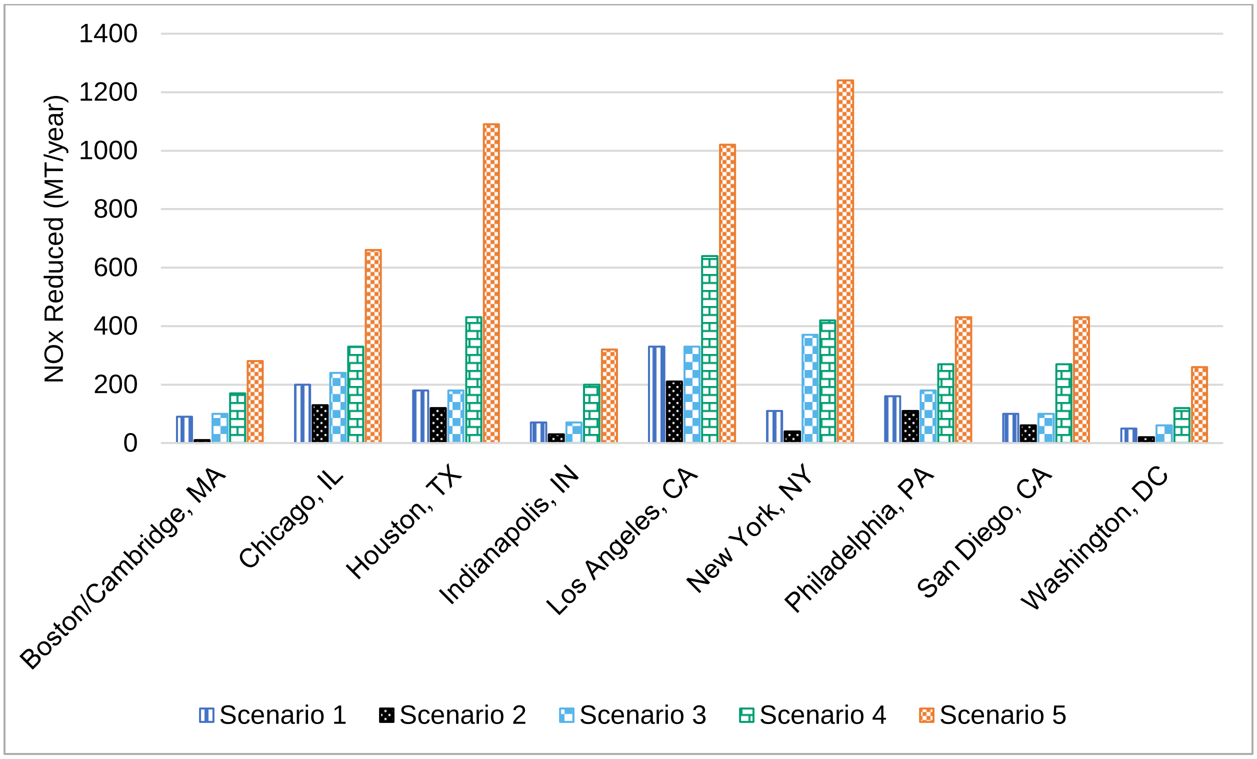
[18] TTI's value of time measure is based on median BLS wage estimates for all occupations. Additional information can be found in the value of time technical appendix: https://tti.tamu.edu/documents/mobility-report-2021-appx-c.pdf

[19] Equivalencies derived using EPA's Greenhouse Gas Equivalencies Calculator for 500,000 metric tons of CO_2e



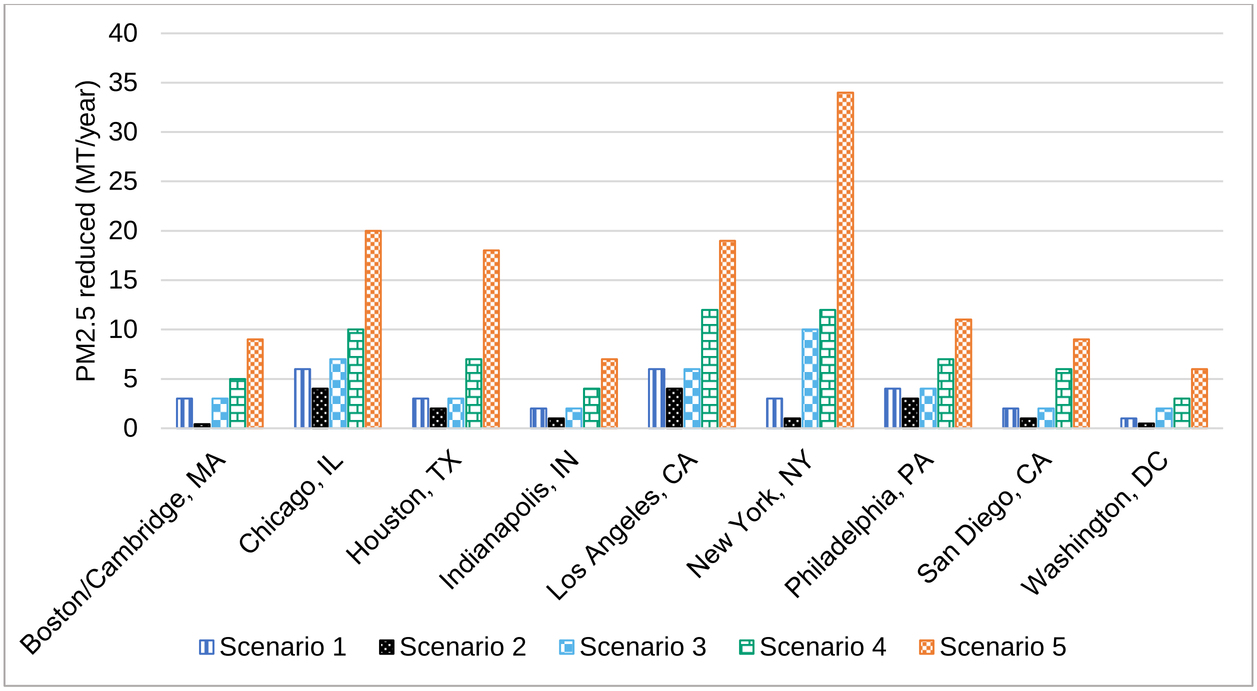
Source: FHWA.

Figure 5. Graph. Annual CO_2e reductions by city and scenario.



Source: FHWA.

Figure 6. Graph. Annual NO_x reductions by city and scenario.



Source: FHWA.

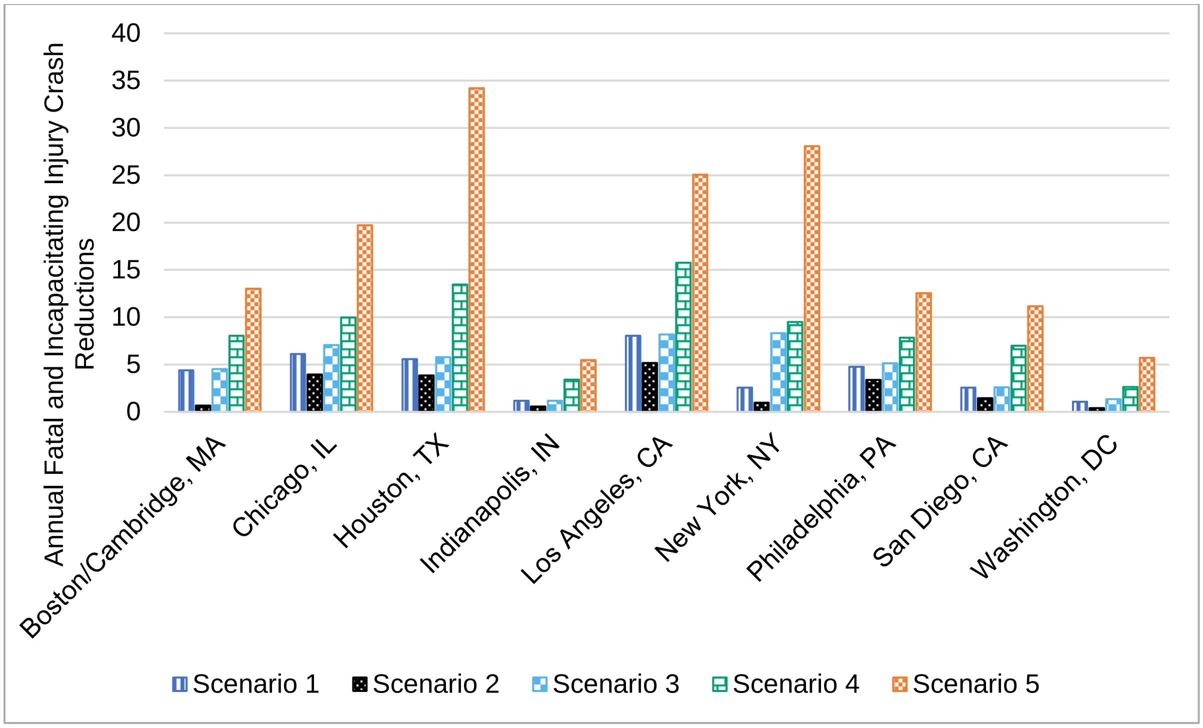
Figure 7. Graph. Annual PM-2.5 reductions by city and scenario.

Safety Impacts

Based on discussions with the peer review group consulted for this analysis, the research team decided it was appropriate to assume crash reductions trended linearly with VMT. That is, citywide crash reductions would mirror the relative VMT reductions presented in figure 2. TRIMMS v4.0 provides crash rates (crashes per million VMT) for each city. Based on those crash rates, expected annual reductions in combined fatal and incapacitating injury crashes (assuming 19 working days each month and the "most likely" 2x pre-pandemic telework rate scenario) are displayed in figure 8. While these estimates may seem relatively small in magnitude, any reductions in fatalities or incapacitating injuries on roadways improve safety; this is reflected in Vision Zero—a "strategy to eliminate all traffic fatalities and severe injuries"—initiatives adopted across over 45 communities across the U.S. (Vision Zero Network 2022).[20] The large impact of seemingly small crash reduction estimates is further demonstrated when considering the value of a statistical life (VSL), or "the additional cost that individuals would be willing to bear for improvements in safety (that is, reductions in risks) that, in the aggregate, reduce the expected number of fatalities by one" (USDOT, 2021, p.1). USDOT's latest 2021 figure for VSL is $11.8 million (USDOT, 2022b). USDOT cost-benefit analysis guidance (USDOT, 2022a) asserts the fraction of VSL applicable toward incapacitating injuries as approximately 0.048 VSL or $564,365. These VSL estimates are applied here toward the crash reductions, assuming linear scaling based on the most recent USDOT VSL guidance (USDOT, 2021), for each scenario and plotted in figure 9.

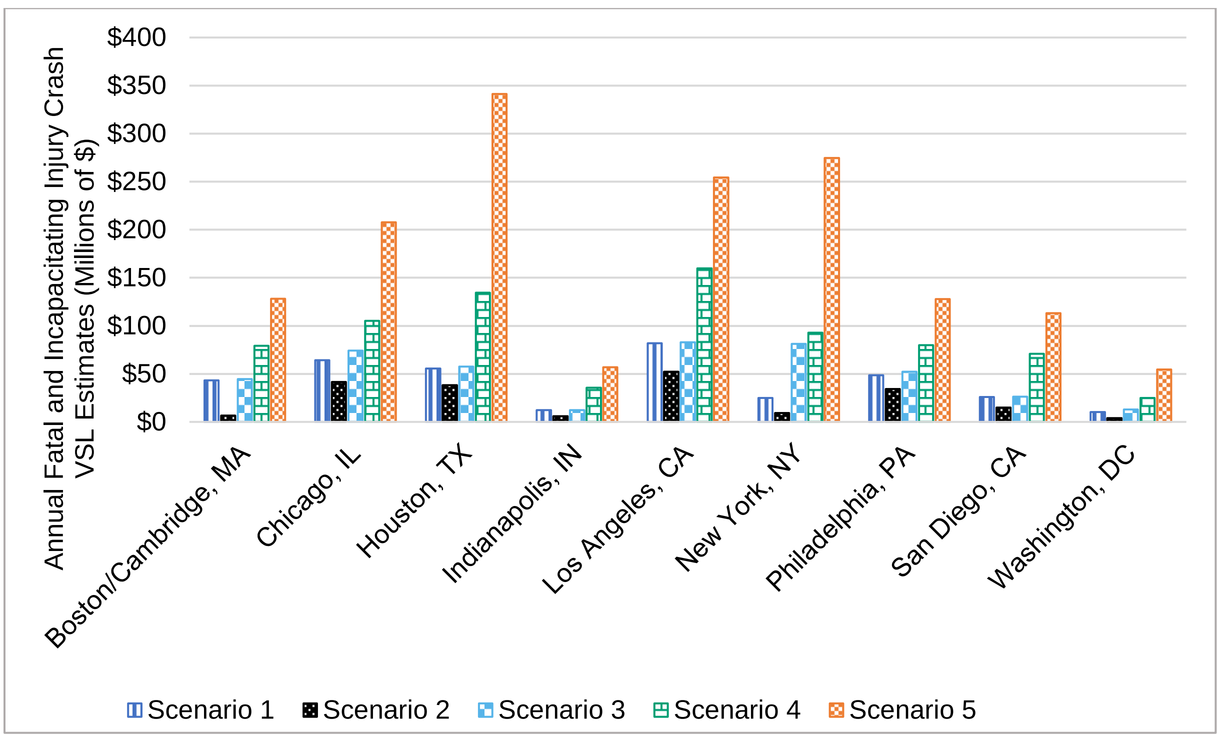
---

[20] See more information about Vision Zero here: https://highways.dot.gov/safety/zero-deaths/vision-zero-cop/vision-zero-community-practice



Source: FHWA.

Figure 8. Graph. Annual fatal and incapacitating injury crash reductions by city and scenario.



Source: FHWA.

Figure 9. Graph. Annual fatal and incapacitating injury crash reduction VSL estimates by city and scenario.

CHAPTER 5. REFERENCES

Axhausen, K.W., J. Molloy, C. Chervenkov, F. Becker, B. Hintermann, B. Schoeman, T. Gotschi, A. Castro Fernandez, and U. Tomic. 2021. "Empirical Analysis of Mobility Behavior in the Presence of Pigovian Transport Pricing." *ETH Zurich* 1704. https://www.research-collection.ethz.ch/handle/20.500.11850/500100, last accessed April 20, 2022.

Brueckner, Jan K., and Sofia F. Franco. 2018. "Employer-Paid Parking, Mode Choice, and Suburbanization." *Journal of Urban Economics* 104 (C): 35–46.

California EPA Air Resources Board. 2021. "California's Parking Cash-Out Program." Sacramento, CA: California EPA Air Resources Board.

Central Houston. 2018. "Downtown 2018 Commute Survey." Central Houston: Houston, TX. https://www.centralhouston.org/media/filer_public/54/5c/545c9b37-0e47-412b-b4b0-0ce56bdd994b/2018_downtown_commute_survey_full_report.pdf, last accessed April 19, 2022.

City of Berkeley. 2022. "Ch. 9.88 Commuter Benefit Program, Berkeley Municipal Code." Berkeley, CA: City of Berkeley. https://berkeley.municipal.codes/BMC/9.88.030, last accessed July 26, 2022.

City of Richmond. 2022. "Commuter Benefits Ordinance." Richmond, CA: City of Richmond. https://www.ci.richmond.ca.us/3119/Commuter-Benefits-Ordinance, last accessed July 26, 2022.

CMAP. 2020. "My Daily Travel Survey" (web page). https://www.cmap.illinois.gov/data/transportation/travel-survey, last accessed March 30, 2022.

Commute Seattle. 2016. "Seattle Employer Transportation Benefits Survey Results." Seattle, WA: Commute Seattle.

Concas, Sisinnio, and Nagesh Nayak. 2012. "A Meta-Analysis of Parking Pricing Elasticity." 12-4207. Washington, DC: Transportation Research Board. https://trid.trb.org/view/1130741, last accessed October 28, 2021.

Cox Automotive. 2022a. "New-Vehicle Prices Flirt with Record High in May, According to Kelley Blue Book, as Luxury Share Remains Strong." *Cox Automotive Inc.* (blog). June 9, 2022. https://www.coxautoinc.com/market-insights/kbb-atp-may-2022/, last accessed July 8, 2022.

———. 2022b. "Used-Vehicle Supply Holds Steady as Asking Prices Rise." *Cox Automotive Inc.* (blog). May 19, 2022. https://www.coxautoinc.com/market-insights/used-vehicle-supply-holds-steady-as-asking-prices-rise/, last accessed July 8, 2022.

Currans, Kristina M., Gabriella Abou-Zeid, and Nicole Iroz-Elardo. 2021. "Linking Residential Parking to Automobile Transportation Impact Outcomes at a Development Level." *Transportation Research Record: Journal of the Transportation Research Board* 2675, no. 1: 321-331.

CUTR. 2018. “TRIMMS User Manual Version 4.0.” Publication Number. Tampa, Florida: University of South Florida.

De Borger, Bruno, and Bart Wuyts. 2009. “Commuting, Transport Tax Reform and the Labour Market: Employer-Paid Parking and the Relative Efficiency of Revenue Recycling Instruments.” *Urban Studies* 46, no. 1: 213–233.

Demographia. 2020. “Demographia United States Central Business Districts (Downtowns).” Belleville, IL: Demographia. http://demographia.com/db-cbd2000.pdf, last accessed March 30, 2022.

Ding, Ling, and Xu Yang. 2020. “The Response of Urban Travel Mode Choice to Parking Fees Considering Travel Time Variability.” *Advances in Civil Engineering* 2020. https://doi.org/10.1155/2020/8969202, last accessed October 28, 2021.

Dong, Jing, Diane Davidson, Frank Southworth, and Tim Reuscher. 2012. “Analysis of Automobile Travel Demand Elasticities with Respect to Travel Cost.” Publication Number. Washington, D.C.: FHWA.

DVRPC. 1993. “Regional Analysis of Parking.” 93038. Philadelphia, PA: Delaware Valley Regional Planning Commission. https://www.dvrpc.org/reports/93038.pdf, last accessed April 19, 2022.

DVRPC. 2016. “2012-2013 Household Travel Survey.” Philadelphia, PA: Delaware Valley Regional Planning Commission.

Employers Resource. 2018. “What Are FICA and FUTA?” *Employers Resource* (blog). February 26, 2018. https://employersresource.com/business-taxes/what-are-fica-and-futa/, July 18, 2022.

Espey, Molly. 1996. “Explaining the Variation in Elasticity Estimates of Gasoline Demand in the United States: A Meta-Analysis.” *The Energy Journal* 17, no. 3: 49–60.

Evangelinos, Christos, Stefan Tscharaktschiew, Edoardo Marcucci, and Valerio Gatta. 2018. “Pricing Workplace Parking via Cash-Out: Effects on Modal Choice and Implications for Transport Policy.” *Transportation Research Part A: Policy and Practice* 113, July: 369–80. https://doi.org/10.1016/j.tra.2018.04.025, last accessed October 10, 2021.

Farrell, Séona, Margaret O’Mahony, and Brian Caulfield. 2005. “Attitudes and Behavioral Responses to Measures to Deal with Workplace Parking: Case Study of Dublin, Ireland.” *Transportation Research Record* 1932, no. 1: 178–87. https://doi.org/10.1177/0361198105193200121, last accessed October 28, 2021.

FHWA. 2009. “Non-Toll Pricing: A Primer.” FHWA-HOP-08-044. Washington, D.C.: FHWA. https://ops.fhwa.dot.gov/publications/fhwahop08044/cp_prim6_00.htm, last accessed July 11, 2022.

———. 2020. “Travel.” *Status of the Nation’s Highways, Bridges, and Transit: Conditions & Performance*, 23rd ed. Washington, D.C.: FHWA. https://www.fhwa.dot.gov/policy/23cpr/chap3.cfm, last accessed April 29, 2022.

Gillen, David. 1994. “Peak Pricing Strategies in Transportation, Utilities, and Telecommunications: Lessons for Road Pricing.” *Transportation Research Board Special*

Report Curbing Gridlock, no. 242. https://trid.trb.org/view/390815, last accessed October 28, 2021.

Gillingham, Kenneth. 2013. "Identifying the Elasticity of Driving: Evidence from a Gasoline Price Shock in California." *Regional Science and Urban Economics* 47, May: 13–24. https://doi.org/10.1016/j.regsciurbeco.2013.08.004, last accessed December 8, 2022.

Glascock, Jane, Carol Cooper, and Mark Keller. 2003. "The Downtown Seattle Access Project Parking Cash Out Experience: Results and Recommendations." Seattle, Washington: King County Metro. https://ops.fhwa.dot.gov/congestionpricing/value_pricing/pubs_reports/projectreports/pdfs/cashout_waparking.pdf, last accessed July 8, 2022.

Greenberg, Allen, and John (Jay) Evans. 2015. "Pay-to-Save Transportation Pricing Strategies and Comparative Greenhouse Gas Reductions: Responding to Final Federal Rule for Existing Electric Utility Generating Units." *Transportation Research Record* 2530, no. 1: 114–23. https://doi.org/10.3141/2530-14, last accessed October 28, 2021.

Hamre, Andrea, and Ralph Buehler. 2014. "Commuter Mode Choice and Free Car Parking, Public Transportation Benefits, Showers/Lockers, and Bike Parking at Work: Evidence from the Washington, DC Region." *Journal of Public Transportation* 17, no. 2. https://www.sciencedirect.com/science/article/pii/S1077291X22001631, last accessed June 20, 2022.

Howell, Amanda, Kristina Currans, Steven Gehrke, Gregory Norton, and Kelly Clifton. 2018. "Transportation Impacts of Affordable Housing: Informing Development Review with Travel Behavior Analysis." *Journal of Transport and Land Use* 11, no. 1. https://jtlu.org/index.php/jtlu/article/view/1129, last accessed January 11, 2019.

Huff, Samantha. 2020. "DC Commuter Benefits Law: Comply or Be Fined." https://godcgo.com/dc-commuter-benefits-law-comply-or-be-fined/, last accessed July 26, 2022.

ICF and CUTR. 2005. "Analyzing the Effectiveness of Commuter Benefits Programs." Transit Cooperative Research Program Report 107. Washington, D.C.: Transportation Research Board.

Indianapolis MPO. 2011. "Central Indiana Travel Survey: Final Report." Indianapolis, IN: The Indianapolis Metropolitan Planning Agency. https://d16db69sqbolil.cloudfront.net/mpo-website/downloads/Technical-Studies/Central_Indiana_Travel_Survey_2008-2009.pdf, last accessed October 29, 2021.

INRIX. 2017. "New INRIX Study Finds Parking Is the Largest Cost of Driving." INRIX Press Releases. https://inrix.com/press-releases/cod-us/, last accessed June 22, 2022.

Khordagui, Nagwa. 2019. "Parking Prices and the Decision to Drive to Work: Evidence from California." *Transportation Research Part A: Policy and Practice* 130, December: 479–95. https://doi.org/10.1016/j.tra.2019.09.064, last accessed October 10, 2021.

Kneebone, Elizabeth, and Natalie Holmes. 2015. "The Growing Distance between People and Jobs in Metropolitan America." Washington, D.C.: Brookings Metropolitan Policy Program.

Knittel, Christopher, and Shinsuke Tanaka. 2019. “Driving Behavior and the Price of Gasoline: Evidence from Fueling-Level Micro Data.” w26488. Cambridge, MA: National Bureau of Economic Research. https://doi.org/10.3386/w26488, last accessed January 26, 2022.

K.T. Analytics, Inc. 1994. “TDM Status Report: Parking Cash-Out.” Publication Number. Washington, D.C.: The Federal Transit Administration. https://rosap.ntl.bts.gov/view/dot/13374, last accessed July 11, 2022.

Lari, Adeel, Frank Douma, Kate Lang Yang, Kathryn Caskey, and Colin Cureton. 2014. “Innovative Parking Pricing Demonstration in the Twin Cities: Introducing Flexibility and Incentives to Parking Contracts.” Research Report. Report Number. Publication City: MnDOT.

Liston, Larry, Chris Hansen, Dan Woog, and Shannon Bird. 2022. *Alternative Transportation Options Tax Credit*.

Litman, Todd. 2015. “Transit Price Elasticities and Cross-Elasticities.” Publication Number. Victoria, BC: Victoria Transport Policy Institute.

———. 2022a. “Understanding Transport Demands and Elasticities: How Prices and Other Factors Affect Travel Behavior.” Victoria, BC: Victoria Transport Policy Institute. https://www.vtpi.org/elasticities.pdf, last accessed April 20, 2022.

———. 2022b. “A New Traffic Safety Paradigm.” Victoria, BC: Victoria Transport Policy Institute. https://www.vtpi.org/ntsp.pdf, last accessed March 30, 2022.

———. 2022c. “Understanding Transport Demands and Elasticities: How Prices and Other Factors Affect Travel Behavior.” Victoria, BC: Victoria Transport Policy Institute.

MA Executive Office for Administration and Finance. 2008. “Fringe Benefits, Payroll Taxes and Indirect Costs (A&F 5).” Boston, MA: State of Massachusetts. https://www.mass.gov/administrative-bulletin/fringe-benefits-payroll-taxes-and-indirect-costs-af-5, last accessed July 18, 2022.

MassDOT. 2012. “Massachusetts Department of Transportation Massachusetts Travel Survey.” Boston, MA: massDOT.

McGuckin, Nancy, Heather Contrino and Hikari Nakamoto. 2017. “Mandatory Travel During Peak Period.” Analysis Brief. https://trid.trb.org/view/910150, last accessed October 28, 2021.

McKenzie, Brian. 2014. “Modes Less Traveled—Bicycling and Walking to Work in the United States: 2008–2012.” ACS-25. Washington, DC: American Community Survey Reports. https://www2.census.gov/library/publications/2014/acs/acs-25.pdf, last accessed May 31, 2022.

MDOT. 2021. “Maryland Commuter Tax Credit” (web page). https://www.mdot.maryland.gov/tso/pages/index.aspx?pageid=41, last accessed April 28, 2022.

Methipara, Jasmy. 2014. “Mobility Challenges for Households in Poverty.” Publication Number. Washington, D.C.: FHWA.

Mokhtarian, Patricia L., Xinyi Wang, and Sung Hoo Kim. 2022. "Integrating Aggregate and Disaggregate Approaches to Assess the Post COVID 19 Impacts of Teleworking on Vehicle Travel." Presented at the The 101st Annual Meeting of the Transportation Research Board. Washington, D.C.: Transportation Research Board.

MTC. 2021. "Commuter Benefits Program" (web page). https://mtc.ca.gov/operations/traveler-services/commuter-benefits-program, last accessed July 26, 2022.

MWCOG. 2018. "Regional Travel Survey" (web page). https://www.mwcog.org/transportation/data-and-tools/household-travel-survey/, last accessed April 19, 2022.

———. 2020. "2019 State of the Commute Survey Report." Washington, D.C.: MWCOG.

National Renewable Energy Laboratory. 2022. "Transportation Secure Data Center" (web page). www.nrel.gov/tsdc, last accessed March 30, 2022.

NYC Consumer and Worker Protection. 2020. "Commuter Benefits Law FAQs" (web page). https://www1.nyc.gov/site/dca/about/commuter-benefits-FAQs.page, last accessed July 26, 2022.

NYMTC. 2014. "2010/2011 Regional Household Travel Survey (RHTS)" (web page). https://www.nymtc.org/DATA-AND-MODELING/Travel-Surveys/2010-11-Travel-Survey, last accessed October 28, 2021.

Parkopedia. 2020. "Parkopedia 2019 Parking Index North America." Publication Number. Publisher City: Publisher Name. https://cdn2.hubspot.net/hubfs/5540406/Parkopedia_North-America-Parking-Index-2019_Final.pdf?__hstc=91933061.2602e2f59bd0bdd68a82cd5934874b64.1578004250210.1578004250210.1578072603724.2&__hssc=91933061.1.1578072603724, last accessed October 28, 2021.

Rhode Island. 2014. "2014 Rhode Island General Laws: Title 37 - Public Property and Works: Chapter 37-5 - Department of Transportation: Section 37-5-7.1 - Parking Cash-Out Programs." Providence: State of Rhode Island. https://law.justia.com/codes/rhode-island/2014/title-37/chapter-37-5/section-37-5-7.1/, last accessed March 3, 2022.

RTA. 2021. "RTA COVID-19 Lapsed Rider Survey." Chicago: Regional Transportation Authority. https://www.rtachicago.org/sites/default/files/2021-04/RTA%20COVID-19%20Lapsed%20Rider%20Survey%20-%20Final%20Report.pdf, last accessed March 30, 2022.

San Francisco County Transportation Authority. 2016. "San Francisco Parking Supply and Utilization Study." Final Report. San Francisco, CA: San Francisco County Transportation Authority. https://www.sfcta.org/sites/default/files/2019-03/Parking_Supply_final_report_11.29.16.pdf, last accessed October 28, 2021.

San Francisco Department of the Environment. 2022. "San Francisco's Commuter Benefits Ordinance" (web page). https://sfenvironment.org/commuter-benefits-ordinance-sf, last accessed April 19, 2022.

SANDAG. 2013. "Employee Commute Survey" (web page). https://www.sandag.org/-/media/SANDAG/Documents/PDF/data-and-research/applied-research-and-performance-monitoring/surveys/employee-commute-survey-draft-report-version-2t-2013-11-11.pdf, last accessed March 23, 2022.

———. 2018. "Park & Ride/Commute Survey Summary Report." San Diego, CA: SANDAG. https://icommutesd.com/docs/default-source/default-document-library/2018-sandag-commute-behavior-survey-report.pdf?sfvrsn=2, last accessed March 30, 2022.

Shin, Eun Jin. 2020. "Commuter Benefits Programs: Impacts on Mode Choice, VMT, and Spillover Effects." *Transport Policy* 94, August: 11–22. https://doi.org/10.1016/j.tranpol.2020.05.001, last accessed October 12, 2021.

Shoup, Donald and Mary Jane Breinholt. 1997. "Employer-Paid Parking: A Nationwide Survey of Employers' Parking Subsidy Policies." UTC No 506. Berkley, CA: The University of California Transportation Center. https://escholarship.org/uc/item/3z49q768, last accessed April 19, 2022.

Shoup, Donald. 1997. "Evaluating the Effects of Parking Cash Out: Eight Case Studies." Working Paper. Berkeley, CA: The University of California Transportation Center.

———. 1997. "Evaluating the Effects of Cashing out Employer-Paid Parking: Eight Case Studies." *Transport Policy* 4, no. 4: 201–16. https://doi.org/10.1016/S0967-070X(97)00019-X, last accessed October 28, 2021.

———. 2005. "Planning Advisory Services Report Number 532: Parking Cash-Out." Chicago, IL: American Planning Association.

SHRM. 2022. "Covering Costs of Added Expenses: How Do Your Benefits Stack Up?" Alexandria, VA: Society for Human Resource Management. https://www.shrm.org/hr-today/trends-and-forecasting/research-and-surveys/pages/other.aspx, last accessed February 13, 2023.

Su, Q., and L. Zhou. 2012. "Parking Management, Financial Subsidies to Alternatives to Drive Alone and Commute Mode Choices in Seattle." *Regional Sci. Urban Econ* 42, no. 1: 88–97.

Texas A&M Transportation Institute. 2013. "2007-2009 H-GAC MPO Household Travel Survey Technical Summary." College Station, TX: Texas Department of Transportation. https://ftp.dot.state.tx.us/pub/txdot-info/tpp/survey/houston-2007-household.pdf, last accessed April 19, 2022.

Thaler, Richard. 1980. "Toward a Positive Theory of Consumer Choice." *Journal of Economic Behavior & Organization* 1, no. 1: 39–60. https://doi.org/10.1016/0167-2681(80)90051-7, last accessed October 28, 2021.

The Louis Berger Group. 2008. "Examining the Speed-Flow-Delay Paradox in the Washington, DC Region: Potential Impacts of Reduced Traffic on Congestion Delay and Potential for Reductions in Discretionary Travel during Peak Periods." FHWA-HOP-09-017. Washington, D.C.: FHWA. https://ops.fhwa.dot.gov/publications/fhwahop09017/fhwahop09017.pdf, last accessed April 11, 2022.

Tomer, Adie, and Joseph Kane. 2014. "Cars Remain King and Barrier to Economic Opportunity." *Brookings* (blog). Brookings Institution. October 23, 2014.

https://www.brookings.edu/blog/the-avenue/2014/10/23/cars-remain-king-and-barrier-to-economic-opportunity/, last accessed February 25, 2022.

U.S. BLS. 2021a. "National Compensation Survey: Employee Benefits in the United States, March 2021." Washington, D.C.: U.S. Department of Labor. https://www.bls.gov/ncs/ebs/benefits/2021/employee-benefits-in-the-united-states-march-2021.pdf, last accessed April 19, 2022.

———. 2021b. "Employee Benefits Survey: National Compensation Survey - Benefits" (web page). https://www.bls.gov/ncs/ebs/, last accessed June 21, 2022.

U.S. Census Bureau. 2018. "2018 SUSB Annual Data Tables by Establishment Industry" (web page). https://www.census.gov/data/tables/2018/econ/susb/2018-susb-annual.html, last accessed March 25, 2022.

U.S. EPA. 2005. "Parking Cash-Out: Implementing Commuter Benefits as One of the Nation's Best Workplaces for Commuters." Washington, D.C.: US Environmental Protection Agency.

USDOT. 2021. "Departmental Guidance: Treatment of the Value of Preventing Fatalities and Injuries in Preparing Economic Analyses." Washington, DC: USDOT. https://www.transportation.gov/sites/dot.gov/files/2021-03/DOT VSL Guidance - 2021 Update.pdf, last accessed June 21, 2022.

———. 2022a. "Benefit-Cost Analysis Guidance for Discretionary Grant Programs." Washington, D.C.: U.S. Department of Transportation Office of the Secretary. https://www.transportation.gov/sites/dot.gov/files/2022-03/Benefit%20Cost%20Analysis%20Guidance%202022%20%28Revised%29.pdf, last accessed June 21, 2022.

———. 2022b. "Departmental Guidance on Valuation of a Statistical Life in Economic Analysis" (web page). https://www.transportation.gov/office-policy/transportation-policy/revised-departmental-guidance-on-valuation-of-a-statistical-life-in-economic-analysis, last accessed June 21, 2022.

Vaca, Erin, and J. Richard Kuzmyak. 2005. "Chapter 13. Parking Pricing and Fees." *Traveler Response to Transportation System Changes*. Transit Cooperative Research Program, Report No. 95. Washington, D.C.: Transportation Research Board.

Van Hattum. 2009. "Parking Cash-Out: Where 'Smart Growth' and Effective Transit Intersect." Minneapolis, MN: Downtown Minneapolis Transportation Management Organization.

Vision Zero Network. 2022. "What Is Vision Zero?" (web page). https://visionzeronetwork.org/about/what-is-vision-zero/, last accessed April 12, 2022.

Walczak, Jared. 2019. "Local Income Taxes in 2019" *Tax Foundation* (blog). July 30, 2019. https://taxfoundation.org/local-income-taxes-2019/, last accessed July 18, 2022.

Washbrook, Kevin, Wolfgang Haider, and Mark Jaccard. 2006. "Estimating Commuter Mode Choice: A Discrete Choice Analysis of the Impact of Road Pricing and Parking Charges." *Transportation* 33, no. 6: 621–639. https://doi.org/10.1007/s11116-005-5711-x, last accessed September 21, 2020.

Watters, Paul, Margaret O'Mahony, and Brian Caulfield. 2006. "Response to Cash Outs for Work Place Parking and Work Place Parking Charges." *Transport Policy*, Parking, 13, no. 6: 503–510. https://doi.org/10.1016/j.tranpol.2006.05.008, last accessed October 28, 2021.

West, S.E. 2004. "Distributional Effects of Alternative Vehicle Pollution Control Policies." *Journal of Public Economics* 88, no. 3–4: 735–57.

West, S.E., and R.C. Williams III. 2004. "Estimates from a Consumer Demand System: Implications for the Incidence of Environmental Taxes." *Journal of Environmental Economics and Management* 47, no. 3: 535–58.

Wilson, Kea. 2022. "D.C. 'Parking Cash Out' Law Makes Employers Refund Workers Who Don't Drive." *Streetsblog USA* (blog). January 7, 2022. https://usa.streetsblog.org/2022/01/07/d-c-parking-Cash-Out-law-makes-employers-refund-workers-who-dont-drive/, last accessed February 23, 2022.

York, Erica. 2021. "2022 Tax Brackets." *Tax Foundation* (blog). November 10, 2021. https://taxfoundation.org/2022-tax-brackets/, last accessed July 26, 2022.

APPENDIX A. IMPLEMENTATION RESOURCES

While there is some guidance related to parking cash-out implementation strategies, much of that guidance is limited to providing advice for programs run by individual employers and not to municipalities attempting to implement broader policies. A major implementation hurdle at the municipal level, however, may be employer buy-in and compliance resistance. Being able to convey implementation strategies and benefits for employers is thus valuable for policy makers considering city-level ordinances.

One of the most comprehensive guidance documents available, the Federal Transit Administration's (FTA's) published "TDM Status Report: Parking Cash Out" (1994) notes a diverse array of considerations related to implementation applicability, policy development, program exemptions, enforcement, costs, and benefits. Some highlights include:

- The potential for parking cash-out alone to achieve significant impacts is dependent, in part, on the degree of employer-subsidized parking in an area. That is, where there is more subsidized parking, a larger proportion of employees would be eligible for parking cash-out (and subsequently take the cash). As explored with some scenarios in this FHWA study report, parking cash-out for employees with parking subsidies may be combined with other commuter benefits policies (i.e., pre-tax transit benefits) for employees without parking subsidies, increasing potential effectiveness.
- The structure of leased parking in an area is also key to consider. Parking costs may be lumped into employers' building leases (which may be non-negotiable), or parking may be leased separately. In the latter case, employers often could offload spaces that commuters choose to stop using to cover costs associated with providing parking cash-out.
- With an ordinance, employer impacts may vary based on their existing benefits' offerings, employer sizes, or parking lease versus ownership status. Note these topics are touched on in the discussion of results in this FHWA study report.
- Localities may wish to re-evaluate parking requirements for new commercial developments, given cash-out is expected to reduce parking demand.
- Monitoring and enforcement are critical in the implementation process. In the most limited form, this may involve posted notice of the policy, retained records of participating employees, and periodic checks for compliance. A more proactive approach might involve annual reporting requirements to be reviewed by the regulating jurisdiction.

A more recent report published by the U.S. EPA, "Parking Cash-Out: Implementing Commuter Benefits as One of the Nation's Best Workplaces for Commuters℠" (2005) provides some additional information on parking cash-out and implementation:

- Complexities associated with implementing parking cash-out are usually experienced one-time only at a program's onset, with employers modifying payroll systems to account for some employees taking additional taxable cash.

- A general step-wise framework for implementation is provided, geared toward employers, and its steps include: 1) analyze current parking conditions and policies, 2) determine how to structure a commuter benefits program, 3) obtain senior management approval, 4) work with payroll to set up appropriate payroll codes, 5) develop a process for employees to elect their commuter benefit, and 6) publicize and implement the parking cash-out program. Additional guidance on each step is provided. Municipalities considering an ordinance could provide context-sensitive modifications to this guidance to help employers with compliance.

FHWA's "Non-Toll Pricing: A Primer" (2009) covers some additional implementation considerations, including how incentives may play a role in supporting employer buy-in and compliance with parking cash-out programs.

APPENDIX B. ADDITIONAL SCENARIOS CONSIDERED FOR ANALYSIS

Prior to selecting scenarios for analysis, FHWA considered a number of potential alternatives. The purpose of this appendix is to share with readers a few approaches that FHWA elected not to analyze, but nevertheless, some cities might consider as policy approaches possibly worthy of their consideration.

Instead of policies being mandated, incentives such as tax credits could be used to encourage employers to change their commuter benefits offerings. Incentives could be provided to employers to offer cash-out to employees, or to offer it in a more desired form. As an example, employers could be provided an incentive, such as a 30 percent fully refundable tax credit for each of two years, for offering monthly cash-out, such as at the minimum level prescribed in either Scenario 1 or Scenario 2. A hybrid mandate/incentive policy is also possible. Employers that are required to offer monthly cash-out could be provided fully refundable tax credits to offer the cash-out in a daily instead of a monthly form. If this approach were to be pursued, the tax credit should be sufficiently small or tailored (i.e., applied only for employees currently offered parking benefits) so that employers are not encouraged to begin to offer parking benefits that they had not previously offered. One challenge with assessing tax credits is estimating how many employers would take advantage of them.

A hybrid approach entailing parking and cordon charges could be pursued. All parking facilities (including employer-provided parking facilities) would be required to charge a surtax on those arriving or departing during peak hours. This scenario has one unique advantage over the ones that were analyzed; namely, it raises revenues that could be used to improve city transportation. It also has a unique disadvantage: commuters with jobs that provide little scheduling flexibility and who feel that they need to continue to drive alone to work would not be able to avoid a higher commute cost.

Since some policies would be more challenging to implement than others, it is expected that full implementation would generally take some time. With the exception of the extension to exempt small employers (with fewer than 20 employees) from Scenario 1 and Scenario 3, the impacts of other exceptions, whether temporary or permanent, was not evaluated. It is likely that some grace period would be included in ordinances to accommodate employers whose parking is bundled with their office space lease, or who own employee parking, to enable employers to recoup their costs for parking that goes unused due to the cash-out program. These variances were not analyzed for simplicity and also in large part because it is presumed that a reasonable amount of transition time would be provided by ordinances.

Under any of the scenarios FHWA did analyze, employers could be required or encouraged to provide additional support for employees to use sustainable transportation options. Examples include preferential parking for carpoolers and vanpoolers, comprehensive telework programs that include office-sharing, compressed work weeks, shuttles to/from transit stations, or on-site bicyclist accommodations. These policies would increase the take-up rates of the scenarios, although it would be challenging to estimate the degree of impact.

APPENDIX C. DATA AND ANALYSIS METHODOLOGY

This appendix provides additional details on the data and methods applied for this study, as well as the general assumptions made during the analysis process.

Data Sources

This section describes several data sources compiled that were used in the analysis process. Table 6 shows values for each city, while the following subsections describe the data sources for each element. Locally specific data was used, wherever possible. Additionally, the team tried to identify the most recent pre-pandemic data available, if possible, such that estimates would not be skewed by potential deviations from typical behaviors or situations observed during the pandemic.[21] In some cases, the team used older data sources or made assumptions based on similar cities due to data limitations. Ultimately, the selected input data reflect the best available sources—even if not ideal in all cases—at the time of analysis and were selected in consultation with the peer review group for this research. Any assumptions made for specific sources are discussed here; additional assumptions considered throughout the analysis process are presented in a later subsection.

Number of Employees–Citywide

The number of employees (citywide) for each city are taken from the U.S. Census Bureau's American Community Survey (ACS) dataset.[22] For Boston/Cambridge, a sum of the employees in Boston and Cambridge was used.

Number of Employees–CBD

To determine the number of employees in the CBD, the team used Demographia's *United States Central Business Districts (Downtowns)* (2020) publication derived from the Census Transportation Planning Package 2012–2016. The report defines the CBD using census tracts and seeks to include the complete concentration of high-rise buildings (generally of 10 or more floors). This is a "tight" CBD definition, which is intended to include employment sites most conducive to transit commuting. The medium and lower density employment that sometimes surrounds downtown are generally excluded. Data for Cambridge is not available in the Demographia report. As such, this analysis assumes that all the employees in Cambridge work in the CBD area.

Percent of Employees with Access to Free/Subsidized Parking

A variety of local data sources have been used to identify the percentage share of employees with access to free or subsidized parking at their workplace. Most reports either only reported on fully subsidized parking or provided vague information about the level of parking subsidies. Because

[21]Note that post-pandemic expectations are accounted for later in this analysis through telework expectations.
[22] See the data from ACS Table B08601 2019 5-Year Estimates by Workplace Geography here: https://data.census.gov/table?q=B08601&tid=ACSDT5Y2019.B08601

of this, this analysis primarily considers parking cash-out policies to apply to employees with *fully* subsidized parking; estimates may undercount actual effects that may occur if various subsidy levels could be included in analysis.[23]

- Houston, TX: Downtown Commute Survey[24] (Central Houston, 2018)
- New York, NY: 2010/2011 Regional Travel Survey (New York Metropolitan Transportation Council (NYMTC), 2014)
- Los Angeles, CA: Park & Ride/Commute Survey (San Diego Association of Governments (SANDAG), 2018)
- Chicago, IL: 2020 Chicago "My Daily Travel" household travel survey (HTS) (CMAP, 2020)
- San Diego, CA: Park & Ride/Commute Survey (SANDAG, 2018)
- Philadelphia, PA: 2012–2013 HST (Delaware Valley Regional Planning Commission (DVRPC), 2016)
- Indianapolis, IN: Central Indiana Travel Survey for CBD (Indianapolis Metropolitan Planning Organization (MPO), 2011)
- Washington, DC: State of the Commute Survey (MWCOG, 2020)
- Boston/Cambridge, MA: Estimate provided by peer review group member John Attanucci based on Massachusetts Bay Transportation Authority (MBTA) survey data

Percent of Employees with Access to Transit Benefits

To estimate the percent of employees with access to transit benefits, local data for each city's region was used where available, with many data sources overlapping those used to identify parking benefits. For the remaining cities, data from the updated 2021 National Compensation Survey by the BLS (2021 National Compensation Survey (NCS) BLS; Table 41, Quality of life benefits) was used.

- Houston, TX: Downtown Commute Survey (Central Houston, 2018)
- New York, NY: 2010/2011 Regional Travel Survey (NYMTC, 2014)
- Los Angeles, CA: Park & Ride/Commute Survey (SANDAG, 2018)
- Chicago, IL: COVID-19 Lapsed Rider Survey (Chicago Regional Transportation Authority (RTA), 2021), weighted average of rates observed by employees riding Chicago Transit Authority (CTA), Metra, and Pace system
- San Diego, CA: Park & Ride/Commute Survey (SANDAG, 2018)
- Philadelphia, PA: 2012–2013 HTS (DVRPC, 2016)
- Indianapolis, IN Central Indiana Travel Survey for CBD (Indianapolis MPO, 2011)
- Washington, DC: State of the Commute Survey (MWCOG, 2020)

---

[23] See APPENDIX D. ADDITIONAL RESULTS for additional discussion on this matter.

[24] Houston's survey included two different response options to indicate the offering of a parking subsidy. One response option clearly indicated that the parking was free while the second was more ambiguous. Given Houston shares many characteristics of other lower-density cities that FHWA analyzed with relatively high rates of free and subsidized parking, FHWA considered adding the positive responses (for a sum of 41 percent) from the survey together to be reasonable.

- Boston/Cambridge, MA: Estimate provided by peer review group member based on MBTA survey data

Work Trip Mode Split–Citywide

Citywide work trip mode splits were estimated using the U.S. Census Bureau's ACS dataset (Table B08601 2019 5-Year Estimates by Place Geography).

Work Trip Mode Split–Employees with Access to Fully Subsidized Parking

To estimate the mode split for employees with access to fully subsidized parking, the following approaches were taken:

- New York: Mode split for employees with access to fully subsidized parking obtained from 2010/2011 Regional Travel Survey (NYMTC, 2014)
- Philadelphia: Mode split for employees with access to fully subsidized parking obtained from 2012–2013 HTS (DVRPC, 2016)
- Washington, D.C.: Mode split for employees with access to fully subsidized parking obtained from State of the Commute Survey (MWCOG, 2020)
- Chicago: Drive alone mode share for employees with access to fully subsidized parking from "My Daily Travel Data" HTS (CMAP, 2020); remaining mode-shares re-proportioned based on citywide split
- Indianapolis: Drive alone mode share for employees with access to fully subsidized parking from Heartland in Motion 2014 HTS, obtained from the National Renewable Energy Laboratory (2022); remaining mode-shares re-proportioned based on citywide split
- Houston, San Diego, and Los Angeles: Due to unavailability of regional sources, the percent change in the drive-alone mode share for Indianapolis from the citywide rate to the rate for employees with fully subsidized parking was applied to the drive-alone mode share for these cities given similarities in starting mode shares, parking prices, and built environments; remaining mode-shares were re-proportioned based on citywide split.
- Boston/Cambridge: Due to unavailability of regional sources, the percent changes in the drive-alone mode share for Chicago, Washington, D.C., and Philadelphia from the citywide rate to the rate for employees with fully subsidized parking were averaged and applied to the drive-alone mode share for Boston/Cambridge given similarities in starting mode shares, parking prices, and built environments; remaining mode-shares were re-proportioned based on citywide split.

Average One-Way Commute Trip Length

To estimate this measure, the team pulled commute trip length data from the 2017 National Household Travel Survey (NHTS) for all cities (except Houston, TX). Data were pulled for each city's appropriate Metropolitan Statistical Areas, given this is the closest level of geographic granularity available in the NHTS public data. Then, the dataset was limited to home-based work trips to reflect average commute distances. Trip lengths were disaggregated by mode; NHTS mode definitions were based on the closest possible alignment with U.S. Census Bureau mode definitions in the ACS Table B08601: Means of Transportation to Work by Workplace Geography. A local data source (Central Houston 2018) was used to get estimates for Houston.

CBD Parking Price

To estimate CBD parking prices, data from Parkopedia, a parking reservation booking site and database, was used. The 2019 North American Parking Index (Parkopedia, 2020) details the 50 most expensive parking rates in North American central cities. Monthly rates were available for all cities in the current study, except for Indianapolis.

The team considered other potential parking reservation websites that could provide similar data, but ultimately chose Parkopedia for the following reasons:

- **Time of data collection:** Parkopedia data were collected in 2019, and as such may mitigate any changes in parking prices that are not expected to continue long term due to the COVID-19 pandemic.
- **Spatial focus:** Parkopedia data reflect parking rates in the city center and no assumptions were made regarding the price of parking outside of CBDs; rather, a policy decision was made for the FHWA analysis that the value of cash-out payments in non-CBD areas would be required to equal the cost of a typical monthly transit pass in the studied city.
- **Data volume:** Parkopedia compiles parking data across 15,000 cities—a total of 70 million spots.

While Parkopedia could be used for almost all cities in this analysis, an alternative data source was needed for Indianapolis. Another parking reservation site, SpotHero, Inc., provided a data point for Indianapolis which was used to derive an estimate in line with the Parkopedia data. To estimate a monthly CBD rate for Indianapolis aligned with the Parkopedia data, a normalization factor was developed by taking the ratio of the Parkopedia parking rate to the SpotHero, Inc. parking rate for each of the remaining eight cities where data from both sources was available. An average of these normalization factors was calculated and multiplied by Indianapolis' SpotHero, Inc. parking rate. The resulting value estimates the 2019 monthly CBD parking rate for Indianapolis.

SpotHero, Inc.'s website has two alternate locations to show parking rates, both of which have different rates; as such, the above methodology was applied to both those instances. While the distinction between the two locations isn't clear, the team hypothesized one provides historical estimates, averaged across some time, while one shows the most up-to-date parking prices. In the absence of additional information illuminating the benefit of using one datapoint over another, the study team averaged the results based on the two rates to estimate Indianapolis's parking price.

For all cities, per day parking costs were estimated from monthly parking costs by dividing the monthly cost by an estimated 19 commuting days each month.

Transit Fares

For analysis purposes, the study team made no assumptions regarding the price paid for parking outside of CBDs; rather, a policy decision was made that the value of cash-out payments in non-CBD areas would be required to equal the cost of a typical monthly transit pass in the studied city. The per day cost was calculated by dividing the monthly cost by an estimated 19 commuting days each month.

Transit fare data was obtained from a variety of local fare data sources:

- Houston, TX: Houston METRO price for coverage of Zone 2, since Zone 2 covers the inner Houston CBD
- Los Angeles, CA: LA Metro Zone 1 EZ Pass cost, since Zone 1 provides access to the greatest number of commuters in the region
- New York, NY: Weighted price based on fares and weekday ridership on the New York Metropolitan Transportation Authority (MTA), Long Island Rail Road, Metro North, and NJ Transit. Assumed 50 percent of trips on MTA were commutes and 90 percent of trips on other services were commutes. Fare zones (where applicable) were averaged. A maximum value of $280 per month (the 2022 maximum for tax exempt benefits) was used.
- Chicago, IL: Weighted price based on fares and weekday ridership on METRA and CTA/PACE. Assumed 50 percent of trips on CTA/PACE were commutes and 90 percent of trips on METRA were commutes. Fare zones (where applicable) were weighted based on ridership. A maximum value of $280 per month was used.
- San Diego, CA: Cost of San Diego Metropolitan Transit System regional monthly fare pass
- Indianapolis, IN: Cost of 31-day fare pass on IndyGo
- Philadelphia, PA: Cost of monthly fare pass on the Southeastern Pennsylvania Transportation Authority
- Boston/Cambridge, MA: Weighted price based on fares and ridership on MBTA and commuter rail. MBTA cost based on LinkPass and assumed 50 percent of trips using pass were commutes. Commuter rail price weighted by zone and assumed 90 percent of trips were commutes. Fare zones (where applicable) were weighted based on ridership. A maximum value of $280 per month was used.
- Washington, D.C.: Weighted price based on fares and total ridership on the Washington Metropolitan Area Transit Authority (WMATA) and Virginia Railway Express (VRE). Assumed 50 percent of trips on WMATA were commutes and 90 percent of trips on VRE were commutes. VRE fare zones were averaged. A maximum value of $280 per month was used.

Tax Rates

The study team compiled 2022 Federal and State income tax rates from Tax Foundation (York 2021). The average wage for an earner in each study area was determined based on a 2021 analysis by CareerBuilder®,[25] and the average tax rate was computed using brackets based on that rate.

[25]See https://www.careerbuilder.com/advice/average-salary-by-city.

Table 6. Summary of core input data.

City	Employee population, citywide	Employee population, central business district (CBD)	% Employees offered free parking	% Employees offered transit benefits	Citywide mode shares, drive alone	Citywide mode shares, transit	Employees with fully subsidized parking mode shares, drive alone	Employees with fully subsidized parking mode shares, transit	Average one-way commute trip length (miles), drive-alone	Per day monthly parking rate, CBD	Transit trip cost, daily	Tax rate (State + Federal)
Boston/ Cambridge, MA	827,852	410,055	45%	85%	41%	38%	60%	25%	13.9	$17.74	$5.95	36.7%
Chicago, IL	1,530,905	572,724	43%	10%	47%	33%	52%	30%	12.9	$12.72	$6.00	34.6%
Houston, TX	1,873,491	161,432	41%	13%	81%	3%	83%	3%	18.8	$6.19	$6.50	29.7%
Indianapolis, IN	547,906	87,210	79%	6%	85%	1%	87%	1%	11.6	$5.29	$3.16	32.9%
Los Angeles, CA	2,154,978	164,839	79%	23%	71%	9%	72%	8%	13.2	$7.19	$6.95	39.0%
New York, NY	4,733,695	1,927,440	4%	20%	23%	58%	76%	12%	15.7	$34.48	$7.05	36.1%
Philadelphia, PA	784,744	223,105	52%	15%	51%	27%	66%	19%	15.6	$13.60	$9.16	32.7%
San Diego, CA	926,419	56,995	88%	14%	77%	4%	78%	4%	13.8	$7.27	$3.79	39.0%
Washington, DC	840,050	431,345	23%	66%	42%	37%	83%	9%	14.6	$14.39	$8.11	38.2%

Calculating Travel Impacts

This section describes the approach the research team took for calculating the travel impacts (i.e., the reduction in commute VMT) resulting from implementing a parking cash-out program.

For some scenarios, cities in California (Los Angeles and San Diego) went through additional analytical steps. Because California has an existing cash-out requirement, the research team assumed that some share of employees at companies offering parking are already also offering cash-out. As part of its Employee Commute Survey, SANDAG (2013) reported that 5.5 percent of survey respondents indicated that they receive “cash or other incentives for not using parking” (figure 62 in that report); also, when asked if there is free parking at their work site, 90 percent out of the 99.4 percent who responded to the question, replied “yes” (figure 73 in that report). Thus, the analysis assumed that 6.1 percent of employees in California cities with free parking were also offered cash-out and that most new cash-out requirements would not impact these employees. While data comparable to that offered by this San Diego survey were not also available for Los Angeles, the two cities were considered sufficiently similar to allow the San Diego survey results to also be applied to Los Angeles.

The approaches described for each scenario in this section include an explanation for adjustments, if any, made for the California cities. Note that while Washington, D.C. recently implemented a parking cash-out law (Wilson, 2022), impacts were not considered given the recency of the legislation and lag-time in observing impacts, and the pre-implementation data used in analysis.

Scenario 1 (Monthly Parking Cash-Out) Approach

The approach to analyzing an ordinance requiring employers to offer a monthly cash-out involved the following steps:

Estimate the number of employees with access to parking cash-out policies. The starting point for this analysis was the total number of employees with a workplace location in each city. The analysis used available data, typically from regional travel surveys and from the U.S. Census Bureau, to estimate the share of these employees who are offered free parking (Equation 1).

$$EP = ET \ x \ S_P$$

Equation 1. The number of employees with access to free or subsidized parking.

Where:

- EP = Employees with access to free or subsidized parking
- ET = Total employees with workplaces in analysis area
- S_P = Share of employees offered free or subsidized parking

The final employee baseline was then determined by subtracting the number of employees with access to free or subsidized parking who also have access to transit benefits. An adjustment was made later in the analysis to account for this population.

Estimate the average "opportunity cost" associated with the cash-out policy. The driver response to parking cash-out offers depends on the change in driving costs. For purposes of examining travel behavior, the option to receive cash in lieu of a parking space can be viewed as an increase in the cost of driving; that is, the cash forgone is an opportunity cost to driving and parking at work.

The opportunity cost is based on the market rate of parking in the city for scenarios requiring employers to offer the full cash-out value of the parking. For scenarios in which employees receive cash in lieu of parking, the cash would be considered taxable income. As such, the opportunity cost typically starts with the price of parking reduced by an average marginal tax rate (Equation 2).

$$OC = PR\ x\ (1 - MT)$$

Equation 2. Standard opportunity cost of forgoing a parking cash-out offer.

Where:

- OC = Opportunity cost
- PR = Market rate of parking in analysis area
- MT = Average marginal tax rate

However, it is expected that rather than taking their cash-out in the form of taxable cash, employees who currently use transit or subsequently switch to transit would elect to receive—and employers would choose to offer—a tax-free transit benefit, plus any additional taxable cash to make up the difference in price between the parking cash-out value and the monthly cost of a transit pass.

The research team calculated an opportunity cost for parking based on the monthly average parking rate and the monthly average transit pass cost for each city. The team assumed that commuters accepting cash-out and abandoning driving and parking would shift to alternative travel modes in proportion to their pre-existing mode shares for non-SOV travel.

For the purpose of determining this opportunity cost, the cash-out value is equal to the average monthly commercial parking rate in CBDs, and outside of CBDs, the cash-out rate is assumed to be equal to the average cost of riding transit into the city. Based on this assumption, a per day rate was determined using Equation 3 through Equation 5.

$$APR = [DPR \times CBD] + [DTR \times (1 - CBD)]$$

Equation 3. Per day monthly parking rate, weighted by CBD population.

Where:

- APR = Average parking rate, weighted by CBD population
- DPR = Daily parking rate (estimated from monthly parking cost)
- DTR = Daily transit trip cost
- CBD = Percentage of Population Working in CBD

Next, the average cash-out value offered was determined as Equation 4:

$$ACO = [(DPR \times (1 - MT)) \times CBD] + [(DTR \times (1 - MT)) \times (1 - CBD)]$$

Equation 4. Average cash-out offered, weighted by CBD population.

Where, *ACO* = Average cash-out offered, and all other variables are as previously defined.

The average benefit taken (ultimately used as the opportunity cost for analysis) is then defined as Equation 5:

$$ABT = [APR \times TMS] + [ACO \times (1 - TMS)]$$

Equation 5. Average benefit taken (opportunity cost of driving for Scenario 1).

Where, *ABT* = Average benefit taken, *TMS* = percentage of employees who do not drive alone that commute via transit, and all other variables are as previously defined. These values are displayed for the cities in this analysis in Table 7.

Table 7. Opportunity costs of driving for Scenario 1.

Cost Related Figures	Boston/ Cambridge, MA	Chicago, IL	Houston, TX	Indianapolis, IN	Los Angeles, CA	New York, NY	Philadelphia, PA	San Diego, CA	Washington, DC
Monthly parking rates, central business district (CBD)	$337	$242	$118	$100	$137	$655	$258	$138	$273
Per day monthly rate, CBD	$17.74	$12.72	$6.19	$5.29	$7.19	$34.48	$13.60	$7.27	$14.39
Per day monthly rate, non-CBD minimum (equal to transit trip cost)	$5.95	$6.00	$6.50	$3.16	$6.95	$7.05	$9.16	$3.79	$8.11
Per day monthly rate, weighted by CBD population	$11.79	$8.51	$6.47	$3.50	$6.97	$18.22	$10.42	$4.00	$11.33
Marginal tax rate	36.7%	34.6%	29.7%	32.9%	39.0%	36.1%	32.7%	39.0%	38.2%
After tax cash-out offered, full subsidy, CBD	$11.24	$8.32	$4.36	$3.55	$4.39	$22.02	$9.15	$4.44	$8.90
After tax cash-out offered, full subsidy, non-CBD minimum	$3.77	$3.92	$4.57	$2.12	$4.24	$4.50	$6.16	$2.31	$5.01
Average cash-out offered, weighted by CBD population	$7.47	$5.57	$4.55	$2.35	$4.25	$11.64	$7.01	$2.44	$7.01
Average benefit taken (including tax-free benefit)	$10.22	$7.41	$4.57	$2.46	$5.07	$14.92	$8.91	$2.70	$9.30

Estimate the change in VMT with the cash-out ordinance. Based on the number of employees offered cash-out and thus experiencing the opportunity cost, the resulting reduction in trips and VMT was calculated in two different ways, described below.

Version 1: Trip Reduction Impacts for Mobility Management Strategies (TRIMMS)

For one approach, the research team used the TRIMMS model developed by the University of South Florida. TRIMMS is a sketch planning tool that can be used to analyze many types of strategies at a regional or sub-area scale. The tool is Microsoft® Excel-based, and preloaded with metropolitan-specific data, including employment and travel data, and travel elasticities and cross elasticities derived from national research. The user can adjust the parameter values and price elasticities. Default parameters were adjusted for starting commuter mode shares (to reflect the population receiving fully subsidized parking).

TRIMMS evaluates strategies that directly affect the cost of travel, including parking pricing and public transit costs. The model uses inputs provided by the user or defaults of mode shares, average trip lengths and travel time by mode, average vehicle occupancy, parking costs, and trip costs. For this analysis, the employee populations and parking costs specific to each city were entered into TRIMMS, along with estimated initial commute mode shares for the population of employees subject to the cash-out ordinance, excluding the small portion of California employees offered cash-out because of the statewide law in advance of any city ordinances. Given that the cash-out requirement would apply only to worksites with free or subsidized parking, an estimate of mode share for employees with access to free parking was used. Additionally, the research team updated the variable identified as the auto travel elasticity with respect to parking price to -0.30 based on values identified in the literature. (Since price changes in most scenarios involve free parking as the starting condition, and an elasticity calculation is impossible if any of the values is zero, it was surmised that the input elasticity value being sought was really the price elasticity of VMT when parking pricing is included within the bundle of travel costs.)

TRIMMS calculates adjusted mode shares based on the policy strategies applied. For this analysis, the final (adjusted) mode shares were pulled from the model results. By multiplying the original and final mode shares by the employee population for the city, the absolute change in commute trips was calculated (Equation 6). By applying the average trip distance by mode to the change in the number of vehicle trips, the change in VMT was calculated. Average vehicle occupancy rates were used to adjust VMT reductions from new carpool and vanpool commuters.

$$VMR = EP \; x \; 2 \; x \left[\left((S_{A0} - S_{A1}) \; x \; D_A \right) + \left((S_{R0} - S_{R1}) \; x \frac{D_R}{O_R} \right) + \left((S_{V0} - S_{V1}) \; x \frac{D_V}{O_V} \right) \right]$$

Equation 6. VMT reduced using TRIMMS.

Where:

VMR = Vehicle miles reduced
EP = Employees offered parking cash-out
S_{A0} = Starting auto drive-alone mode share

S_{A1} = Final auto drive-alone mode share
D_A = Average one-way drive-alone commute distance
S_{R0} = Starting carpool mode share
S_{R1} = Final carpool mode share
D_R = Average one-way carpool commute distance
O_R = Average occupancy of carpool trip
S_{V0} = Starting vanpool mode share
S_{V1} = Final vanpool mode share
D_V = Average one-way vanpool commute distance
O_V = Average occupancy of vanpool trip

Version 2: Elasticity Calculations

For the second approach, the research team calculated a change in vehicle travel directly based on a travel price elasticity from the literature (i.e., without using TRIMMS). The change in vehicle travel was calculated from the percentage change in vehicle operating costs with the addition of the parking cash-out opportunity cost using an arc elasticity of -0.30 for the change in vehicle travel in relation to the parking costs as derived from the literature review (Equation 7).

$$R = \left[\frac{OC}{OC + (TC\ x\ D_A\ x\ 2)}\right]^{EL_P}$$

Equation 7. Percentage reduction in vehicle travel using travel elasticity.

Where:

R = Percentage reduction in vehicle travel
OC = Opportunity cost
TC = Variable vehicle trip cost per mile
D_A = Average one-way drive-alone commute distance
EL_P = Arc elasticity for the change in vehicle travel in relation to the parking costs (-0.30)

The analysis assumes that employees taking the cash-out drive the same average round-trip commute distance as other drivers; thus, the percentage reduction in vehicle travel is equivalent to the percentage reduction in commute trips, or the share of drivers that accepts the cash-out offer (Equation 8).

$$VTR = R\ x\ EP\ x\ S_{A0}$$

Equation 8. Percentage reduction in vehicle travel.[26]

Where:

VTR = Vehicle trips reduced
R = Percentage reduction in vehicle travel
EP = Employees with access to parking offers

[26]Equivalent to the percentage reduction in commuter trips.

S_{A0} = Starting auto drive-alone mode share

To calculate the VMT reduction, the vehicle trips reduced were multiplied by the average driving commute distance for the area (Equation 9).

$$VMR = VTR\ x\ D_A\ x\ 2$$

Equation 9. Reduction in vehicle miles traveled for Scenario 1.

Where:

VMR = Vehicle miles reduced
VTR = Vehicle trips reduced
D_A = Average one-way drive-alone commute distance

In order to compare the results to the outputs from TRIMMS, the research team used the percentage reduction in VMT from this approach to estimate a change in mode shares, assuming that the reduction in vehicle travel all came from drive-alone commute trips. The other mode shares were assumed to increase based on their relative shares from the TRIMMS results.

Midpoint

The TRIMMS methodology yielded an estimated 13 percent reduction in VMT in Los Angeles at worksites that would offer cash-out under Scenario 1, which is similar to the 12 percent average reduction Shoup (1997) found in his study of eight work sites, lending some support to the use of this methodology. However, the eight case studies analyzed by Shoup showed individual VMT reductions ranging from 5 percent to 24 percent, with the highest reduction levels at work sites in downtown Los Angeles (a 16 percent and 24 percent reduction, respectively). The TRIMMS approach yielded estimated impacts of cash-out for cities with high initial SOV rates, such as Indianapolis, San Diego, and Houston, that appeared quite low. By contrast, the elasticity approach made no downward adjustment in results in such cities. Specific results for affected employers (i.e., worksites offering cash-out under this scenario) from both Version 1 and Version 2 are summarized in Table 8. The elasticity-based VMT reduction figures are higher than the figures developed using TRIMMS for all cities except Boston/Cambridge and Chicago (likely due to these two cities having the lowest starting drive-alone mode share, effecting the impact of the elasticity method on drive-alone vehicle trip and VMT).

Table 8. Comparison of reductions in VMT at worksites offering parking cash-out (Scenario 1) using different calculation approaches.

City	Version 1 (TRIMMS)	Version 2 (Elasticity)
Boston/Cambridge, MA	28%	27%
Chicago, IL	27%	23%
Houston, TX	6%	13%
Indianapolis, IN	3%	12%
Los Angeles, CA	13%	18%
New York, NY	24%	30%
Philadelphia, PA	23%	23%
San Diego, CA	6%	11%
Washington, DC	13%	25%

TRIMMS = Trip Reduction Impacts for Mobility Management Strategies

After a discussion with the peer review group, it was decided to take a midpoint of the mode share results of the Version 1 (TRIMMS) and Version 2 (Elasticity) approaches to reflect the likely higher impacts of cash-out associated with downtown and other urban locations, but also not to overestimate the impacts. By taking a midpoint, the final mode shares lie halfway between each version's results. The drive-alone mode shares and mid-points for each city are shown as an example in Table 9. The process for determining VMT reductions from these mode shares follows Equation 6.

Table 9. Comparison of drive-alone mode shares at worksites offering parking cash-out (Scenario 1) using different calculation approaches.

City	Version 1 (TRIMMS)	Version 2 (Elasticity)	Midpoint
Boston/Cambridge, MA	42%	44%	43%
Chicago, IL	37%	40%	39%
Houston, TX	75%	72%	74%
Indianapolis, IN	83%	76%	80%
Los Angeles, CA	60%	59%	60%
New York, NY	57%	53%	55%
Philadelphia, PA	49%	50%	50%
San Diego, CA	73%	70%	71%
Washington, DC	71%	63%	67%

TRIMMS = Trip Reduction Impacts for Mobility Management Strategies

California Adjustment

For Los Angeles and San Diego, the analysis described above only applied to the employee population that was not already offered parking cash-out as a result of the California mandate.

Thus, trip and VMT changes in those two cities were calculated relative to travel by the baseline population of employees offered parking subsidies but not already offered cash-out.

Adjustment for Employees Receiving Transit Benefits

The analysis also adjusted final results to account for employees who had access to free parking, and who also had access to transit benefits. These commuters were treated differently under the assumption that, with the provision of transit benefits, their responsiveness to this policy would be expected to be somewhat muted, reflective of less change in the benefits they are offered. Making this adjustment was reliant on calculations conducted for Scenario 2 (employer-paid transit/vanpool benefit). First, VMT per employee was determined for two populations:

1. **Employees previously receiving fully subsidized parking (and now eligible for cash-out) without transit benefits:** The final mode shares from Scenario 1 and average trip lengths and vehicle occupancies for drive-alone, carpool, and vanpool modes were used to determine this figure.
2. **Employees previously receiving fully subsidized parking and transit benefits:** The final mode shares from Scenario 2 (described in the following subsection) and average trip lengths and vehicle occupancies for drive-alone, carpool, and vanpool modes were used to determine this figure. The impact on VMT for this population is higher under Scenario 1 than Scenario 2, because in the latter, this population does not receive additional cash reflective of the market value of parking exceeding transit commute costs.

The percent change between the two figures—from 2) to 1)—was determined. Then, this reduction was applied to the baseline VMT for employees receiving fully subsidized parking to determine the estimated VMT reduction for this subset of employees (i.e., population 2). This reduction was added to the reduction determined in the baseline Scenario 1 analysis to get the total estimated VMT reduction.

Scenario 2 (Monthly Employer-Paid Transit/Vanpool Benefit) Approach

The research team attempted to use the TRIMMS model to estimate the impacts of an ordinance requiring employers that offer free/subsidized parking to also offer a monthly commuter benefit (e.g., transit or vanpool benefit). The results were unusually large, suggesting dramatic increases in transit mode share based on the transit price elasticities that are built into the TRIMMS model. The expectation for a monthly commuter benefit requirement under Scenario 2 is that the resulting vehicle trip reductions would be somewhat lower than the impact of offering cash-out under Scenario 1, since Scenario 1 assumes that a tax-free commuter benefit is part of the parking cash-out package, but that was not matched by the preliminary results.

Consequently, the research team estimated travel impacts for Scenario 2 using the same approach as is described in the Scenario 1 analysis; however, instead of using the cash-out value as the opportunity cost, the average transit cost for each city was used instead. The baseline population for Scenario 2 was employees with access to fully subsidized parking who did not already have access to transit benefits. An output of this approach within TRIMMS was shifts to the newly subsidized modes (transit and vanpool), but also to other modes that are not subsidized (carpooling, bicycling, and walking). Initially, only shifts to the subsidized modes were accepted. Shifts to other non-SOV modes, however, show a willingness on the part of SOV drivers to entertain alternatives. Thus, for this analysis, it was then assumed that 25 percent of the employees whom TRIMMS indicated would shift to other modes based on the monetary value of the incentive would take a vanpool or transit benefit if that were the only offer instead of cash because they showed a willingness to stop driving alone.

The State of New Jersey and a number of U.S. cities, including two that are being analyzed here (New York City and Washington, D.C.), have in recent years mandated that some employers make available pre-tax transit benefits to their employees. Because these requirements came into being after the period for which the data being used in this analysis were gathered, no analytical adjustments are required for these cities.

California Adjustment

Employees in Los Angeles and San Diego who were already offered cash-out and thus were excluded from the Scenario 1 analysis, are also excluded in this scenario; employees who were already offered cash-out are not being offered a commuter benefit in this scenario.

Adjustment for Employees Receiving Transit Benefits

Employees with access to fully subsidized parking who already received transit benefits were excluded in this scenario; these employees were not being offered a new commuter benefit in this scenario.

Scenario 3 (Monthly Parking Cash-Out + Pre-Tax Transit Option for Employees without Subsidized Parking) Approach

Under this scenario, in addition to the policy under Scenario 1, a pre-tax transit benefit is offered to all employees who *do not* have access to fully subsidized parking and who do not already receive transit benefits from their employer. The team assumed that the mode shares for the population being offered the pre-tax transit benefit were the same as the citywide shares gathered from the ACS or from regional travel surveys. The baseline population for this component of the analysis was the number of employees *not* receiving fully subsidized parking (or cash-out) who do not already receive transit benefits.

The pre-tax transit benefit offered to employees reduces transit trip cost through tax savings or transit costs multiplied by the marginal tax rate. The research team calculated the percentage increase in transit trips by applying a transit price elasticity (reflecting the change in transit ridership in relation to a change in the price of transit) of -0.15 from the literature to the transit cost reduction. The transit trip increase was applied to the transit mode share and the use of all other modes was assumed to decline proportionally based on their original shares.

Because this scenario is applied on top of the parking cash-out scenario, the trip and VMT reductions in this scenario were added to the reductions in Scenario 1 to calculate the total impact of the combined scenarios.

As also noted in discussing Scenario 2, a number of jurisdictions, including two cities that are being analyzed here (New York City and Washington, DC), have in recent years mandated that some employers make available pre-tax transit benefits to their employees. Because these requirements came into being after the period for which the data being used in this analysis were gathered, no analytical adjustments are required for these cities.

California Adjustment

Because this scenario only applies to employees who are not offered fully subsidized parking, there is no adjustment made for Los Angeles and San Diego, as cash-out would not have been offered to any of these employees.

Adjustment for Employees Receiving Transit Benefits

Since the results here are added to those from Scenario 1 to understand the full impact of this policy, the adjustment made in Scenario 1 for employees eligible for cash-out who already receive transit benefits hold here. No adjustment was made for the population not receiving free parking (or cash-out) who already receive transit benefits, as a new benefit was not being offered to this population.

Scenario 4 (Daily Parking Cash-Out + Pre-Tax Transit Option for Employees without Subsidized Parking) Approach

Scenario 4 reflects the same policy as Scenario 3, except with daily parking cash-out. A daily cash-out option means that rather than being required to give up a parking space for a month, the employee can choose to receive cash on a daily basis whenever the employee uses an alternative to parking at work. More employees are likely to take advantage of a daily versus a monthly cash-out offer and forgo driving since they can do so on a day-by-day basis. The literature review and limited experience with more flexible parking cash-out programs support this conclusion.

For the population of employees offered a daily cash-out option, the impacts of the offer are calculated from the results from Scenario 1.[27] The approach is based on a study of results of the Minneapolis Innovative Parking Pricing Demonstration (Lari et al., 2014), which converted a purchased monthly parking pass to a more flexible pass that provided a small rebate on days that drivers commuted by transit instead of driving and a larger rebate when they neither drove their own car nor took transit. Since drivers purchasing the pass had an option not to purchase monthly parking at all, it was presumed that they had not accepted what was equivalent to a monthly parking cash-out offer. In this study, the most flexible Minneapolis pass option yielded a reduction in parking days of 23.8 percent. Assuming that one-third of this reduction is from telework, and that employers do not offer a cash-out on days employees do not commute at all, a daily cash-out offer was assumed to result in an additional 16 percent shift from solo driving beyond what a monthly cash-out offer would yield. This additional 16 percent reduction was applied to the results of Scenario 1 for those employees with access to the daily cash-out

[27] Note that Scenario 1 calculations are based on monthly market parking rates. While daily parking costs more in the marketplace than pro-rated monthly parking, the daily cash-out rate, as envisioned and modeled, was based on the pro-rated monthly cash-out costs.

The results of the adjusted Scenario 1 for daily cash-out were added to the reduction results from Scenario 3 for the population eligible for pre-tax transit benefits under this policy to estimate the total reduction under Scenario 4.

California Adjustment

For Los Angeles and San Diego, the scenario assumes that the employees who are already offered monthly cash-out have not yet been offered daily cash-out, and thus no adjustment was made.

Adjustment for Employees Receiving Transit Benefits

This adjustment was determined using the same method applied in Scenario 1.

Scenario 5 (Requirement to Eliminate Subsidized Parking Benefit + Provide Universal $5 Per Day Employer-Paid Non-SOV Commute Benefit) Approach

This scenario reflects an ordinance that requires employers that are offering their employees subsidized parking to cease offering it *and* for *all* employers to offer employer-paid non-SOV commute benefits of $5 per commute day. To calculate the trip and VMT impacts in both scenario versions, the research team recreated the approaches described in Scenarios 1, 2, and 4 although with different inputs (e.g., starting mode shares, travel costs), depending on the different employee populations being examined.

Part 1: Employees at Worksites Previously Receiving Fully Subsidized Parking, Now with Unsubsidized Parking and Non-SOV Benefits

For the employee population already receiving fully subsidized parking, as with Scenario 1, the research team calculated mode shares using the TRIMMS and elasticity calculation approaches and then took the midpoints between the two sets of results. Midpoint mode shares were calculated based on three cost points, modeled again as the opportunity cost of driving alone and parking:

1. **Daily cost to park.** Instead of using the after-tax cash-out value of parking, the team used the full price of parking. Under this policy, the team assumed employees who were previously receiving fully subsidized parking would be offered pre-tax parking to purchase. As such, the cost of parking was not inflated to account for taxed wages that would increase the actual total parking cost.
2. **Daily cost to park + full $5 subsidy.** This cost point was used to determine mode shares for transit and vanpool, as these modes can receive pre-tax commute benefits.
3. **Daily cost to park + after-tax $5 subsidy.** This cost point was used to determine mode shares for non-SOV modes other than transit and vanpool, as these modes cannot receive pre-tax commute benefits. The after-tax subsidy was determined using the marginal tax rate estimated for each city.

After arriving at the midpoint mode share calculations for each of the three cost points above, the final mode shares for this population were determined by:

- For transit and vanpool, holding the mode shares from 2)
- For other non-SOV modes, holding the mode shares from 3)
- For drive alone mode, starting with the mode share from 1) adjusting based on the difference in the mode shares for other modes between 1) and 2) or 1) and 3), depending on the mode

Because this scenario assumes a daily non-SOV benefit and daily parking costs, an additional 16 percent mode shift away from driving alone was applied as in Scenario 4. An adjustment for employees receiving transit benefits was made to the final VMT reduction as in Scenario 1, which also relies on data from Scenario 2.

Part 2: California Adjustment

This scenario assumes the cash-out ordinances in Los Angeles and San Diego would hold. As such, VMT reductions were estimated separately for this population. The analysis process followed that outlined in Part 1, except with slightly different cost points:

1. **Cash-out value daily estimate.** In the California cities, some employees with access to free parking are already offered parking cash-out, so they face a different cost than all the other employee populations; their opportunity cost for continuing to drive is the price of parking minus the after-tax value of the cash-out, plus the untaxed value of the transit benefit. This baseline population was estimated to be approximately 6 percent of employees in each city based on SANDAG commuter surveys (SANDAG, 2013).
2. **Cash-out value daily estimate + full $5 subsidy**
3. **Cash-out value daily estimate + after-tax $5 subsidy**

Again, because this scenario assumes a daily non-SOV benefit and daily parking costs, an additional 16 percent mode shift away from driving alone was applied as in Scenario 4. An adjustment for employees receiving transit benefits was made to the final VMT reduction as in Scenario 1, which also relies on data from Scenario 2. However, a separate run of Scenario 2 was estimated specifically for this population to apply for this adjustment, using the mode shares estimated from the first cost-point above as the starting mode shares for the population already receiving cash-out in the California cities.

Part 3: Employees Who Were Not Receiving Fully Subsidized Parking and Now Receive a Non-SOV Benefit

VMT reduction for this population was again determined as in Part 1, but only with the following two cost points since this population experiences no impacts to parking costs:

1. **Full $5 subsidy**
2. **After-tax $5 subsidy**

Final mode shares were determined as in Part 1, except the drive alone mode share was taken from the baseline mode share for employees not receiving fully subsidized parking and adjusted using the same method in Part 1. Baseline mode shares for employees not receiving fully subsidized parking were estimated by subtracting the number of employees receiving fully subsidized parking from the number of employees citywide commuting by each mode for each city, and then calculating the total share of that population taking each mode. Again, because this scenario assumes a daily non-SOV benefit and daily parking costs, an additional 16 percent mode shift away from driving alone was applied as in Scenario 4. An adjustment for employees receiving transit benefits was made to the final VMT reduction as in Scenario 1, which also relies on data from Scenario 2. However, a separate run of Scenario 2 was estimated specifically for this population to apply for this adjustment, starting with the mode share for employees not receiving fully subsidized parking.

Scenario 1A (Monthly Parking Cash-Out for Employees Working for Employers with 20 or More Employees) Approach

This scenario adjusts the results of Scenario 1 to account only for employees working for firms with 20 or more employees; this employer size exclusion follows that put forward by Washington, D.C.'s, parking cash-out law. Additional information and results on this analysis are provided in Appendix D. Additional Results.

There are two overall things required to estimate the impact of the scenario extension to exempt small-employers. The first is to understand the number of employees in the cities working for exempt employers. The second, since the impact of the policies vary based on "starting" commute benefits offers, is understanding the degree to which small-employer benefits offerings differ from other employers.

To estimate the number of employees working for firms with 20 or more employees who would be subject to this policy, data from the Seattle Employer Transportation Benefits Survey (Commute Seattle, 2016) was used to determine the differences in benefits offerings by employer size. This was the only data source that could be found, after an exhaustive search, that differentiates commuter benefits by employer size at a comparable scale (i.e., across an entire jurisdiction) that enabled the team to adjust the data appropriately. The percent of employees receiving free parking and subsidized transit benefits overall were calculated. Then, these percentages were calculated for employees working for firms with 20–100 employees, followed by for employers with more than 100 employees.[28] Differentiation between these categories were made given that employers with more than 500 employees were not surveyed. As such, the team assumed that the largest employers (500+ employees) would match the benefits offerings patterns of large employers (100–499 employees).

The benefits offerings for the mid- and large-size employers were compared to the overall rate to develop a scaling factor for the citywide rates used in this analysis. If the mid- or large-employer rate was *higher* than the citywide rate, the gap between both rates and 100 percent was determined. Then, the difference was divided by the gap between the citywide rate and 100 percent to determine the scaling factor. This factor would be used to "scale up" the commute benefits offerings from the employers not exempt from the policy. If the mid- or large-employer

[28]These cutoffs were used so they could be aligned with data on the percentage of employees working for firms of different sizes from the Census 2018 SUSB Annual Data Tables by Establishment Industry.

rate was *lower* than the citywide rate, the gap between both rates and 0 percent was determined (this is equal to the standing percentages). Then, the difference was divided by the citywide rate to determine the scaling factor to "scale down" the commute benefits offerings. This method to derive the scaling factors, and then to appropriately scale the citywide estimates, is shown in Equations 10 and 11. Example calculations for parking benefits in Seattle are shown in Equations 12 and 13 using the data in Table 10.

Table 10. Seattle Employer Transportation Benefits Survey data summary (data provided courtesy of Commute Seattle).

Employee Size Categories	% Receiving Free Parking	% Receiving Subsidized Transit
Employee's offerings overall (regardless of employer size)	44%	66%
Employees working for larger employers (i.e., 20 or more employees) overall	44%	69%
Employees working for firms with 20-99 employees *[used for scaling]*	47%	55%
Employees working for firms with 100+ employees *[used for scaling]*	41%	82%
Employees working for small employers (i.e., less than 20 employees) *[for comparison]*	46%	44%

$$G\% = \frac{(100\% - CY\%) - (100\% - MLE\%)}{(100\% - CY\%)}$$

Equation 10. Scaling factor equation when the mid- or large-size employer offering is greater than the citywide offering.

Where:

- *CY%* = Percentage of employees overall receiving the benefit
- *MLE%* = Percentage of employees working for mid- or large-size firms receiving the benefit
- *G%* = The extent to which the percentage of employees working for mid- or large-size firms receiving the benefit closes the gap between the overall percentage and 100 percent, compared to the citywide offering

$$G\% = \frac{MLE\% - CY\%}{CY\%}$$

Equation 11. Scaling factor equation when the mid- or large-size employer offering is less than the citywide offering.

Where:

- *CY%* = Percentage of employees overall receiving the benefit

- *MLE%* = Percentage of employees working for mid- or large-size firms receiving the benefit
- *G%* = The extent to which the percentage of employees working for mid- or large-size firms receiving the benefit closes the gap between the overall percentage and 0 percent, compared to the citywide offering

Using Equation 10 and Equation 11, the team arrived at the scaling factors presented in Table 11. An example use of these factors to scale the free parking offering in Houston, TX (41 percent) is shown in Equation 12 and Equation 13.

Table 11. Seattle Employer Transportation Benefits survey data (provided courtesy of Commute Seattle) and scaling factors calculated with Equation 10 and Equation 11.

Employee Size Categories	Scaling factor between % of employees receiving free parking overall and % of employees working for mid- or large-size firms	Scaling factor between % of employees receiving subsidized transit overall and % of employees working for mid- or large-size firms
Employees working for firms with 20–99 employees	5%	-17%
Employees working for firms with 100+ employees	-7%	47%

$$\left(5\% \times (1 - 41\%)\right) + 41\% = 44\%$$

Equation 12. Sample calculation.

Estimating the percentage of Employees Working for Firms with 20–99 Employees Receiving Free Parking Benefits in Houston, TX [this equation format used to apply an increase, or closing the gap toward 100 percent]

$$(41\% \times -7\%) + 41\% = 38\%$$

Equation 13. Sample calculation.

Estimating the percentage of Employees Working for Firms with 100+ Employees Receiving Free Parking Benefits in Houston, TX [this equation format used to apply a decrease, or closing the gap toward 0 percent]

Citywide free parking and transit benefits figures were scaled for all cities. The new baseline population for Scenario 1A was then determined using these new figures, along with data using the Census Statistics of U.S. Businesses (SUSB) Annual Data Tables by Establishment Industry (U.S. Census Bureau 2018). These tables provided estimates of the percentage of employees working for firms between 20–99 employees, and then for firms with 100 or more employees. The results from Scenario 1 were then scaled appropriately based on the difference in the number of employees being served by the policy, and the new citywide commute VMT reductions were calculated.

Scenario 3A (Monthly Parking Cash-Out + Pre-Tax Transit Option for Employees without Subsidized Parking for Employees Working for Employers with 20 or More Employees) Approach

Recall that, to determine the effects of Scenario 3, the impact of the pre-tax transit option for employees without subsidized parking was added to the results of Scenario 1 to determine the overall effect of this policy. Here, the new baseline number of employees eligible for pre-tax transit benefits was determined using the same scaling factors and process as in Scenario 1A to scale the initial results from Scenario 3. Then, these results were added to the reductions calculated in Scenario 1A to determine the overall impact of this scenario.

Calculating Resulting Congestion, Environmental, and Safety Impacts

To calculate the impact of parking cash-out policies on driving-related externalities and costs, the research team first determined reductions to actual commute VMT based on expectations in telework after the COVID-19 pandemic, and then applied per-mile factors to the estimated reductions to arrive at measures for congestion and environmental impacts.

Accounting for Telework

The research team investigated several sources on expectations for telework after the COVID-19 pandemic. Mokhtarian, Wang, and Kim (2022), through a series of surveys, estimated post-pandemic telework occasions to be between 1.4x to 3.2x pre-pandemic rates, with the "most likely" scenario being around 2x pre-pandemic rates. Based on these estimates, the team scaled down the baseline number of commuters identified based on pre-pandemic data (along with baseline commute VMT) to account for increased telework. Total percentage VMT reductions determined through each scenario were then applied to this reduced baseline to determine the raw VMT reduction under each scenario. Raw VMT reductions are reported for the full range provided by Mokhtarian, Wang, and Kim (2022). Congestion, environmental, and safety impacts were then determined based on the most likely scenario (2x pre-pandemic rates).

Emissions

To calculate criteria pollutant and GHG emission impacts of the policy scenarios, regional average per-mile emission factors for CO_2e, oxides of nitrogen (NO_x), and fine particulate matter (PM-2.5) were pulled from TRIMMS; these emissions factors are from the EPA's Motor Vehicle Emission Simulator model (MOVES 2010a)[29]. The per-mile emission rates were multiplied by the VMT reductions to calculate the change in running emissions (Equation 14):

---

[29]The team explored opportunities to update emissions rates based on newer data sources; however, temporal and spatial data limitations led the team to conclude that the rates developed in TRIMMS were the most appropriate to use, save from re-running EPA's latest version of MOVES for the nine cities analyzed.

$$EM_P = RVMT_C \times REF_P$$

Equation 14. Total emissions reduced for pollutant *p*.

Where:

- EM_P = Total emissions reduced for pollutant p
- $RVMT_c$ = Commute vehicle miles reduced
- REF_P = Running emission factor for pollutant p

Congestion

Congestion benefits are highly dependent upon local factors and require detailed modeling for accuracy. The latest version of the TRIMMS model included new data from which congestion could be estimated. Namely, data in TRIMMS lent itself to three potential congestion estimates;[30] the research team estimated results for each. In estimating congestion aligned with each method, the research team estimated that 90 percent of commute VMT occurs during peak hours. Before applying congestion data from TRIMMS, the research team took the following steps:

1. **Estimate all (commute and non-commute) peak VMT, no telework changes.**
   To estimate post-pandemic all peak VMT, the research team first determined an estimate for all peak VMT based on pre-pandemic (i.e., no accelerated telework) conditions. Assuming 90 percent of commute trips occur during peak hours, the research team calculated the number of peak commute vehicle trips and VMT as 90 percent of total estimate commute trips and VMT (based on the number of employees, mode shares, and average trip lengths in each city). Based on analysis of data from the 2009 NHTS (McGuckin et al., 2017), 54.9 percent of trips during the AM peak period are commute trips. Additionally, the average length for all trips was 9.72 miles, compared to 13.36 miles for commuting. The ratio of these figures and proportion of peak commute trips were used with Equation 15 a-c to estimate total peak VMT and non-commute peak VMT.

$$\frac{PRT_C}{0.549} = PRT_A$$

$$\left(\frac{9.72}{13.36}\right) \times PRT_A \times OWTL \times 2 = PVMT_A$$

$$PVMT_A - PVMT_C = PVMT_{NC}$$

Equation 15 a-c. Calculating all peak VMT.

[30]Additional information about the measures used can be found in the TRIMMS 4.0 documentation, accessed at https://mobilitylab.org/calculators/download-trimms-4-0/

Where:

- PRT_C = Peak commute round trips
- PRT_A = All (commute + non-commute) peak round trips
- *OWTL* = One way commute trip length (city-specific)
- $PVMT_C$ = Baseline peak commute VMT (based on the number of employees, mode shares, and average trip lengths in each city)
- $PVMT_A$ = All peak VMT
- $PVMT_{NC}$ = Non-commute peak VMT

2. **Estimate all peak VMT, assuming telework changes.**
   Non-commute peak VMT is held constant from the above step and added to peak commute VMT that takes into account telework reductions (based on the NEW number of commuting employees given changes in telework, along with mode shares, and average trip lengths in each city) to get the estimated value for all (commute and non-commute) peak VMT.

Next, the team tested results from each potential methodological approach available given data provided in TRIMMS:

Method 1: Using Average Added Delay

TRIMMS provides a regional-specific measure of *average added delay* (minutes per VMT). To estimate impacts of the scenarios on peak-hour congestion using this method, peak baseline minutes of delay and the percent change in congestion based on that delay for each scenario were estimated for each city using the derived all peak VMT value and average added delay from TRIMMS (Equation 16 a-c).

$$DF \times PVMT_A = BPD$$

$$DF \times RVMT_C = RPD$$

$$\frac{RPD}{BPD} = \%\Delta D$$

Equation 16 a-c. Percent change in congestion (vehicle minutes of delay), Method 1.

Where:

- $PVMT_A$ = All peak VMT
- $RVMT_c$ = Expected reduction in commute VMT based on a given scenario (based on expected percentage reduction and $PVMT_A$)
- *DF* = Average added delay factor (from TRIMMS) in minutes per vehicle mile traveled (presented in Table 12)
- *BPD* = Baseline peak delay (minutes)
- *RPD* = Reduced peak delay (minutes)
- $\%\Delta D$ = Percent change in peak delay due to reduction in commute VMT for a given scenario

Table 12. Average delay (minutes/VMT) metrics from TRIMMS v4.0.[31]

City	Average added delay (minutes/VMT)
Boston/Cambridge, MA	0.33
Chicago, IL	0.37
Houston, TX	0.37
Indianapolis, IN	0.26
Los Angeles, CA	0.33
New York, NY	0.26
Philadelphia, PA	0.32
San Diego, CA	0.21
Washington, DC	0.4

Method 2: Using Elasticity

TRIMMSv4.0 calculated elasticities reflecting the percentage change in delay relative to a 1 percent change in VMT using a panel regression (accounting for total delay, area VMT, land area density, real per capita gross domestic product, and year fixed-effects to control for variation over time). The derived elasticities are specific to urban area size, as presented in Table 13. All cities in this study fall into the "Very Large" urban area size category (>3M people), except for Indianapolis, which is classified as a "Large" area (1–3M people).

Table 13. Added delay with respect to VMT from TRIMMS v4.0.[32]

Urban Area Size	Elasticity Value (% change in total delay for each % change in VMT)
Very Large	0.49
Large	0.31
Medium	0.24
Small	0.78

[31] Values obtained from TRIMMS v4.0 tool. Note that TRIMMS reports values at the metropolitan-area level. As such, some values may be less accurate for cities, a caveat to the congestion estimation approach. For example, one might expect New York City's average delay to be similar to that in other large, dense cities. In contrast, the value presented in Table 12 is lower in New York's metro region than other metro regions, likely because the concentrated added delay factor one might observe within the city is diluted by lower added delay factors across the metropolitan region.

[32] Values obtained from TRIMMS v4.0 documentation. Although the cities in this study fall only into the "Large" and "Very Large" size categories, it is worth noting that the elasticity for "Small" urban areas may be greater than that for the largest urban areas given network capacity constraints. That is, with smaller networks, it may not take much in terms of additional vehicles added to the system before congestion impacts become very substantial in such areas.

To estimate the impact of each scenario on delay using this method, the percent change in all peak VMT as a result of each policy scenario was multiplied by the appropriate elasticity for each city (Equation 17).

$$\%\Delta D = \%\Delta PVMT_A \times \varepsilon_{d,VMT}$$

Equation 17. Percent change in congestion (vehicle minutes of delay), Method 2.

Where:

- $\%\Delta PVMT_A$ = The percent change in all peak VMT (takes telework into account)
- $\varepsilon_{d,VMT}$ = Elasticity for added delay with respect to VMT
- $\%\Delta D$ = Percent change in peak delay due to reduction in commute VMT for a given scenario

Method 3: Marginal Added Delay

The third method applied to estimate congestion impacts of the scenarios combines approaches from the previously described two methods. The method starts with baseline delay, *BPD*, as measured in Equation 16. Unlike Method 1, Method 3 does not assume that baseline delay factor holds for changes in VMT introduced to the system. Instead, Method 3 estimates *marginal added delay*, in minutes, for the additional VMT change, as suggested by TRIMMS and in Equation 18.

$$\Delta Delay = BPD\left[\left(\frac{PVMT_{A,N}}{PVMT_A}\right)^{\varepsilon_{d,VMT}} - 1\right]$$

Equation 18. Marginal added delay.

Where:

- $PVMT_A$ = All peak VMT
- $PVMT_{A,N}$ = Expected all peak VMT after scenario is applied ($PVMT_A$ + $RVMT_c$ from Method 1)
- $\varepsilon_{d,VMT}$ = Elasticity for added delay with respect to VMT
- *BPD* = Baseline peak delay (minutes)
- $\Delta Delay$ = Expected change in delay (minutes)

Then, the percent change in delay is calculated as shown below, where all variables are as previously defined (Equation 19):

$$\%\Delta D = \frac{\Delta Delay}{BPD}$$

Equation 19. Percent change in congestion (vehicle minutes of delay), Method 3.

Ultimately, as briefly touched upon in CHAPTER 3. CITY AND SCENARIO SELECTION, the research team selected Method 3 given its use of both city-specific baseline delay data and the area-size-specific elasticity value that reflected a more sophisticated (i.e., non-linear) relationship between delay and VMT. Method 3 combined the individual advantages offered by Method 1 and Method 2.

Safety

After consulting the peer review group convened for this research, the team believed it was reasonable to assume reductions in crashes would scale linearly with reductions in VMT for this sketch-level analysis. Deviations from this standard trend during the COVID-19 pandemic might be attributed to higher levels of speeding during this time (Litman, 2022b), which is expected to dissipate as the causes start to recede (e.g., near-empty roadways and pandemic-inspired antisocial behavior). Real numbers of avoided crashes were estimated using estimated VMT reductions (accounting for telework expectations) and the regionally-specific crash rates (crashes on the KABCO Injury Classification Scale[33] per million VMT) provided in TRIMMS.

[33]KABCO Injury Classification Scale: K = Fatality, a victim was killed; A = Incapacitating injury, a victim suffered incapacitating injuries that require hospitalization and/or transport for medical care, such as broken bones, amputation; B = Non-incapacitating injury, injuries to victims were evident to officers at the scene, but they were non-disabling lacerations, scrapes, or minor bruises; C = Possible injury, a victim suffered possible injuries; O = Property-damage only, there were no apparent injuries involved in the crash.

APPENDIX D. ADDITIONAL RESULTS

This appendix summarizes some additional results of extensions to the core analysis performed by the research team.

Daily Citywide VMT Reductions for Affected Commuters Only: Scenarios 1 and 2

While Scenarios 3, 4, and 5 apply to all employees, Scenarios 1 and 2 only apply to a subset of the citywide employee population. Namely, Scenario 1 is a policy impacting employees whose employers offer free parking as a commuter benefit and who do not already receive parking cash-out. The population impacted under Scenario 2 is slightly less than that impacted under Scenario 1. That is, Scenario 2, like Scenario 1, applies to employees who have free workplace parking and who do not already receive parking cash-out, but additionally only to those who do not already receive employer-paid transit commuter benefits.

Recall that results in VMT reduction were reported as the percent change in daily citywide commute VMT. Commuters citywide are impacted by Scenario 3, 4, and 5 unlike under Scenarios 1 and 2. Scenarios 1 and 2 could, however, have major impacts on commuters subjected to their requirements. To highlight this, the VMT reductions produced by Scenarios 1 and 2 can also be presented in terms of the percent change in daily affected commuters' VMT. Percent changes for affected commuters only, since this is a subset of commuters citywide, will be larger than for workers citywide, as the latter includes workers not affected by the policies. The raw reduction being considered (assuming 2x post-pandemic telework rates, in this case) remains the same.

VMT reductions as a percent of affected commuters' VMT are displayed in Table 14 alongside the baseline citywide reductions. Even though Scenario 1 is estimated to produce larger raw VMT reductions compared to Scenario 2 (as is demonstrated by the greater impact of Scenario 1 in the citywide reductions), in some cases (i.e., Washington, D.C.) the percent reduction in *affected* commuter VMT for Scenario 2 is higher than the percent reduction in *affected* commuter VMT for Scenario 1. In a market like Washington, D.C., where a high proportion of commuters already receive transit benefits (66 percent) and where transit commute costs approach the market value of parking, the additional benefit received for the population already receiving transit benefits (the majority of the employee population impacted) would be relatively low. Namely, that benefit would be what remains from the market-rate of parking after applying the value toward transit benefits pre-tax, or approximately $60 a month taxable cash. In contrast, the benefit for the population affected under Scenario 2 (those receiving free parking who do not already have transit benefits) would reflect the full value of their transit commute costs, approximately, or $150 a month. This is a relatively high value compared to what the majority of commuters impacted under Scenario 1 would receive. This results in a greater VMT percent reduction for *affected commuters* under Scenario 2 versus Scenario 1 in this market.

Table 14. Percent reductions in daily affected commuter VMT by scenario and city (with comparisons to citywide impact).*

City	S1: Monthly Cash-Out (Citywide)	S1: Monthly Cash-Out (Affected Commuters Only)	S2: Monthly Commuter Benefit (Citywide)	S2: Monthly Commuter Benefit (Affected Commuters Only)
Boston/Cambridge, MA	10%	15%	1%	15%
Chicago, IL	11%	23%	7%	16%
Houston, TX	3%	7%	2%	5%
Indianapolis, IN	5%	6%	2%	3%
Los Angeles, CA	9%	11%	5%	9%
New York, NY	3%	25%	1%	12%
Philadelphia, PA	13%	19%	9%	16%
San Diego, CA	6%	7%	3%	4%
Washington, DC	4%	10%	2%	12%

*The baseline affected commuter VMT for Scenario 1 is commute VMT for employees with access to fully subsidized parking, without existing parking cash-out; the baseline for Scenario 2 starts with the Scenario 1 baseline and then also excludes VMT from employees who already have access to employer-paid transit commuter benefits.

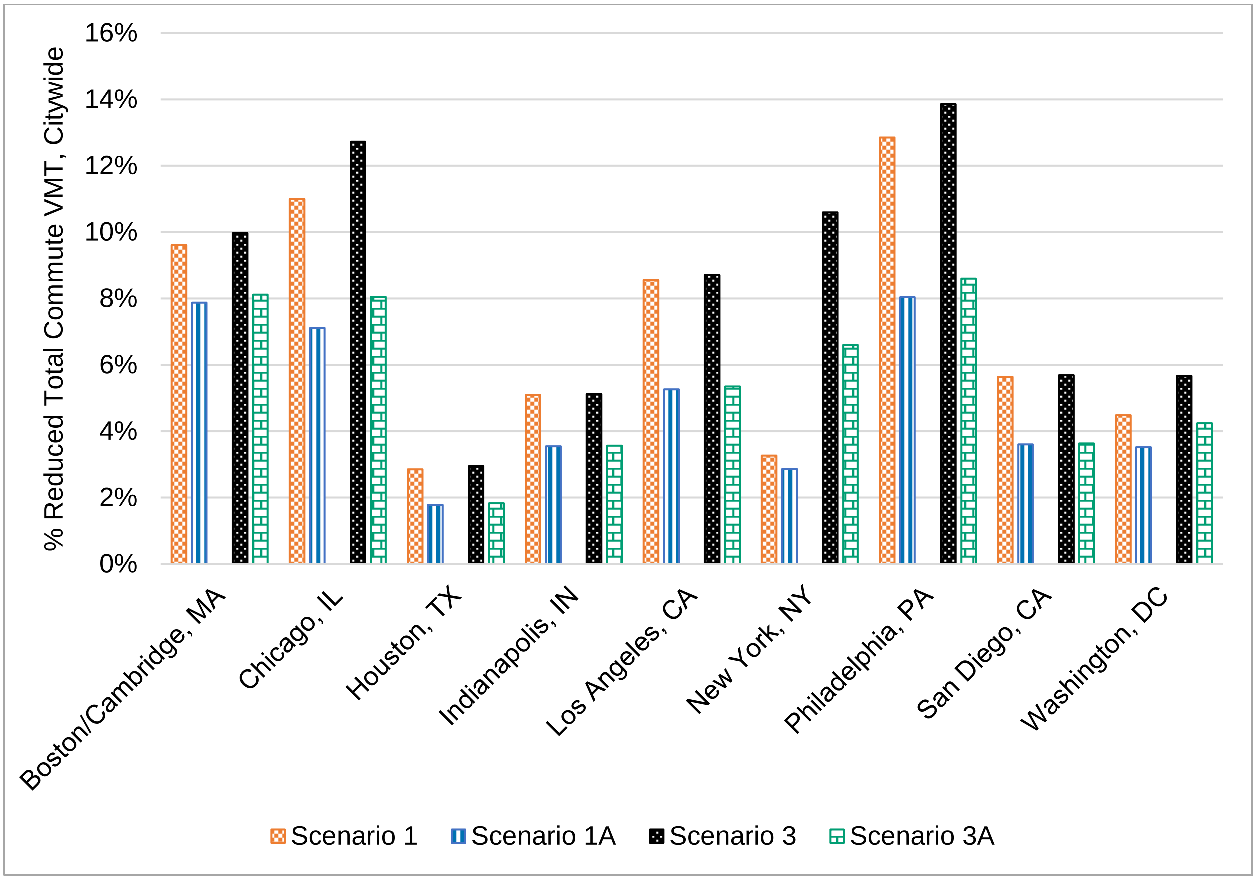
Scenario Extensions to Exempt Small Employers: Scenarios 1A and 3A

Results from the Scenarios 1 and 3 extensions to exempt small employers are displayed in Table 15 and figure 10 (percent reductions in citywide commute VMT, all commuters), and Table 16 and figure 11 (raw VMT reductions under most likely telework scenario). As expected, the reduction potentials of Scenarios 1A and 3A are lower than those for Scenarios 1 and 3, respectively. However, these differences are sometimes (but not always, as explored in the following paragraph) minor, likely because the majority of employees in the analyzed cities (more than 80 percent) work for larger employers. Examining these scenarios through the lens of excluding small employers is valuable, given the number of real-world commuter-benefits ordinances, described earlier, that exempt small employers.

The reductions under this extension to exempt small employers differ more from the base scenarios in some cities (i.e., Chicago, Los Angeles, Philadelphia) than others. This is due to disproportionate differences in the baseline employees impacted under the base and small employer exemption cases. In the case of Los Angeles, for example, VMT reduction potential is more significantly reduced when excluding small employers under Scenarios 1A and 3A, given a greater proportion of employees in Los Angeles than elsewhere working for smaller employers (almost 20 percent compared to 13 percent on average across the other cities). Chicago and Philadelphia, by contrast, have a higher employee population in the biggest employer category (>70 percent) and low starting numbers for the percentage of employees offered transit benefits (10 percent and 15 percent for Chicago and Philadelphia, respectively). Based on the Seattle scaling data presented in the previous section (see Table 10), the proportion of employees working for "large" firms (with 20 or more employees) receiving transit benefits (69 percent) was higher than the proportion receiving transit benefits (44 percent) of employees working for "small" firms (with less than 20 employees), which impacted modeled results. Specifically, the policy impacts would affect employees working for larger employers less than those working for smaller employers (as the change in benefits experienced by employees offered cash-out who were not also offered transit benefits to start would be greater than for those who already had been offered transit benefits), and thus, exempting smaller employers would reduce overall benefits disproportionately. Note that Houston, San Diego, and Indianapolis also have 70 percent or more of their employee population working for large employers and have low starting numbers for the percentage of employees offered transit benefits. However, the percentage change impact of this is not as prominent as in Chicago and Philadelphia for these cities, since the base scenario VMT reductions in these cities were lower to begin with (this trend is more visible when looking at the raw reductions in figure 11). For New York, the differences in impacts between Scenarios 1 and 1A are minimal, given the city's low starting percentage of employees with access to free workplace parking (4 percent). However, once the entire employee population is considered under Scenario 3, the impact of exempting small employers is significant in New York. Additionally, the absolute reductions in VMT reported for New York are, as shown in Table 16, large (indeed, the largest of any of the cities for Scenarios 3 and 3A) due to the size of the employee population (>4 million).

Table 15. Percent reductions in daily citywide commute VMT for Scenarios 1A and 3A compared to citywide results.

City	S1: Monthly Cash-Out	S1A: S1 + Extension to Exempt Small Employers Exemption	S3: Monthly Cash-Out + Pre-Tax Transit Benefit	S3A: S3 + Extension to Exempt Small Employers
Boston/Cambridge, MA	10%	8%	10%	8%
Chicago, IL	11%	7%	13%	8%
Houston, TX	3%	2%	3%	2%
Indianapolis, IN	5%	4%	5%	4%
Los Angeles, CA	9%	5%	9%	5%
New York, NY	3%	3%	11%	7%
Philadelphia, PA	13%	8%	14%	9%
San Diego, CA	6%	4%	6%	4%
Washington, DC	4%	4%	6%	4%

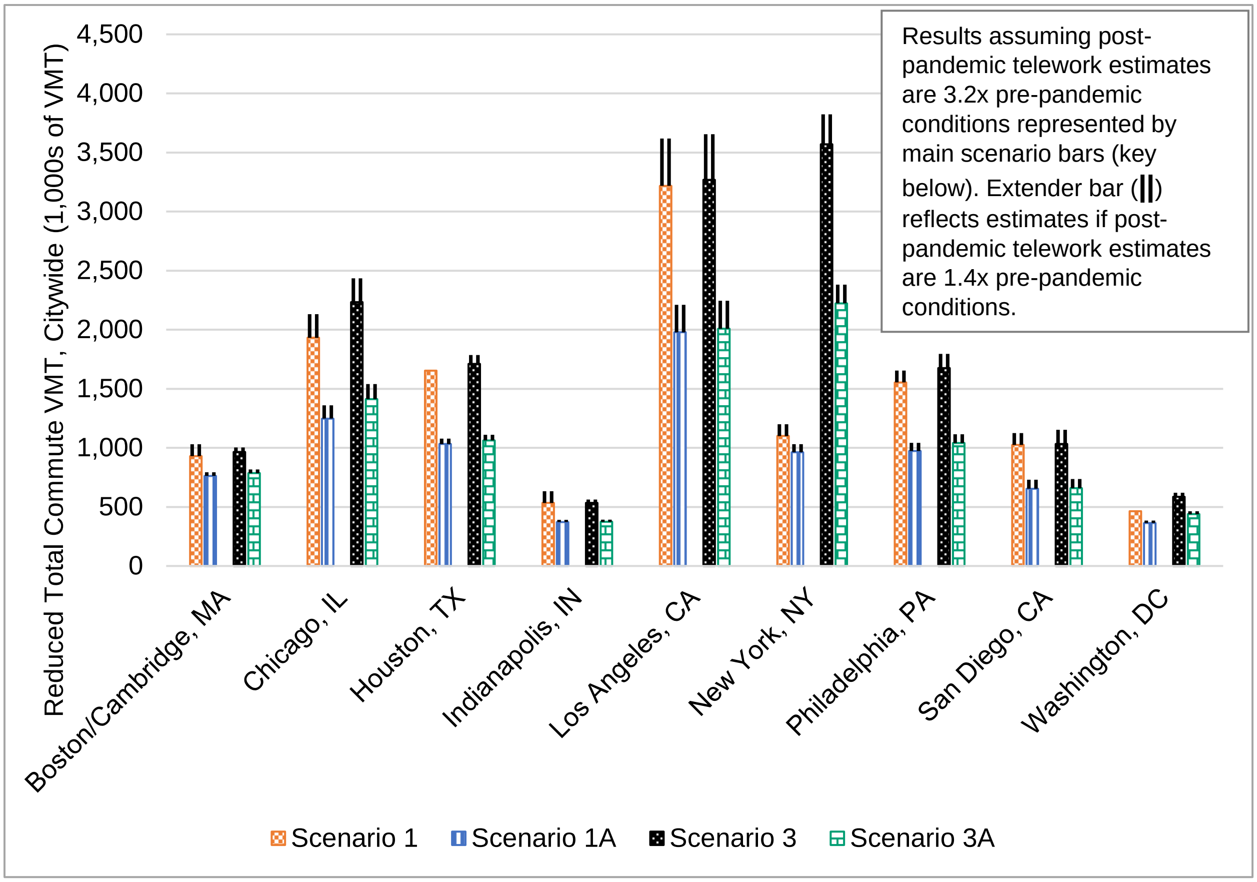


Source: FHWA.

Figure 10. Graph. Percent reductions in daily citywide commute VMT for Scenarios 1A and 3A compared to citywide results.

Table 16. Estimated raw reductions in daily citywide commute VMT for Scenarios 1A and 3A compared to citywide results (assuming "most likely" 2x telework scenario, rounded to the nearest one-hundred thousand).

City	S1: Monthly Cash-Out	S1A: S1 + Extension to Exempt Small Employers	S3: Monthly Cash-Out + Pre-Tax Transit Benefit	S3A: S3 + Extension to Exempt Small Employers
Boston/Cambridge, MA	1.0M	0.8M	1.0M	0.8M
Chicago, IL	2.0M	1.3M	2.4M	1.5M
Houston, TX	1.7M	1.1M	1.8M	1.1M
Indianapolis, IN	0.6M	0.4M	0.6M	0.4M
Los Angeles, CA	3.5M	2.1M	3.5M	2.2M
New York, NY	2.1M	1.0M	3.7M	2.3M
Philadelphia, PA	1.6M	1.0M	1.8M	1.1M
San Diego, CA	1.1M	0.7M	1.1M	0.7M
Washington, DC	0.5M	0.4M	0.6M	0.5M



Source: FHWA.

Figure 11. Graph. Estimated raw reductions in daily citywide commute VMT (in thousands of VMT) for Scenarios 1A and 3A compared to citywide results.

Colored bar reflects results for telework estimates 3.2x pre-pandemic conditions; black bar reflects results for telework estimates 1.4x pre-pandemic conditions

In the case of the Washington, D.C., law, employer-owned parking is also excluded (until it is sold).[34] Because of this, the research team investigated limiting this analysis to consider employers who lease their parking only. The research team was not able to identify a recent data source that described the proportion of employees receiving free parking by employer size and whether or not their employers owned parking. A recent independent dataset describing owned-parking rates was also not identified. Two reports, albeit not recent ones, show that between 45 percent and 69 percent of employers or facilities have owned parking, with higher rates for large employers (~78 percent) (Shoup and Breinholt, 1997; DVRPC, 1993). As such, the outright exclusion of owned parking from the studied scenarios may be very detrimental to affecting travel behavior and negative driving-related externalities. One cautionary note in considering the use of these reports, in addition to their age, is that, at least anecdotally, it does seem that leased parking may be much more prevalent in serving city office populations than others (although, as noted, good data on this is unavailable).

[34] See more about Washington, D.C.'s cash-out law here: https://code.dccouncil.gov/us/dc/council/laws/23-113

While Washington, D.C., excludes owned parking once sold, another alternative is to institute a date-end requirement limiting the exemption for owned parking to no more than, for example, 5 years instead of exempting owned parking entirely for the studied scenarios. Such a requirement could help mitigate the limited reduction potential for related commuter benefits and parking cash-out policies if owned parking is excluded.

Free Versus Partially Subsidized Parking

The referenced data sources to determine the percentage of employees receiving parking subsidies often either did not differentiate between free and partial parking subsidies or relied on questions that, while touching on this difference, were asked vaguely. Additionally, responses sometimes did not provide details on the level of subsidies provided. The current analysis assumes that employees without free workplace parking receive no other parking subsidy. Partial subsidy exclusion from analysis may result in impacts being underestimated.

To investigate what the impact of this assumption would be, the research team reviewed what information was provided by each source referenced for parking subsidies and tried to put this information in the context of Scenario 1. Of the referenced sources, the following gave some information about partial versus full subsidies (for other cities, the only data provided was on free parking or worded vaguely such that other subsidy levels could not be separated out[35]):

- Chicago, IL: While free parking was taken from the referenced weighted 2020 "My Daily Travel" HTS (CMAP, 2020) for parity with the other free parking data sources used across cities and in line with the analysis assumption, the survey also offered information about the percentage of the population receiving parking subsidies, as follows: employer pays 25 percent or less of my parking costs; employer pays between 26 percent and 75 percent of my parking costs; and employer pays for more than 75 percent of my parking costs. Those receiving partial subsidies accounted for <1 percent of the employee population (compared to 43 percent receiving free workplace parking).
- Washington, D.C.: Only free parking data is provided for the urban core, which was used for this analysis. However, free and partial subsidy rates are provided for the region as a whole, which could be used to estimate partial subsidies at the urban core level. No additional information about subsidy level was provided. The ratio between free parking and partially subsidized parking at the regional level could be applied as an estimate of partial subsidy levels in the urban core.

Table 17 summarizes the percentage of employees receiving free and subsidized parking for Chicago (based on the data provided) and for Washington, D.C. (based on the applied estimation).

---

[35]Houston's survey included two different response options to indicate the offering of a parking subsidy. One response option clearly indicated that the parking was free, while the second was more ambiguous. Given that Houston shares many characteristics of other lower-density cities that FHWA analyzed with relatively high rates of free and subsidized parking, FHWA considered adding the positive responses (for a sum of 41 percent) from the survey together to be reasonable.

Table 17. Percentage of employees receiving free and subsidized parking in select cities.

City	Subsidy Level	% of Employees Receiving Parking at Subsidy Level
Chicago, IL	Free (fully subsidized)	43%
Chicago, IL	1%-25%	~0.4%
Chicago, IL	26%-75%	~0.1%
Chicago, IL	76%-99%	~0.4%
Washington, DC	Free (fully subsidized)	23%
Washington, DC	Unknown (between 1% and 99%)	~2%

To evaluate how partial subsidies might impact the policy scenario results, the research team ran a sample analysis for Scenario 1 using subsidy level estimations for Chicago and Washington, D.C. For Chicago, the midpoint of the subsidy ranges provided were used to estimate actual subsidy levels (e.g., 0.4 percent of the employee population received a 13 percent subsidy (midpoint of 1 percent and 25 percent), 0.1 percent of the employee population received a 50.5 percent subsidy (midpoint of 26 percent and 75 percent), and 0.4 percent of the employee population received an 87.5 percent subsidy (midpoint of 76 percent and 99 percent)). Given that no additional information was provided about partial subsidy levels in Washington, D.C., the research assumed a 50 percent parking subsidy for the 2 percent of the employee population reporting to receive partial parking subsidies.

Recall that, under Scenario 1, the research team calculated an opportunity cost for parking based on the monthly average parking rate (assumed parking rate for CBD parking) *and* the monthly average transit pass cost (assumed rate for non-CBD parking) for each city, adjusting for the fact that some employers were already offering subsidized transit or (in California) parking cash-out, and also that some benefits would be tax free (e.g., employer-paid transit passes), while other benefits would be taxable (e.g., cash). This process was repeated for this sample analysis (as outlined in Equation 3 through Equation 5 from *Calculating Travel Impacts* in Appendix C. Data and Analysis Methodology), except parking cost values (both the CBD and non-CBD assumed values) were scaled to reflect the amount of parking subsidy offered. Table 18 shows the calculations for the different subsidy values.

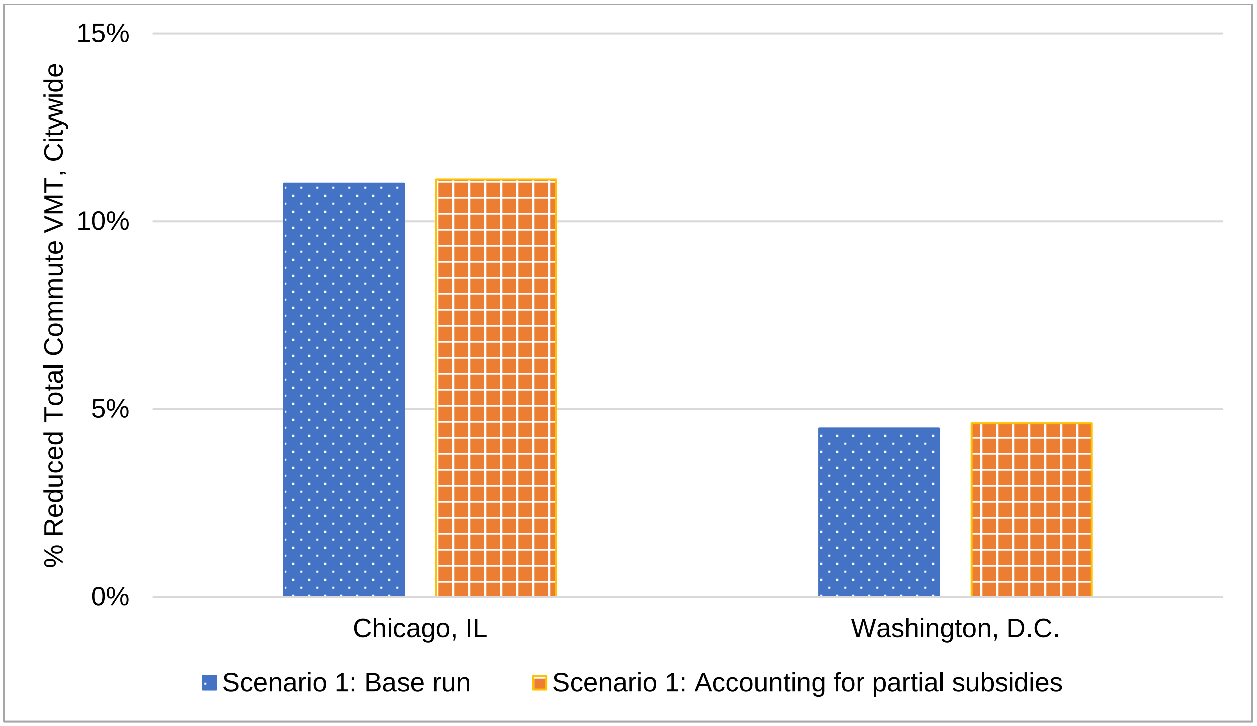
Table 18. Free and partially subsidized parking opportunity cost values used in analysis.

Parking Subsidy Level	Chicago, IL	Washington, D.C.
Free Parking (used in base analysis)	$7.41	$9.30
87.5% Subsidy	$6.49	*N/A*
50% Subsidy	*N/A*	$4.65
50.5% Subsidy	$3.74	*N/A*
13% Subsidy	$0.96	*N/A*

Using these additional opportunity costs for the populations receiving partial subsidies in Chicago and Washington, D.C., the research team re-estimated Scenario 1 to additionally consider this partial-subsidy receiving population. The team ran separate analyses (as defined for

Scenario 1 in Appendix C. Data and Analysis Methodology) for each population with their respective opportunity costs of driving, and then added the weighted results (proportionate to their representation) together.

The results from this sample analysis are displayed in figure 12. These estimates are reductions for citywide commute VMT and not only affected commuters. The values between the base Scenario 1 and the re-run accounting for partial subsidies are not differentiable at the nearest percentage point. This is likely due to the small (<1 percent in Chicago, and 2 percent in Washington, D.C.) employee populations estimated to be receiving partial subsidies, plus the policy being less impactful to shift behavior for partial versus fully subsidized parking cases (because the average benefit received in partial subsidy cases is less than what employees with fully subsidized parking would be eligible for).



Source: FHWA.

Figure 12. Graph. Percent reductions in daily citywide commute VMT for Scenario 1 full vs. partial subsidy comparison.

A number of factors may impact the influence of considering partial subsidies (or not), including the proportion of commuters receiving partial versus full subsidies, the proportion of commuters receiving partial subsidies overall, the amount of the subsidy received, the price of parking, and the estimated opportunity cost of continuing to drive and park. This analysis also assumed the same starting mode shares for those receiving full and partial parking subsidies; if the driving mode shares for those receiving partial subsidies are lower, this sample analysis would overestimate the impacts of accounting for partial subsidies (i.e., if less of the partial subsidy receiving population is driving to start, the raw VMT reduction added to the fully subsidized parking reduction would be lower, producing a lower overall impact). Additionally, these results may change if a higher or lower subsidy amount was actually received by commuters.

Given the unique characteristics of each city in this analysis, as well as the lack of additional data for other cities, the estimates for Chicago and Washington, D.C., should not be accepted as a rule of thumb adjustment for other cities. That being said, these two case studies strongly suggest that accounting for partial subsidies should not drastically impact results in cities where low proportions of the population receive parking subsidies.

APPENDIX E. RESULTS BY CITY

The impacts of each scenario on travel are shown for each city below. In addition, the tables in this appendix show the impacts of vehicle trip and mile reductions on pollution emissions (carbon dioxide (CO_2), nitrogen oxides, and particulate matter), congestion (vehicle hours of delay), and combined fatal and incapacitating injury crashes. VMT percentage reduction estimates presented in this section reflect citywide impacts (i.e., the overall reductions on all commute VMT); impacts for affected commuters only (applicable for Scenario 1 and Scenario 2) were displayed in Table 14. Changes in raw VMT (and subsequent congestion, emissions, and safety impacts) are presented based on the "most likely" 2x pre-pandemic telework rate post-pandemic scenario. Annual figures were derived by scaling daily estimates to annual ones, assuming 19 working days each month. All raw estimates have been rounded[36] and, even still, are subject to uncertainty given the sketch-level nature of this analysis.

BOSTON AND CAMBRIDGE, MASSACHUSSETTS

The travel impacts of each scenario on commute trips in Boston and Cambridge compared to citywide VMT are summarized in Table 19.

Table 19. Impacts on citywide all commuter VMT in Boston and Cambridge.

VMT Result	S1: Monthly Cash-Out	S2: Monthly Commuter Benefit	S3: Monthly Cash-Out + Pre-Tax Transit Benefit	S4: Daily Cash-Out + Pre-Tax Transit Benefit	S5: Eliminate Parking Subsidies + $5 Non-SOV Subsidy	S1A: S1 + Extension to Exempt Small Employers	S3A: S3 + Extension to Exempt Small Employers
Baseline daily commute VMT	9.9M	9.9M	9.9M	9.9M	9.9M	9.9M	9.9M
Change in daily commute VMT	-1.0M	-0.1M	-1.0M	-1.8M	-2.8M	-0.8M	-0.8M
Percentage VMT change	-10%	-1%	-10%	-18%	-29%	-8%	-8%

VMT = vehicle miles traveled. SOV = single occupancy vehicle.

[36]Based on the magnitude of values, VMT and annual hours of delay estimates are rounded to the nearest one-hundred thousand; CO_2e estimates are rounded to the nearest ten-thousand; NO_x estimates are rounded to the nearest ten; PM2.5 and crash estimates are rounded to the nearest one. Decisions on where to round are solely based on the magnitude of the estimates as a way to reflect uncertainty; that is, estimates rounded to the nearest one or ten should not be interpreted as having a higher degree of accuracy than those rounded to the nearest one-hundred thousand.

The impacts of the change in commute travel on congestion, emissions, and safety are summarized in Table 20.

Table 20. Impacts on congestion, emissions, and safety in Boston and Cambridge.

Congestion, Emissions, or Safety Result	S1: Monthly Cash-Out	S2: Monthly Commuter Benefit	S3: Monthly Cash-Out + Pre-Tax Transit Benefit	S4: Daily Cash-Out + Pre-Tax Transit Benefit	S5: Eliminate Parking Subsidies + $5 Non-SOV Subsidy	S1A: S1 + Extension to Exempt Small Employers	S3A: S3 + Extension to Exempt Small Employers
Vehicle hours of delay reduced annually	0.5M	0.1M	0.6M	1.0M	1.7M	0.4M	0.5M
CO_2e reduced (MT/year)	80k	10k	90k	150k	250k	70k	70k
NO_x reduced (MT/year)	90	10	100	170	280	80	80
PM-2.5 reduced (MT/year)	3	<1	3	5	9	2	2
Fatal and incapacitating injury crashes reduced annually	4	1	5	8	13	4	4

CO_2e = carbon dioxide equivalents. MT = metric tons. NO_x = oxides of nitrogen. PM-2.5 = fine particulate matter. SOV = single occupancy vehicle.

CHICAGO, ILLINOIS

The travel impacts of each scenario on commute trips in Chicago compared to citywide VMT are summarized in Table 21.

Table 21. Impacts on citywide all commuter VMT in Chicago.

VMT Result	S1: Monthly Cash-Out	S2: Monthly Commuter Benefit	S3: Monthly Cash-Out + Pre-Tax Transit Benefit	S4: Daily Cash-Out + Pre-Tax Transit Benefit	S5: Eliminate Parking Subsidies + $5 Non-SOV Subsidy	S1A: S1 + Extension to Exempt Small Employers	S3A: S3 + Extension to Exempt Small Employers
Baseline daily commute VMT	18.6M	18.6M	18.6M	18.6M	18.6M	18.6M	18.6M
Change in daily commute VMT	-2.0M	-1.3M	-2.4M	-3.3M	-6.6M	-1.3M	-1.5M
Percentage VMT change	-11%	-7%	-13%	-18%	-36%	-7%	-8%

VMT = vehicle miles traveled. SOV = single occupancy vehicle.

The impacts of the change in commute travel on congestion, emissions, and safety are summarized in Table 22.

Table 22. Impacts on congestion, emissions, and safety in Chicago.

Congestion, Emissions, or Safety Result	S1: Monthly Cash-Out	S2: Monthly Commuter Benefit	S3: Monthly Cash-Out + Pre-Tax Transit Benefit	S4: Daily Cash-Out + Pre-Tax Transit Benefit	S5: Eliminate Parking Subsidies + $5 Non-SOV Subsidy	S1A: S1 + Extension to Exempt Small Employers	S3A: S3 + Extension to Exempt Small Employers
Vehicle hours of delay reduced annually	1.3M	0.8M	1.5M	2.2M	4.4M	0.8M	0.9M
CO_2e reduced (MT/year)	180k	120k	210k	300k	590k	120k	130k
NO_x reduced (MT/year)	200	130	240	340	660	130	150
PM-2.5 reduced (MT/year)	6	4	7	10	20	4	4
Fatal and incapacitating injury crashes reduced annually	6	4	7	10	20	4	4

CO_2e = carbon dioxide equivalents. MT = metric tons. NO_x = oxides of nitrogen. PM-2.5 = fine particulate matter. SOV = single occupancy vehicle.

HOUSTON, TEXAS

The travel impacts of each scenario on commute trips in Houston compared to citywide VMT are summarized in Table 23.

Table 23. Impacts on citywide all commuter VMT in Houston.

VMT Result	S1: Monthly Cash-Out	S2: Monthly Commuter Benefit	S3: Monthly Cash-Out + Pre-Tax Transit Benefit	S4: Daily Cash-Out + Pre-Tax Transit Benefit	S5: Eliminate Parking Subsidies + $5 Non-SOV Subsidy	S1A: S1 + Extension to Exempt Small Employers	S3A: S3 + Extension to Exempt Small Employers
Baseline daily commute VMT	59.7M	59.7M	59.7M	59.7M	59.7M	59.7M	59.7M
Change in daily commute VMT	-1.7M	-1.2M	-1.8M	-4.1M	-10.4M	-1.1M	-1.1M
Percentage VMT change	-3%	-2%	-3%	-7%	-17%	-2%	-2%

VMT = vehicle miles traveled. SOV = single occupancy vehicle.

The impacts of the change in commute travel on congestion, emissions, and safety are summarized in Table 24.

Table 24. Impacts on congestion, emissions, and safety in Houston.

Congestion, Emissions, or Safety Result	S1: Monthly Cash-Out	S2: Monthly Commuter Benefit	S3: Monthly Cash-Out + Pre-Tax Transit Benefit	S4: Daily Cash-Out + Pre-Tax Transit Benefit	S5: Eliminate Parking Subsidies + $5 Non-SOV Subsidy	S1A: S1 + Extension to Exempt Small Employers	S3A: S3 + Extension to Exempt Small Employers
Vehicle hours of delay reduced annually	1.1M	0.7M	1.1M	2.6M	6.7M	0.7M	0.7M
CO_2e reduced (MT/year)	150k	100k	160k	370k	940k	96k	99k
NO_x reduced (MT/year)	180	120	180	430	1090	110	120
PM-2.5 reduced (MT/year)	3	2	3	7	18	2	2
Fatal and incapacitating injury crashes reduced annually	6	4	6	13	34	3	4

CO_2e = carbon dioxide equivalents. MT = metric tons. NO_x = oxides of nitrogen. PM-2.5 = fine particulate matter. SOV = single occupancy vehicle.

INDIANAPOLIS, INDIANA

The travel impacts of each scenario on commute trips in Indianapolis compared to citywide VMT are summarized in Table 25.

Table 25. Impacts on citywide all commuter VMT in Indianapolis.

VMT Result	S1: Monthly Cash-Out	S2: Monthly Commuter Benefit	S3: Monthly Cash-Out + Pre-Tax Transit Benefit	S4: Daily Cash-Out + Pre-Tax Transit Benefit	S5: Eliminate Parking Subsidies + $5 Non-SOV Subsidy	S1A: S1 + Extension to Exempt Small Employers	S3A: S3 + Extension to Exempt Small Employers
Baseline daily commute VMT	10.8M	10.8M	10.8M	10.8M	10.8M	10.8M	10.8M
Change in daily commute VMT	-0.6M	-0.3M	-06M	-1.6M	-2.6M	-0.4M	-0.4M
Percentage VMT change	-5%	-2%	-5%	-15%	-24%	-4%	-4%

VMT = vehicle miles traveled. SOV = single occupancy vehicle.

The impacts of the change in commute travel on congestion, emissions, and safety are summarized in Table 26.

Table 26. Impacts on congestion, emissions, and safety in Indianapolis.

Congestion, Emissions, or Safety Result	S1: Monthly Cash-Out	S2: Monthly Commuter Benefit	S3: Monthly Cash-Out + Pre-Tax Transit Benefit	S4: Daily Cash-Out + Pre-Tax Transit Benefit	S5: Eliminate Parking Subsidies + $5 Non-SOV Subsidy	S1A: S1 + Extension to Exempt Small Employers	S3A: S3 + Extension to Exempt Small Employers
Vehicle hours of delay reduced annually	0.2M	0.1M	0.2M	0.5M	0.8M	0.1M	0.1M
CO_2e reduced (MT/year)	50k	20k	50k	140k	220k	30k	30k
NO_x reduced (MT/year)	70	30	70	200	320	50	50
PM-2.5 reduced (MT/year)	2	1	2	4	7	1	1
Fatal and incapacitating injury crashes reduced annually	1	1	1	3	5	1	1

CO_2e = carbon dioxide equivalents. MT = metric tons. NO_x = oxides of nitrogen. PM-2.5 = fine particulate matter. SOV = single occupancy vehicle.

LOS ANGELES, CALIFORNIA

The travel impacts of each scenario on commute trips in Los Angeles compared to citywide VMT are summarized in Table 27.

Table 27. Impacts on citywide all commuter VMT in Los Angeles.

VMT Result	S1: Monthly Cash-Out	S2: Monthly Commuter Benefit	S3: Monthly Cash-Out + Pre-Tax Transit Benefit	S4: Daily Cash-Out + Pre-Tax Transit Benefit	S5: Eliminate Parking Subsidies + $5 Non-SOV Subsidy	S1A: S1 + Extension to Exempt Small Employers	S3A: S3 + Extension to Exempt Small Employers
Baseline daily commute VMT	40.5M	40.5M	40.5M	40.5M	40.5M	40.5M	40.5M
Change in daily commute VMT	-3.5M	-2.2M	-3.5M	-6.8M	-10.8M	-2.1M	-2.2M
Percentage VMT change	-9%	-5%	-9%	-17%	-27%	-5%	-5%

VMT = vehicle miles traveled. SOV = single occupancy vehicle.

The impacts of the change in commute travel on congestion, emissions, and safety are summarized in Table 28.

Table 28. Impacts on congestion, emissions, and safety in Los Angeles.

Congestion, Emissions, or Safety Result	S1: Monthly Cash-Out	S2: Monthly Commuter Benefit	S3: Monthly Cash-Out + Pre-Tax Transit Benefit	S4: Daily Cash-Out + Pre-Tax Transit Benefit	S5: Eliminate Parking Subsidies + $5 Non-SOV Subsidy	S1A: S1 + Extension to Exempt Small Employers	S3A: S3 + Extension to Exempt Small Employers
Vehicle hours of delay reduced annually	2.0M	1.2M	2.0M	3.9M	6.3M	1.2M	1.2M
CO_2e reduced (MT/year)	310k	200k	320k	610k	970k	190k	200k
NO_x reduced (MT/year)	330	210	340	650	1030	200	210
PM-2.5 reduced (MT/year)	6	4	6	12	19	4	4
Fatal and incapacitating injury crashes reduced annually	8	5	8	16	25	5	5

CO_2e = carbon dioxide equivalents. MT = metric tons. NO_x = oxides of nitrogen. PM-2.5 = fine particulate matter. SOV = single occupancy vehicle.

NEW YORK, NEW YORK

The travel impacts of each scenario on commute trips in New York City compared to citywide VMT are summarized in Table 29.

Table 29. Impacts on citywide all commuter VMT in New York City.

VMT Result	S1: Monthly Cash-Out	S2: Monthly Commuter Benefit	S3: Monthly Cash-Out + Pre-Tax Transit Benefit	S4: Daily Cash-Out + Pre-Tax Transit Benefit	S5: Eliminate Parking Subsidies + $5 Non-SOV Subsidy	S1A: S1 + Extension to Exempt Small Employers	S3A: S3 + Extension to Exempt Small Employers
Baseline daily commute VMT	35.3M	35.3M	35.3M	35.3M	35.3M	35.3M	35.3M
Change in daily commute VMT	-1.2M	-0.4M	-3.7M	-4.3M	-12.6M	-1.0M	-2.3M
Percentage VMT change	-3%	-1%	-11%	-12%	-36%	-3%	-7%

VMT = vehicle miles traveled. SOV = single occupancy vehicle.

The impacts of the change in commute travel on congestion, emissions, and safety are summarized in Table 30.

Table 30. Impacts on congestion, emissions, and safety in New York City.

Congestion, Emissions, or Safety Result	S1: Monthly Cash-Out	S2: Monthly Commuter Benefit	S3: Monthly Cash-Out + Pre-Tax Transit Benefit	S4: Daily Cash-Out + Pre-Tax Transit Benefit	S5: Eliminate Parking Subsidies + $5 Non-SOV Subsidy	S1A: S1 + Extension to Exempt Small Employers	S3A: S3 + Extension to Exempt Small Employers
Vehicle hours of delay reduced annually	0.5M	0.2M	1.7M	1.9M	5.9M	0.4M	1.0M
CO_2e reduced (MT/year)	100k	40k	330k	380k	1,120k	90k	210k
NO_x reduced (MT/year)	110	40	370	420	1240	100	230
PM-2.5 reduced (MT/year)	3	1	10	12	34	3	6
Fatal and incapacitating injury crashes reduced annually	3	1	8	9	28	2	5

CO_2e = carbon dioxide equivalents. MT = metric tons. NO_x = oxides of nitrogen. PM-2.5 = fine particulate matter. SOV = single occupancy vehicle.

PHILADELPHIA, PENNSYLVANIA

The travel impacts of each scenario on commute trips in New York City compared to citywide VMT are summarized in Table 31.

Table 31. Impacts on citywide all commuter VMT in Philadelphia.

VMT Result	S1: Monthly Cash-Out	S2: Monthly Commuter Benefit	S3: Monthly Cash-Out + Pre-Tax Transit Benefit	S4: Daily Cash-Out + Pre-Tax Transit Benefit	S5: Eliminate Parking Subsidies + $5 Non-SOV Subsidy	S1A: S1 + Extension to Exempt Small Employers	S3A: S3 + Extension to Exempt Small Employers
Baseline daily commute VMT	12.7M	12.7M	12.7M	12.7M	12.7M	12.7M	12.7M
Change in daily commute VMT	-1.6M	-1.2M	-1.8M	-2.7M	-4.3M	-1.0M	-1.1M
Percentage VMT change	-13%	-9%	-14%	-21%	-34%	-8%	-9%

VMT = vehicle miles traveled. SOV = single occupancy vehicle

The impacts of the change in commute travel on congestion, emissions, and safety are summarized in Table 32.

Table 32. Impacts on congestion, emissions, and safety in Philadelphia.

Congestion, Emissions, or Safety Result	S1: Monthly Cash-Out	S2: Monthly Commuter Benefit	S3: Monthly Cash-Out + Pre-Tax Transit Benefit	S4: Daily Cash-Out + Pre-Tax Transit Benefit	S5: Eliminate Parking Subsidies + $5 Non-SOV Subsidy	S1A: S1 + Extension to Exempt Small Employers	S3A: S3 + Extension to Exempt Small Employers
Vehicle hours of delay reduced annually	0.9M	0.6M	1.0M	1.5M	2.5M	0.6M	0.6M
CO_2e reduced (MT/year)	140k	100k	160k	240k	380k	90k	100k
NO_x reduced (MT/year)	160	120	180	270	430	100	110
PM-2.5 reduced (MT/year)	4	3	4	7	11	3	3
Fatal and incapacitating injury crashes reduced annually	5	3	5	8	13	3	3

CO_2e = carbon dioxide equivalents. MT = metric tons. NO_x = oxides of nitrogen. PM-2.5 = fine particulate matter.

SAN DIEGO, CALIFORNIA

The travel impacts of each scenario on commute trips in San Diego compared to citywide VMT are summarized in Table 33.

Table 33. Impacts on citywide all commuter VMT in San Diego.

VMT Result	S1: Monthly Cash-Out	S2: Monthly Commuter Benefit	S3: Monthly Cash-Out + Pre-Tax Transit Benefit	S4: Daily Cash-Out + Pre-Tax Transit Benefit	S5: Eliminate Parking Subsidies + $5 Non-SOV Subsidy	S1A: S1 + Extension to Exempt Small Employers	S3A: S3 + Extension to Exempt Small Employers
Baseline daily commute VMT	19.6M	19.6M	19.6M	19.6M	19.6M	19.6M	19.6M
Change in daily commute VMT	-1.1M	-0.6M	-1.1M	-3.0M	-4.8M	-0.7	-0.7M
Percentage VMT change	-6%	-3%	-6%	-15%	-25%	-4%	-4%

VMT = vehicle miles traveled. SOV = single occupancy vehicle.

The impacts of the change in commute travel on congestion, emissions, and safety are summarized in Table 34.

Table 34. Impacts on congestion, emissions, and safety in San Diego.

Congestion, Emissions, or Safety Result	S1: Monthly Cash-Out	S2: Monthly Commuter Benefit	S3: Monthly Cash-Out + Pre-Tax Transit Benefit	S4: Daily Cash-Out + Pre-Tax Transit Benefit	S5: Eliminate Parking Subsidies + $5 Non-SOV Subsidy	S1A: S1 + Extension to Exempt Small Employers	S3A: S3 + Extension to Exempt Small Employers
Vehicle hours of delay reduced annually	0.4M	0.2M	0.4M	1.1M	1.8M	0.2M	0.3M
CO_2e reduced (MT/year)	100k	50k	100k	260k	420k	60k	60k
NO_x reduced (MT/year)	100	60	100	270	430	60	60
PM-2.5 reduced (MT/year)	2	1	2	6	9	1	1
Fatal and incapacitating injury crashes reduced annually	3	1	3	7	11	2	2

CO_2e = carbon dioxide equivalents. MT = metric tons. NO_x = oxides of nitrogen. PM-2.5 = fine particulate matter. SOV = single occupancy vehicle.

WASHINGTON, D.C.

The travel impacts of each scenario on commute trips in Washington, D.C., compared to citywide VMT are summarized in Table 33.

Table 35. Impacts on Citywide All Commuter VMT in Washington, D.C.

VMT Result	S1: Monthly Cash-Out	S2: Monthly Commuter Benefit	S3: Monthly Cash-Out + Pre-Tax Transit Benefit	S4: Daily Cash-Out + Pre-Tax Transit Benefit	S5: Eliminate Parking Subsidies + $5 Non-SOV Subsidy	S1A: S1 + Extension to Exempt Small Employers	S3A: S3 + Extension to Exempt Small Employers
Baseline daily commute VMT	10.7M	10.7M	10.7M	10.7M	10.7M	10.7M	10.7M
Change in daily commute VMT	-0.5M	-0.2M	-0.6M	-1.2M	-2.6M	-0.4M	-0.5M
Percentage VMT change	-4%	-2%	-6%	-11%	-24%	-4%	-4%

VMT = vehicle miles traveled. SOV = single occupancy vehicle.

The impacts of the change in commute travel on congestion, emissions, and safety are summarized in Table 34.

Table 36. Impacts on congestion, emissions, and safety in Washington, D.C.

Congestion, Emissions, or Safety Result	S1: Monthly Cash-Out	S2: Monthly Commuter Benefit	S3: Monthly Cash-Out + Pre-Tax Transit Benefit	S4: Daily Cash-Out + Pre-Tax Transit Benefit	S5: Eliminate Parking Subsidies + $5 Non-SOV Subsidy	S1A: S1 + Extension to Exempt Small Employers	S3A: S3 + Extension to Exempt Small Employers
Vehicle hours of delay reduced annually	0.3M	0.1M	0.4M	0.8M	1.8M	0.3M	0.3M
CO_2e reduced (MT/year)	40k	20k	50k	100k	230k	30k	40k
No_x reduced (MT/year)	50	20	60	120	260	40	50
PM-2.5 reduced (MT/year)	1	<1	2	3	6	1	1
Fatal and incapacitating injury crashes reduced annually	1	<1	1	3	6	1	1

CO_2e = carbon dioxide equivalents. MT = metric tons. NO_x = oxides of nitrogen. PM-2.5 = fine particulate matter. SOV = single occupancy vehicle.

APPENDIX F. NON-EMPLOYEE FINANCIAL IMPACTS: EMPLOYER COSTS AND GOVERNMENT TAX REVENUES

Chapter 1. Background covered some financial impacts and benefits related to parking cash-out and commuter benefits policies. Here, some additional elaboration on financial impacts is provided, which may be useful for those considering implementation of such programs, or ordinances requiring such programs.

Employer Costs

As discussed previously, to the extent employers can reduce their parking expenses when their employees who had been driving accept a parking cash-out offer, the policy would on its face appear to be revenue neutral to employers.

For employees driving to and parking at work who forfeit a parking space leased by their employer to accept a cash-out offer, employers should be able to cover the cost of a cash-out payment through savings on parking lease costs if the lease allows this or if the lease at least allows the employer to sublet the parking to another user. But changes in benefits can add to employer costs. Parking benefits that are cashed out and taken as a wage increase impose a small payroll tax burden on employers (and employees). Similarly, some employees accepting a cash-out offer may previously have declined a parking benefit prior to cash-out having been offered. In such instances, employers could not use parking cost savings to fund the cash-out payments. As employers, however, retain complete control over the level of commuter benefits that they offer, and can change such level at any time of their choosing, they can thus make changes to their programs after a parking cash-out requirement is imposed—such as by levying a very small charge on employee parking—to ensure that their commuter benefits related expenditures do not rise. Combining parking cash-out with transit or vanpool benefits, which offer equivalent payroll tax savings as parking subsidies do for employers, would reduce the taxable portion of commuter benefits resulting from cash out.

As with parking benefits, employers can save on payroll taxes both in the provision of employer-paid commuter benefits (e.g., monthly transit/vanpool passes, as modeled in Scenario 2) or the provision of pre-tax transit benefits (e.g., allowing employees to set aside pre-tax income for transit, as modeled in Scenarios 3 and 4). Recall that as a qualified transportation fringe benefit under Public Law (Pub. L. No.) 115-97, employers may pay up to $300 per month (as of 2023) for their employees' transit or vanpool commuting without any payroll tax or employee income tax obligation being incurred.[37] With respect to pre-tax commuter benefits, employers save on payroll taxes for each dollar deducted for eligible commute modes by employees. At the Federal level, savings on payroll taxes include those levied under the Federal

[37]Federal tax laws underwent some changes in tax year 2018 as a result of the December 2017 enactment of Public Law (Pub. L. No.) 115-97. Prior to 2018, an employer could also deduct the expense of providing these benefits from its taxes.

Insurance Contributions Act (FICA) and the Federal Unemployment Tax Act (FUTA) (Employers Resource 2018). In contrast, almost all States' payroll taxes are levied solely for Unemployment Insurance (UI) tax purposes,[38] and all States' UI taxes use taxable wages as defined under FUTA. The Federal taxable wage base for FUTA is quite low, at only $7,000 per employee. Many States use a taxable wage base at or near the Federal amount for State UI tax purposes. Given most employees have income that far exceeds the taxable wage base, exclusions for commuter benefits may not make much of a difference in terms of total UI tax liability (K. Loughead, *Tax Foundation*, email message to study team, July 13, 2022). As such, payroll savings at the Federal level may be more substantial than at the State level.

The above considerations related to parking cash-out, employer-paid commuter benefits, and pre-tax transit benefits are relevant in considering cost implications for Scenarios 1–4. Of all the scenarios modeled, Scenario 5 is unique in its requirement that all employers offer an incentive for non-SOV travel and eliminate parking subsidies. Employers that were previously subsidizing parking under this scenario could apply recovered costs toward the incentive offering. For employees who use the incentive for transit or vanpool commuting, all employers may save on payroll taxes per Pub. L. No. 115-97. Employers that were not providing parking subsidies may incur some new costs with this additional benefit offering. All employers may, however, benefit from increased employee satisfaction associated with this new offering, which may help employers competitively recruit and retain employees, reducing subsequent costs with each.

Government Tax Revenues

The modeled scenarios implementing parking cash-out (Scenarios 1, 3, and 4) have potential to raise revenues in the form of increased income taxes. As stated by Shoup (1997), "[b]ecause cash in lieu of a parking subsidy is taxable, while the parking subsidy itself is tax exempt, commuters who voluntarily choose taxable cash in lieu of a tax-exempt parking subsidy will pay more in Federal and State income taxes. Tax revenues rise without an increase in tax rates, and without eliminating the tax-exemption for parking subsidies" (p. 32).

Consider a simplified example based on Scenario 1 in the presented analysis, estimating the employee population receiving free workplace parking only who would switch their commute away from non-SOV driving to take the parking cash-out offer.[39] Based on the number of employees making the switch and the average benefit taken, the research team estimates an additional $316 million in State and Federal tax revenue annually for the nine cities studied in this analysis alone. Further, while the presented analysis considered only State (including

[38] One exception notable here, given it includes a city in our analysis, is Massachusetts, which funds additional programs (universal health insurance and Medicare tax) using payroll taxes (MA Executive Office for Administration and Finance 2008), but still follows Federal law on payroll deductions such that eligible commuter benefits would be excluded.

[39] This simple example does not account for additional potential revenue from employees receiving transit benefits who would also be eligible for, and take, the cash-out. It also assumes that all employees would take the cash-out as taxable cash versus applying the benefit to pre-tax eligible commuter benefits, like vanpool and transit. Note, however, that our presented analysis is sensitive to both of these things through adjustments made.

Washington, D.C.) and Federal taxes in modeling prices, cities with local income taxes[40] could also stand to benefit from the increased tax revenue provided by parking cash-out programs.

While not analyzed as part of this study, cities looking to raise revenues from commuter parking could tax such parking, and if they are already taxing it and worry that less usage would mean less tax revenue, then they could raise their parking tax rates to meet their revenue goals. This would have an added benefit of further discouraging commuter driving and parking.

[40] A reason that income taxes imposed at the city level were not considered in the analysis the same way that Federal and State income taxes were is because many cities do not impose such taxes and, for those that do, the rates tend to be low. Of the eight cities studied that could potentially charge city income taxes (not including Washington, D.C., which is thought of more as a city-State in this analysis, and where its income taxes were considered in the analysis), these four do not charge any income taxes: Boston, Chicago, Los Angeles, and San Diego. New York City only charges its own resident workers income taxes (with a rate that varies between 3.078 and 3.876%), and nothing to workers who do not reside in the city. Philadelphia charges 3.4567% for non-residents and 3.8809% for residents. Indianapolis is subjected to a Marion County, Indiana, income tax for residents and non-residents alike of 2.02% (on top of the State income tax of 3.23%) (Walczak 2019).

APPENDIX G. ADDITIONAL EQUITY DISCUSSION

As previously noted, the parking cash-out and related commuter benefits policies examined in this analysis have various implications for equity. This appendix continues this discussion supported by the U.S. Census Bureau data and local data, where available, to comment on the distribution of expected benefits to be realized based on the studied scenarios.

Census Data Comparisons

The research team compiled the following data from the U.S. Census Bureau's ACS PUMS data, based on ACS 5-Year 2019 estimates:

- **Employee wage income[41] and vehicle ownership**: Given vehicle ownership is a household measure, vehicles owned in the household were divided by the estimated number of adults in the household. This indicator, vehicles per adult in the household, was thought to be a better indicator of vehicle access than household vehicle ownership alone, given distinctions in literature highlighting travel behavior differences across "car-deficit households" (Blumenberg, Brown, & Schouten, 2020).
- **Employee wage income to primary commute mode:** While benefits in various scenarios may be offered to all commuters, under some scenarios, only commuters using certain modes may realize such benefits, or benefits realized might be unequal across travel modes. Further, while the goal of such policies may be to encourage commuters to mode shift, some commuters may be unable to shift to certain modes (e.g., no access to transit near home and workplace too far for walking or biking).

Here, these data are used to discuss equity implications across scenarios; note, with respect to discussions about commute mode, however, that commute distributions from PUMS data are not tailored to the population receiving free workplace parking. As such, applicability to Scenarios 1 and 2 may vary. The most granular geography at which PUMS data is published is for Public Use Microdata Areas (PUMAs), which are, according to the U.S. Census Bureau, "non-overlapping, statistical geographic areas that partition each State or equivalent entity into geographic areas containing no fewer than 100,000 people each." For these crosstabulations, only PUMAs that intersected or overlapped with the Census Place geographies for the city of interest were included in the sample. Additionally, only responses by employed individuals were included in the sample to limit the crosstabulation to the population of interest. Estimates were weighted using person-level weights.

[41]From the ACS 2019 Subject Definitions, "Wage or salary income includes total money earnings received for work performed as an employee during the past 12 months. It includes wages, salary, Armed Forces pay, commissions, tips, piece-rate payments, and cash bonuses earned before deductions were made for taxes, bonds, pensions, union dues, etc." This does not include self-employment income, rental income, Social Security, Supplemental Security Income (SSI), public assistance income, disability income, or other sources of income.

Employee Wage Income and Vehicles Owned Per Adult in The Household

The crosstabulation between employee wage income and vehicle ownership is displayed in Table 37 and visualized in figure 13. Examining figure 13, the general trend is as employee wages increase, a lower proportion of households appear to own fewer than one vehicle per adult in the household and a greater proportion of households appear to have one or more vehicles available per adult in the household. One exception is in New York City, where a U-shaped trend is observed in zero-car ownership. This is likely because the wealthiest households can afford to locate in more central urban locations, where parking may be more expensive and where non-auto modes may be competitive with auto travel. As such, these households may choose to be car-free.

To evaluate the relationship between employee wage income and vehicle ownership per adult category, income levels were split to divide the lowest-income group (<$25,000) from all higher ones.[42] Vehicle ownership levels were consolidated into "Less than one vehicle per adult" and "One or more vehicle per adult" categories. Then, Chi-square tests were conducted to examine the relation between this binary income and vehicle ownership splits. The relation between these income and vehicle ownership variables was significant for all cities in the analysis,[43] and indicated that the lowest-income group was more likely to own less than one vehicle per adult in the household compared to the consolidated higher income groups.

These distributions demonstrate that any policies where benefits are geared toward car owners, most especially free parking, will also skew benefits toward wealthier employees. If an individual does not own a car (or has fewer cars available than commuters in a household), one could assume that that person does not drive to work in their own vehicle (or if they have fewer household vehicles available, one could assume that it is less likely that they drive their own vehicle). If policies offering additional benefits are geared toward a population more likely to use and own personal vehicles, there may be shortfalls in terms of equity offerings. Further, commuters who do not receive free parking with low access to transit may not be able to realize the offered pre-tax transit or vanpool benefits under Scenarios 3 and 4, or if offered free parking, employer-paid transit under Scenario 2. Alternatively, Scenario 5 would benefit all commuters who do not drive to work equally, regardless of car ownership status (and implications of this on commute travel). As such, this scenario would be expected to have benefits realized more proportionately across income groups than the others examined.

---

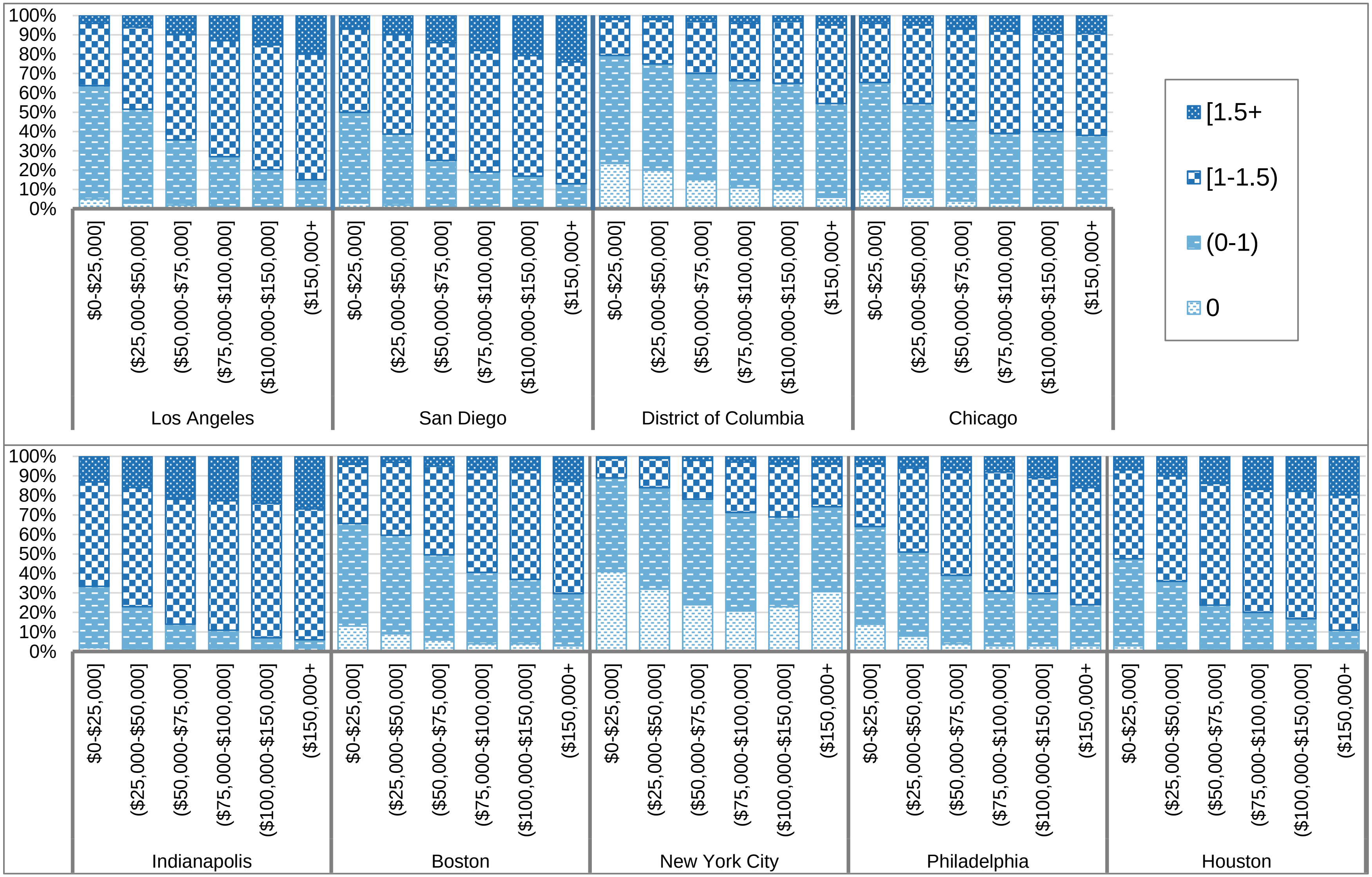
[42] The highest income category was excluded in the case of New York City, given the unique deviation of this group in the context of this location.

[43] Los Angeles (χ^2 (1, N = 119,609) = 7,168, p <0.01), San Diego (χ^2 (1, N = 39,276) = 1,797, p <0.01), Washington, DC (χ^2 (1, N = 8,807) = 68, p <0.01), Chicago (χ^2 (1, N = 58,040) = 1,456, p <0.01), Indianapolis (χ^2 (1, N = 26,689) = 933, p <0.01), Boston (χ^2 (1, N = 32,277) = 791, p <0.01), New York City (χ^2 (1, N = 128,106) = 2,037, p <0.01), Philadelphia (χ^2 (1, N = 30,195) = 1,255, p <0.01), and Houston (χ^2 (1, N = 74,417) = 3,574, p <0.01)

Table 37. Employee wage income by vehicles per adult in household (HH): % of employees in wage category in vehicles per adult category.

Employee Wage Income	Vehicles per Adult in HH	Los Angeles	San Diego	Washington D.C.	Chicago	Indianapolis	Boston	New York City	Philadelphia	Houston
$0-$25,000]	0	5%	3%	24%	10%	2%	13%	41%	14%	3%
$0-$25,000]	(0-1)	58%	47%	57%	56%	31%	52%	48%	50%	45%
$0-$25,000]	[1-1.5)	32%	43%	19%	31%	53%	30%	10%	32%	46%
$0-$25,000]	[1.5+	4%	7%	2%	4%	13%	4%	1%	4%	7%
($25,000-$50,000]	0	3%	2%	20%	6%	1%	9%	32%	8%	1%
($25,000-$50,000]	(0-1)	49%	37%	55%	49%	22%	50%	52%	43%	35%
($25,000-$50,000]	[1-1.5)	43%	52%	23%	41%	61%	37%	15%	43%	54%
($25,000-$50,000]	[1.5+	6%	10%	2%	5%	16%	3%	1%	6%	10%
($50,000-$75,000]	0	2%	1%	15%	4%	1%	6%	24%	4%	1%
($50,000-$75,000]	(0-1)	34%	24%	55%	42%	13%	44%	54%	35%	23%
($50,000-$75,000]	[1-1.5)	55%	61%	27%	48%	64%	46%	20%	54%	63%
($50,000-$75,000]	[1.5+	10%	14%	3%	7%	22%	5%	2%	7%	14%
($75,000-$100,000]	0	1%	1%	11%	3%	1%	4%	21%	3%	1%
($75,000-$100,000]	(0-1)	26%	18%	56%	36%	10%	37%	51%	28%	19%
($75,000-$100,000]	[1-1.5)	60%	63%	30%	53%	67%	53%	26%	61%	63%
($75,000-$100,000]	[1.5+	13%	18%	4%	8%	23%	7%	3%	8%	17%
($100,000-$150,000]	0	1%	1%	10%	3%	1%	4%	23%	3%	1%
($100,000-$150,000]	(0-1)	19%	16%	55%	37%	6%	33%	46%	27%	16%
($100,000-$150,000]	[1-1.5)	64%	63%	32%	51%	69%	56%	27%	60%	66%
($100,000-$150,000]	[1.5+	15%	21%	3%	9%	24%	7%	4%	11%	18%
($150,000+	0	1%	1%	6%	3%	0%	3%	31%	3%	1%
($150,000+	(0-1)	14%	12%	49%	35%	6%	27%	44%	21%	10%
($150,000+	[1-1.5)	65%	63%	41%	53%	67%	58%	22%	60%	70%
($150,000+	[1.5+	20%	24%	5%	9%	27%	13%	4%	16%	20%

“]” indicates the interval includes the bracketed number; “(“ indicates the interval is greater than (but does not include) the bracketed number.



Source: FHWA, based on U.S. Census Bureau 2019 Data.

Figure 13. Graphs. Vehicles per adult in household (HH) by employee wage income.

“]” indicates the interval includes the bracketed number; “(“ indicates the interval is greater than (but does not include) the bracketed number

Employee Wage Income and Commute Travel

The crosstabulation between employee wage income and vehicle ownership is displayed in Table 38 and visualized in figure 14. In cities with higher public transportation commute rates overall (e.g., Boston, Chicago, New York City, Philadelphia, and Washington, D.C.), public transportation commuting tends to follow a U-shaped trend, decreasing from low-income to high-income categories, until mode share increases again in the highest income categories. Similar to the explanation provided for vehicle ownership in New York City, this trend may be due to the wealthiest households locating themselves in the city's urban core, where access to high quality transit allows for easy travel via public transportation. A similar, albeit less pronounced, trend can be observed for walking mode shares in Boston, Chicago, New York City, and Philadelphia. In contrast, walk mode share stays relatively constant across income groups in Washington, D.C., for employees earning $75,000 or more. Note, too, that in many cities, the auto commuting mode share levels off after the lowest-income group.

Here, analysis is focused on walking commuters, as this subset of commuters is generally more likely to fall into the lowest income categories across the cities considered for analysis, where the findings for cycling in the cities that were analyzed is less clear.[44] To evaluate the relationship between employee wage income and walking commutes, income levels were split to divide the lowest-income group (<$25,000) from all higher ones *except* the highest income levels, given the U-shaped trend observed for walking behaviors due to unique characteristics of this group (e.g., ability to locate centrally in walkable distances for commutes). Commutes were consolidated into "Walking" and "Other mode" categories. Then, Chi-square tests were conducted to examine the relation between this binary income split and the commute mode. The relation between these income and vehicle ownership variables was significant for all cities in the analysis except Washington, D.C.,[45] and indicated that the lowest-income group was more likely to commute via walking than the higher income groups. This result indicates that, for almost all cities in this analysis, Scenario 5 would offer enhanced benefits for a greater share of low-income commuters—*if* those commuters are unable to mode-switch—compared to other scenarios, given its universal non-SOV benefits offerings regardless of current workplace parking subsidies.

---

[44]Note across that U.S. more broadly, the lowest-income households exhibit higher rates of both walking and biking commuting compared to higher income households (McKenzie 2014).

[45]Los Angeles (χ^2 (1, N = 112,263) = 662, p <0.01), San Diego (χ^2 (1, N = 36,735) = 195, p <0.01), Chicago (χ^2 (1, N = 53,799) = 180, p <0.01), Indianapolis (χ^2 (1, N = 25,473) = 82, p <0.01), Boston (χ^2 (1, N = 28,219) = 83, p <0.01), New York City (χ^2 (1, N = 128,106) = 1,390, p <0.01), Philadelphia (χ^2 (1, N = 28,230) = 130, p <0.01), and Houston (χ^2 (1, N = 68,948) = 236, p <0.01).

Table 38. Employee wage income by primary commute mode: % of employees of wage category in commute mode category.

Employee Wage Income	Primary Commute Mode	Los Angeles	San Diego	Washington D.C.	Chicago	Indianapolis	Boston	New York City	Philadelphia	Houston
$0-$25,000]	Car, truck, or van	78%	85%	42%	69%	92%	60%	29%	66%	91%
$0-$25,000]	Public transportation[1]	11%	5%	39%	20%	2%	26%	54%	22%	3%
$0-$25,000]	Biked/walked	5%	4%	10%	6%	2%	9%	12%	6%	2%
$0-$25,000]	Worked from home	4%	5%	7%	3%	3%	4%	3%	4%	3%
$0-$25,000]	Other[2]	3%	2%	2%	2%	1%	2%	2%	2%	2%
($25,000-$50,000]	Car, truck, or van	88%	91%	53%	78%	95%	67%	39%	76%	94%
($25,000-$50,000]	Public transportation[1]	5%	3%	34%	15%	0%	22%	50%	16%	2%
($25,000-$50,000]	Biked/walked	2%	1%	8%	3%	1%	6%	8%	4%	1%
($25,000-$50,000]	Worked from home	3%	4%	4%	3%	4%	3%	3%	3%	3%
($25,000-$50,000]	Other[2]	2%	1%	2%	1%	1%	1%	1%	1%	1%
($50,000-$75,000]	Car, truck, or van	90%	91%	52%	76%	94%	67%	43%	78%	94%
($50,000-$75,000]	Public transportation[1]	3%	2%	29%	16%	0%	21%	47%	14%	1%
($50,000-$75,000]	Biked/walked	2%	1%	13%	4%	1%	7%	6%	4%	1%
($50,000-$75,000]	Worked from home	4%	5%	5%	4%	5%	3%	3%	4%	4%
($50,000-$75,000]	Other[2]	1%	1%	2%	1%	1%	1%	1%	1%	1%
($75,000-$100,000]	Car, truck, or van	88%	89%	47%	72%	92%	67%	44%	78%	91%
($75,000-$100,000]	Public transportation[1]	3%	1%	29%	18%	0%	20%	45%	12%	2%
($75,000-$100,000]	Biked/walked	2%	1%	16%	4%	1%	7%	6%	4%	1%
($75,000-$100,000]	Worked from home	5%	7%	6%	5%	7%	5%	3%	5%	6%
($75,000-$100,000]	Other[2]	1%	1%	2%	1%	0%	1%	2%	1%	1%
($100,000-$150,000]	Car, truck, or van	87%	88%	43%	61%	88%	64%	41%	73%	90%
($100,000-$150,000]	Public transportation[1]	3%	1%	31%	24%	0%	20%	46%	14%	2%
($100,000-$150,000]	Biked/walked	2%	1%	17%	6%	1%	7%	7%	4%	1%
($100,000-$150,000]	Worked from home	7%	8%	7%	8%	10%	8%	4%	8%	6%
($100,000-$150,000]	Other[2]	1%	1%	2%	1%	1%	2%	2%	1%	1%

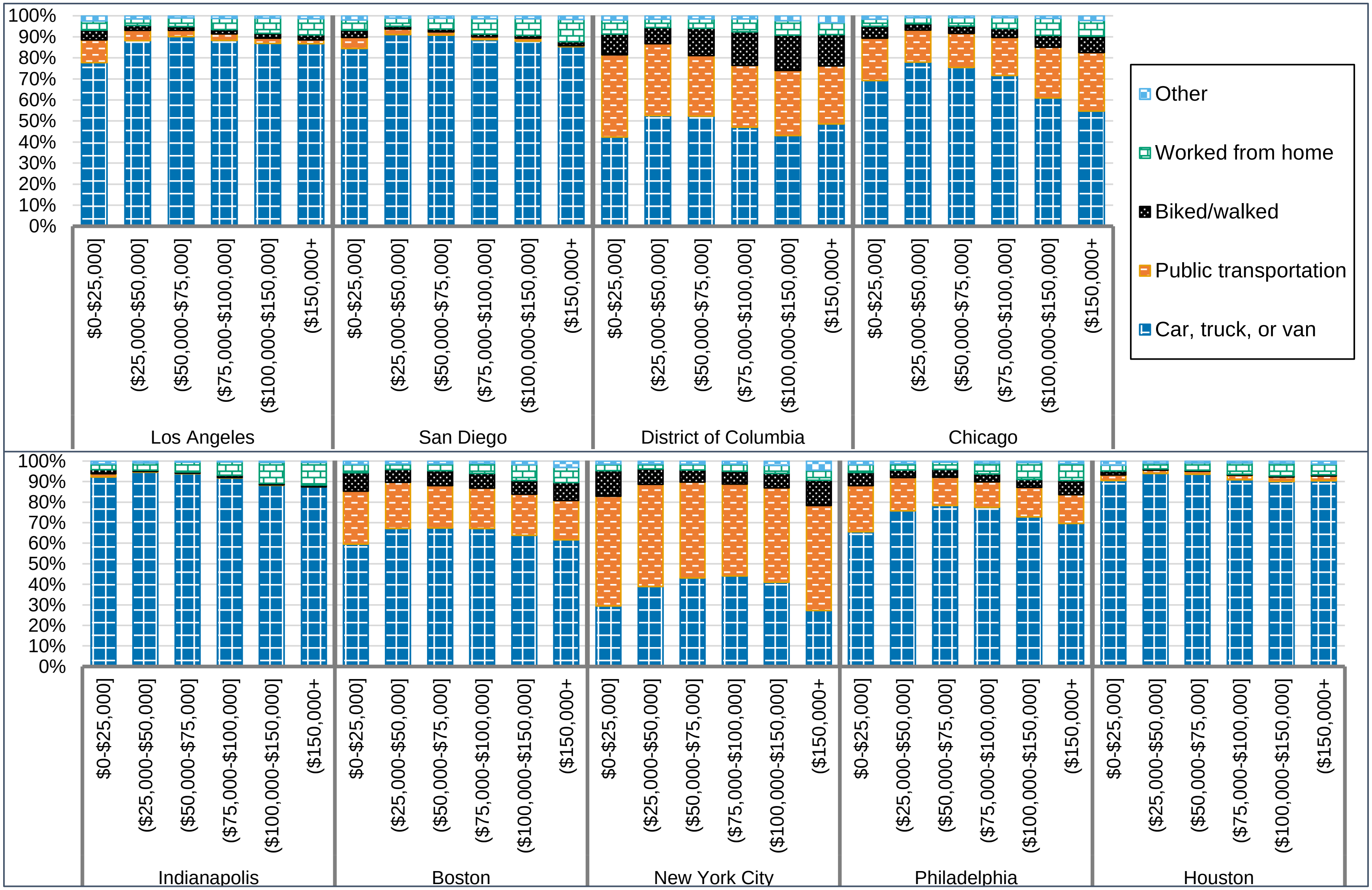
Table 39. Employee wage income by primary commute mode: % of employees of wage category in commute mode category (continuation).

Employee Wage Income	Primary Commute Mode	Los Angeles	San Diego	Washington D.C.	Chicago	Indianapolis	Boston	New York City	Philadelphia	Houston
($150,000+	Car, truck, or van	87%	85%	49%	55%	88%	62%	27%	70%	90%
($150,000+	Public transportation[1]	2%	1%	28%	28%	0%	19%	51%	14%	2%
($150,000+	Biked/walked	3%	2%	15%	8%	1%	9%	12%	7%	1%
($150,000+	Worked from home	8%	11%	6%	8%	11%	7%	5%	8%	5%
($150,000+	Other[2]	1%	2%	3%	2%	1%	3%	5%	1%	2%

[1]Bus; subway or elevated rail; long-distance train or commuter train; light rail, streetcar, or trolley

[2]Ferryboat, taxicab, motorcycle, other method

"]" indicates the interval includes the bracketed number; "(" indicates the interval is greater than (but does not include) the bracketed number.



Source: FHWA, based on U.S. Census Bureau 2019 Data

Figure 14. Graphs. Primary commute mode by employee wage income.

"]" indicates the interval includes the bracketed number; "(" indicates the interval is greater than (but does not include) the bracketed number

Household Travel Survey Data

The research team conducted a scan of available HTS data for the nine cities analyzed. Results of this scan are displayed in Table 40. Regional survey data capturing income, industry, and provision of commute-related benefits (parking and/or transit) was at least partially available for six cities, with all of these datapoints available for four of the six cities. Cities without appropriate data that are excluded from this supplementary analysis include Houston and Boston/Cambridge (lacking data on provision of commuter benefits) and San Diego (lacking city- or regionally-specific survey data). Available surveys vary in recency and definitions (e.g., of industries). Findings from these surveys relevant for the six cities for which any appropriate regional data is available are summarized in this section.

Table 40. Summary of the best available household travel survey data related to each city.

Region/Survey	Income?[1]	Industry?[2]	Free Parking?	Transit benefit?
Los Angeles, CA: 2001-2002 Southern California Regional Travel Survey (National Renewable Energy Laboratory, 2022)	Yes	Yes	Yes	Yes
San Diego, CA: 2012 CA (Statewide) HTS** (National Renewable Energy Laboratory, 2022)	Yes	Yes	No	Yes
Washington, D.C.: 2017/2018 Regional Travel Survey (Metropolitan Washington Council of Governments (MWCOG), 2018)	Yes	Yes	Yes	Yes
Chicago, IL: 2018–2019 My Daily Travel Survey (Chicago Metropolitan Agency for Planning (CMAP), 2020)	Yes	Yes	Yes	Yes
Indianapolis, IN: Madison County Council of Governments – Heartland in Motion 2014 (National Renewable Energy Laboratory, 2022)	Yes	Yes	Yes	No
Boston/Cambridge, MA: MassDOT 2011 Household Travel Survey (HTS) (MassDOT, 2012)	Yes	No	No	No
New York City, NY: 2010/2011 Regional Travel Survey (New York Metropolitan Transportation Council (NYMTC), 2014)	Yes	Yes	Yes	Yes
Philadelphia, PA: 2012–2013 HTS ((DVRPC, 2016)	Yes	Yes	Yes	Yes
Houston, TX: 2007–2009 Houston-Galveston Area Council (H-GAC) Metropolitan Planning Organization (MPO) HTS (Texas A&M Transportation Institute (TTI), 2013)	Yes	Yes	No	No

[1]While person-level income is available in PUMS data, HTSs typically only collected household income, which is the metric flagged here.
[2]Specific data related to industry varies across surveys. Some provide detailed North American Industry Classification System (NAICS) codes, while others provide general employer information (e.g., private firm/company, non-profit firm/organization, government, etc.). As such, industry-related data may not be consistent across surveys or regions.
**Although the 2012 CA HTS contains some information noted in this table, it does not support weighting to the city or region level, versus city or regional surveys that would enable specific weights. As such, use of this survey to explore San Diego data has been excluded.

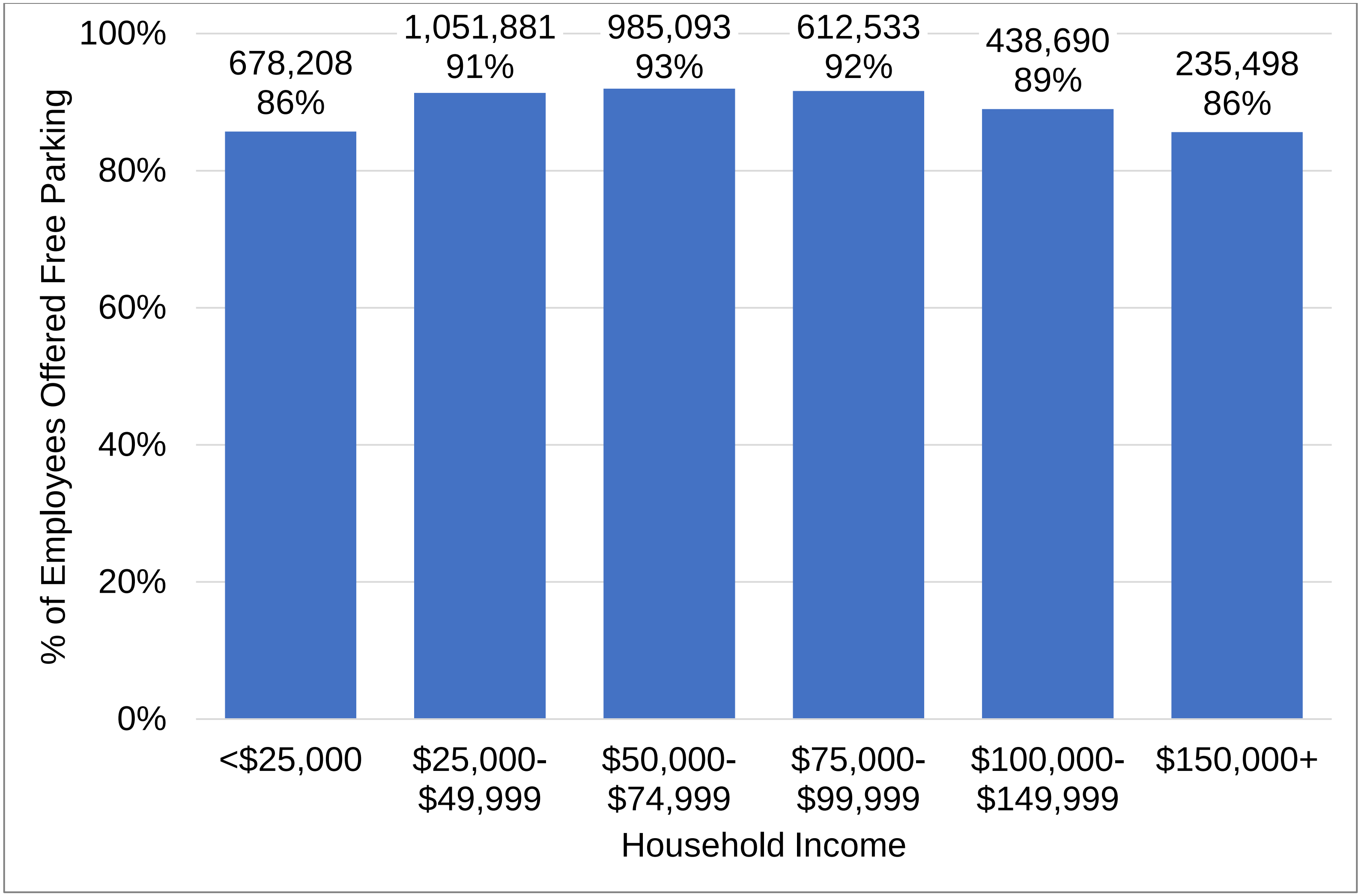
Visualizations of available data from the seven surveys where information is available are displayed in figure 15 through figure 25. For each survey, data is displayed segmented by income, although significant differences in benefits received were evaluated by both industry/sector and income throughout this section. Note that each survey defined industries or sectors differently (e.g., some used North American Industry Classification System (NAICS) codes, which were consolidated for this visualization; the MWCOG survey just described basic sector (e.g., public or private)). Regional weighted data (which these surveys typically display) may show slightly different or diluted trends compared to cities. It is important to consider that, unlike the PUMS, HTSs provide household-level income, not employee-level income. As such, observed trends may be skewed to not fully reflect those that would be observed with employee-level income. Most of the surveys are regional, and data for the entire region was retained so that weights could be appropriately applied.

Data for the Los Angeles region (figure 15 and figure 16) show some variance in benefits offerings by household income groups, more prominently for transit benefits (figure 16) versus free parking offerings (figure 15). Free parking offerings seem to follow a U-shaped pattern across income groups. Transit benefits offerings, in contrast, increase with rising income overall, with some deviation in the middle-income levels. Examining trends by income and sector, Pearson's Chi-square test revealed that the lowest income group (<$25,000) is significantly less likely to be offered free parking compared to all higher income groups consolidated within the "Agriculture, Utilities, Construction, Manufacturing, Transportation," "Healthcare and Education," and "Retail, Wholesale, Real Estate, Entertainment, Food Services" sectors.[46] Any policies that expand the baseline number of employees considered for benefits beyond just employees receiving free parking (e.g., Scenarios 3–5) will have positive equity implications, particularly for employees working in these sectors.

With respect to the offering of transit benefits, Pearson's Chi-square test revealed that the lowest income group is significantly less likely to be offered transit benefits compared to all higher income groups consolidated in the "Agriculture, Utilities, Construction, Manufacturing, Transportation," "Finance, Information, Professional Services, Management," and "Retail, Wholesale, Real Estate, Entertainment, Food Services" sectors.[47] Given this, any policies that provide subsidized transit benefits (Scenario 2–5, with Scenario 2 only being offered to employees also receiving free parking) would have positive implications for equity for these sectors in particular.

[46] Agriculture, Utilities, Construction, Manufacturing, Transportation (χ^2 (1, N = 2,801) = 4, $p < 0.05$), Healthcare and Education (χ^2 (1, N = 2,814) = 4, $p < 0.05$), Retail, Wholesale, Real Estate, Entertainment, Food Services (χ^2 (1, N = 3,672) = 13, $p < 0.001$)

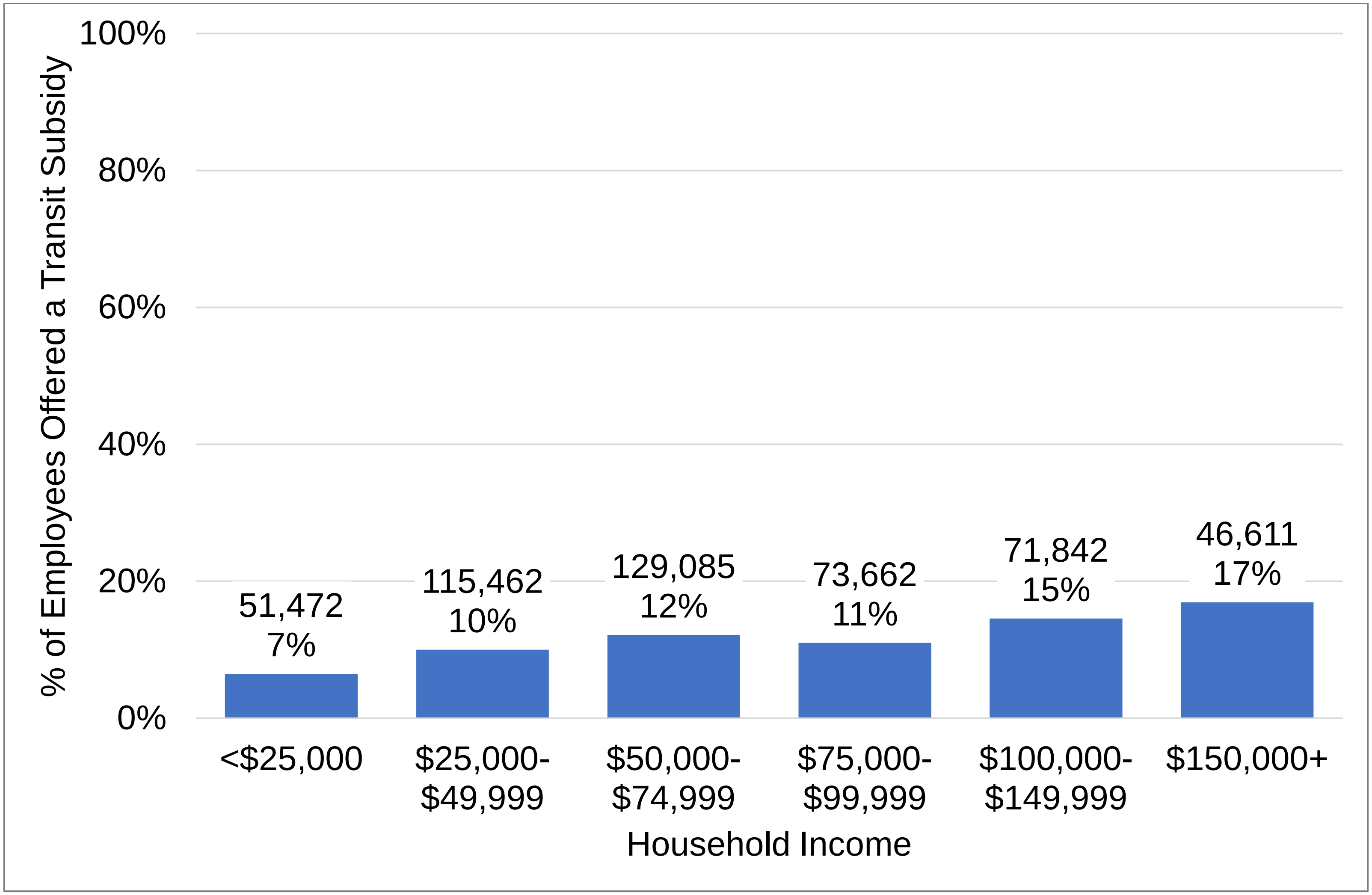
[47] Agriculture, Utilities, Construction, Manufacturing, Transportation (χ^2 (1, N = 2,801) = 37, $p < 0.001$), Finance, Information, Professional Services, Management (χ^2 (1, N = 2,464) = 8, $p < 0.01$), Retail, Wholesale, Real Estate, Entertainment, Food Services (χ^2 (1, N = 3,672) = 10, $p < 0.01$)



Source: FHWA, based on 2001-2002 Southern California Regional Travel Survey Data (National Renewable Energy Laboratory, 2022)

Figure 15. Graph. Los Angeles income and free workplace parking distribution.

Bar labels represent the weighted number of employees in each income group offered free parking, followed by the weighted percentage of employees in that income group offered free parking.



Source: FHWA, based on 2001-2002 Southern California Regional Travel Survey Data (National Renewable Energy Laboratory, 2022)

Figure 16. Graph. Los Angeles income and transit benefits distribution.

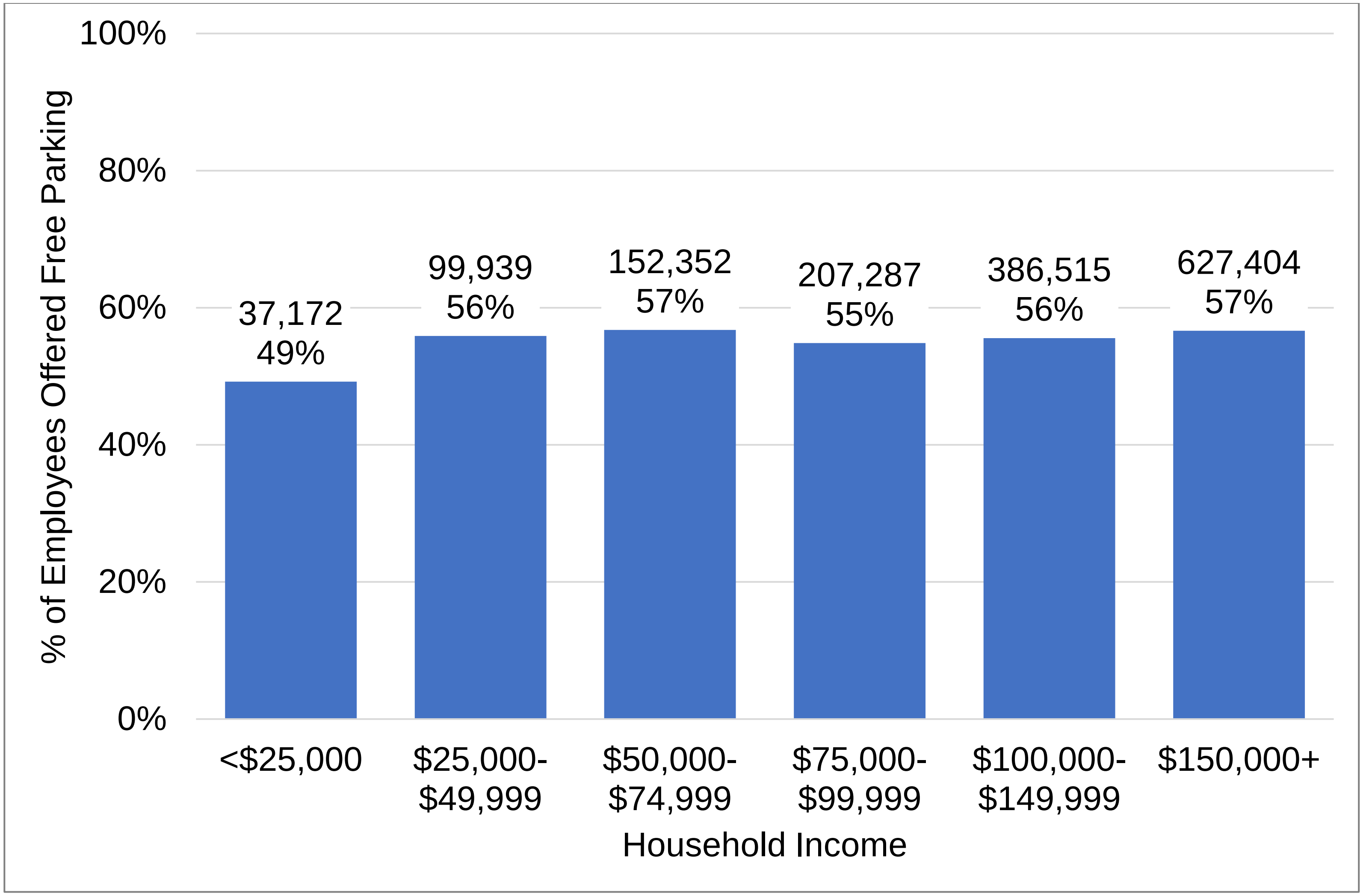
Bar labels represent the weighted number of employees in each income group offered transit benefits, followed by the weighted percentage of employees in that income group offered transit benefits.

Data for the Washington, D.C., region (figure 17 and figure 18) show some variance in benefits offerings by household income groups. Upon visual inspection, the most drastic differences in the provision of free parking benefits are observed jumping from the lowest income group to the others, after which the trend plateaus. The provision of transit benefits shows a more continuous trend, with higher income groups experiencing higher rates of workplace transit benefits compared to lower income groups. Examining trends by income and sector, Pearson's Chi-square test revealed that the lowest income group (<$25,000) is significantly less likely to be offered free parking compared to all higher income groups consolidated within private/for-profit and State or local government sectors.[48] As such, any policies that expand the baseline number of employees considered for benefits beyond just employees receiving free parking (e.g., Scenario 3 through Scenario 5) will have positive equity implications, especially for employees working in private/for-profit and State or local government sectors.

With respect to the offering of transit benefits, Pearson's Chi-square testing revealed that the lowest income group is significantly less likely to be offered transit benefits compared to all higher income groups consolidated within private/for-profit and nonprofit sectors.[49] Policies that provide subsidized transit benefits (Scenario 2 through Scenario 5, with Scenario 2 only being offered to employees also receiving free parking) would have positive implications for equity for these sectors in particular. It should also be noted that, in all sectors beyond Federal government work, a vast majority of employees, regardless of income group, do not receive subsidized transit benefits. This situation likely differs for Washington, D.C., compared to the rest of that region given the city's especially high concentration of Federal workers.

[48] Work for private for-profit firm/company (χ^2 (1, N = 7,294) = 10, p <0.05), Work for State or local government (χ^2 (1, N = 1,828) = 10, p < 0.01)

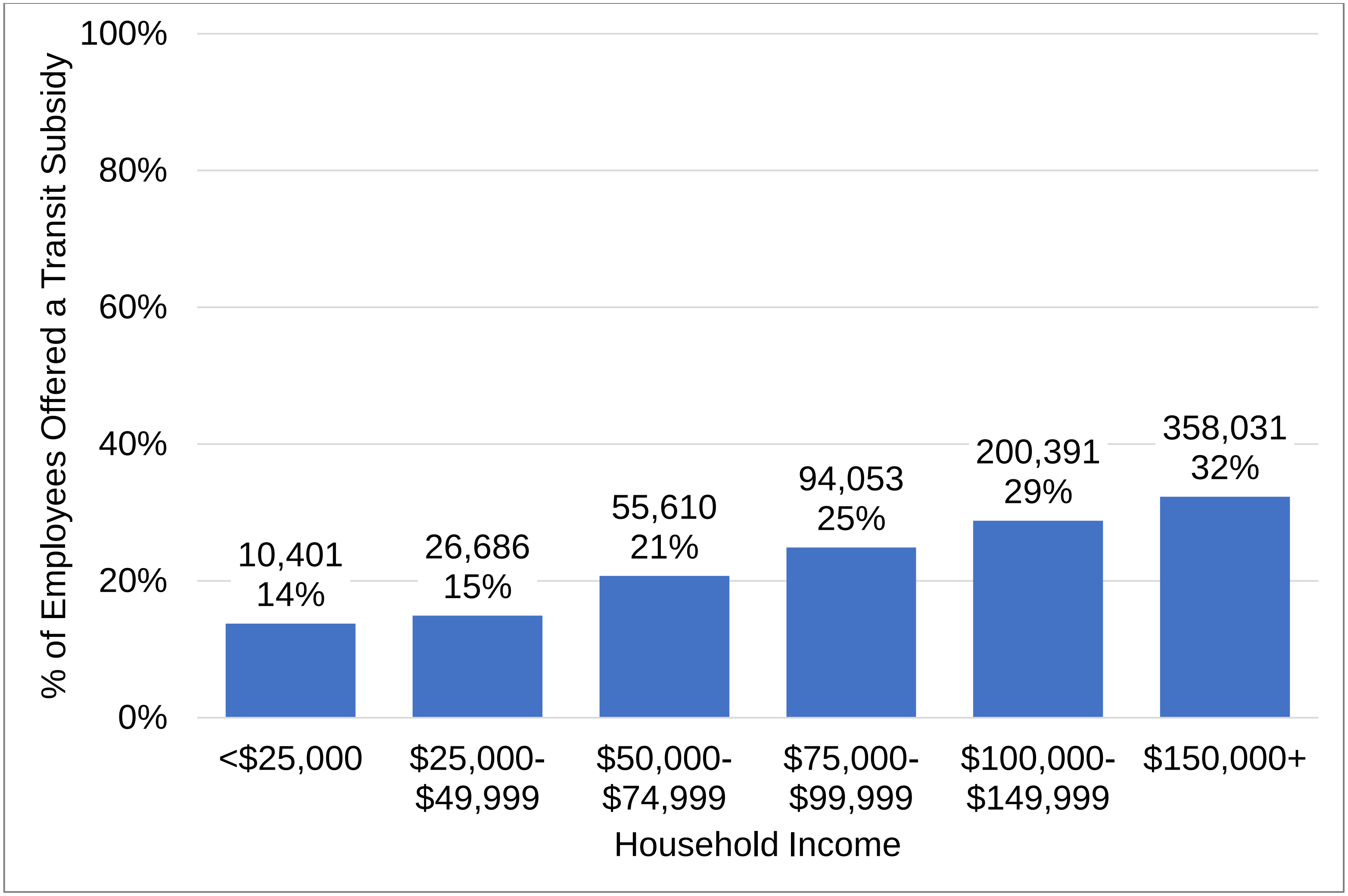
[49] Work for private for-profit firm/company (χ^2 (1, N = 7,294) = 14, p <0.01), Work for nonprofit firm/organization (χ^2 (1, N = 2,600) = 7, p < 0.05)



Source: FHWA, based on 2017/2018 Regional Travel Survey Data (MWCOG, 2018).

Figure 17. Graph. Washington, D.C., region income and free workplace parking distribution.

Bar labels represent the weighted number of employees in each income group offered free parking, followed by the weighted percentage of employees in that income group offered free parking.



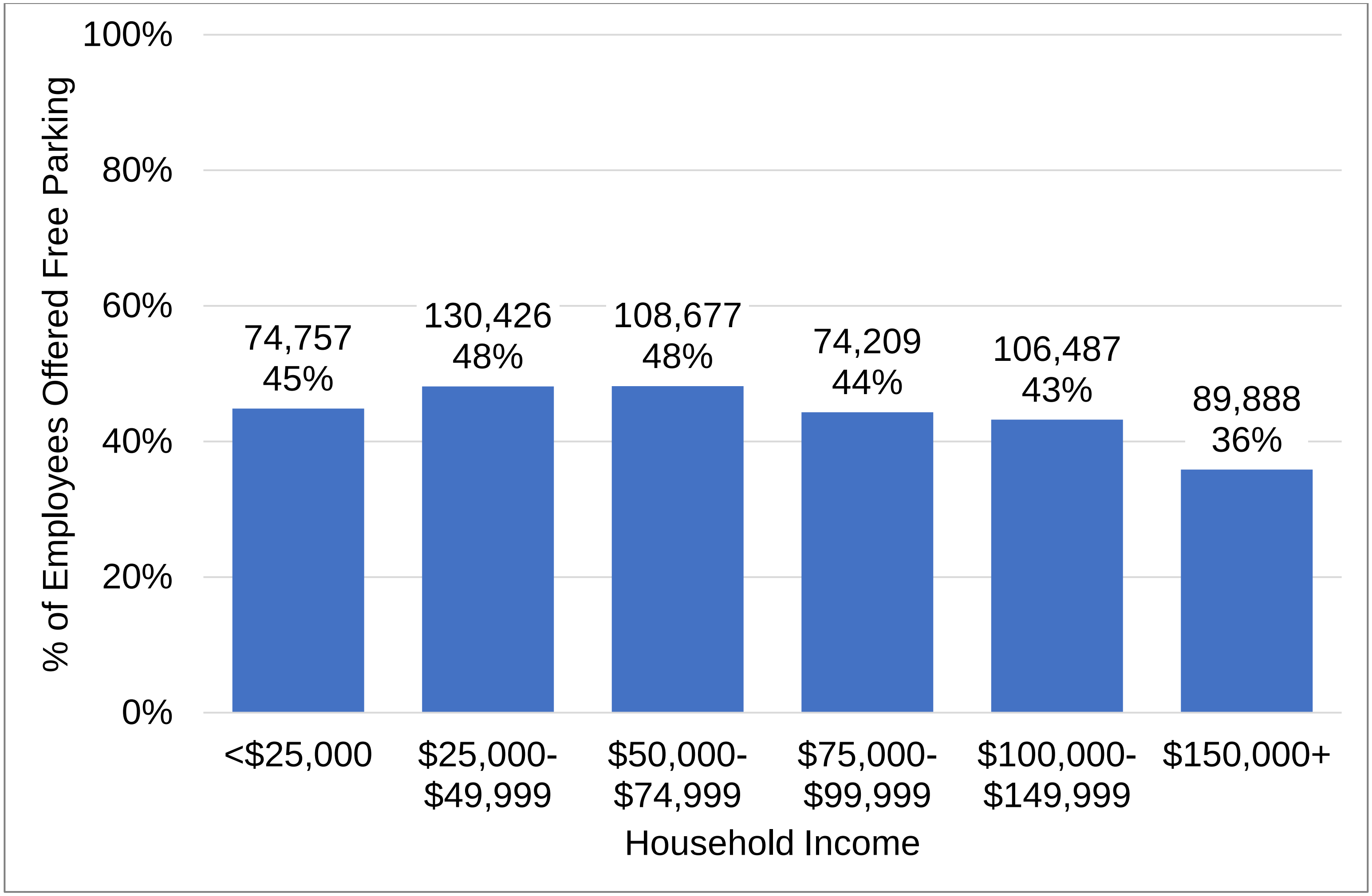
Source: FHWA, based on 2017/2018 Regional Travel Survey Data (MWCOG, 2018)

Figure 18. Graph. Washington, D.C., region income and transit benefits distribution.

Bar labels represent the weighted number of employees in each income group offered transit benefits, followed by the weighted percentage of employees in that income group offered transit benefits.

Examining data for Chicago (figure 19 and figure 20), free parking offerings appear relatively stable across income groups. In contrast, subsidized transit offerings tend to increase as incomes increase. Pearson's Chi-square test did not reveal statistically significant findings relating income and industry across sectors. However, there were significant differences in transit benefits offerings within all sectors, except Public Administration (likely due to lower sample size in the unweighted data), that indicated the lowest income group is significantly less likely to be offered transit benefits compared to all higher income groups consolidated.[50] This indicates there are equity enhancements that could be achieved by expanding transit benefits offerings across sectors.

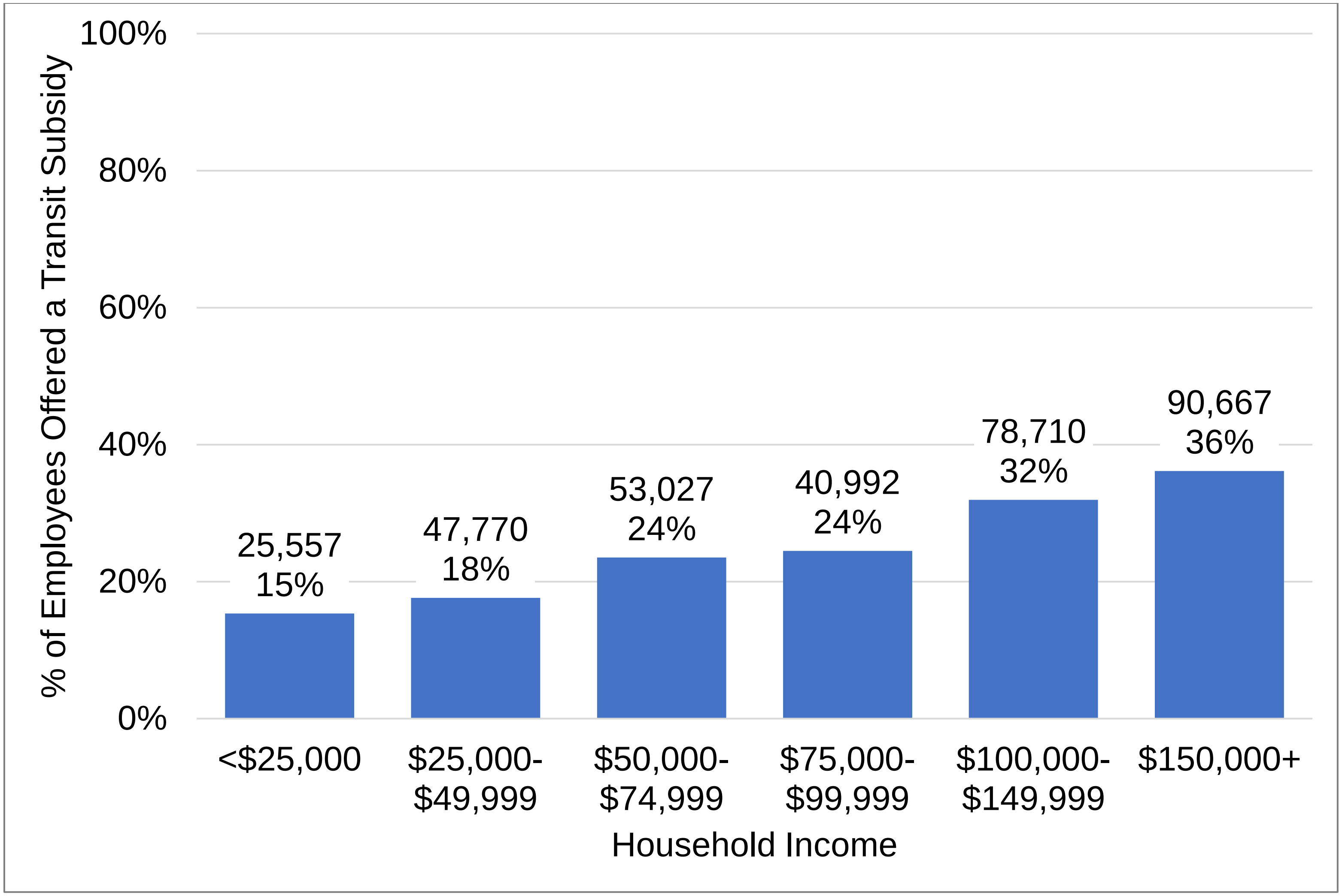
[50] Agriculture, Utilities, Construction, Manufacturing, Transportation (χ^2 (1, N = 887) = 18, $p < 0.01$), Finance, Information, Professional Services, Management (χ^2 (1, N = 1,753) = 20, $p < 0.01$), Healthcare and Education (χ^2 (1, N = 1,577) = 7, $p < 0.05$), Retail, Wholesale, Real Estate, Entertainment, Food Services (χ^2 (1, N = 1,462) = 7, $p < 0.01$). Note, *Other* was not tested.



Source: FHWA, based on 2018-2019 My Daily Travel Survey Data (CMAP, 2020).

Figure 19. Graph. Chicago income and free workplace parking distribution.

Bar labels represent the weighted number of employees in each income group offered free parking, followed by the weighted percentage of employees in that income group offered free parking.



Source: FHWA, based on 2018-2019 My Daily Travel Survey Data (CMAP, 2020).

Figure 20. Graph. Chicago income and transit benefit distribution.

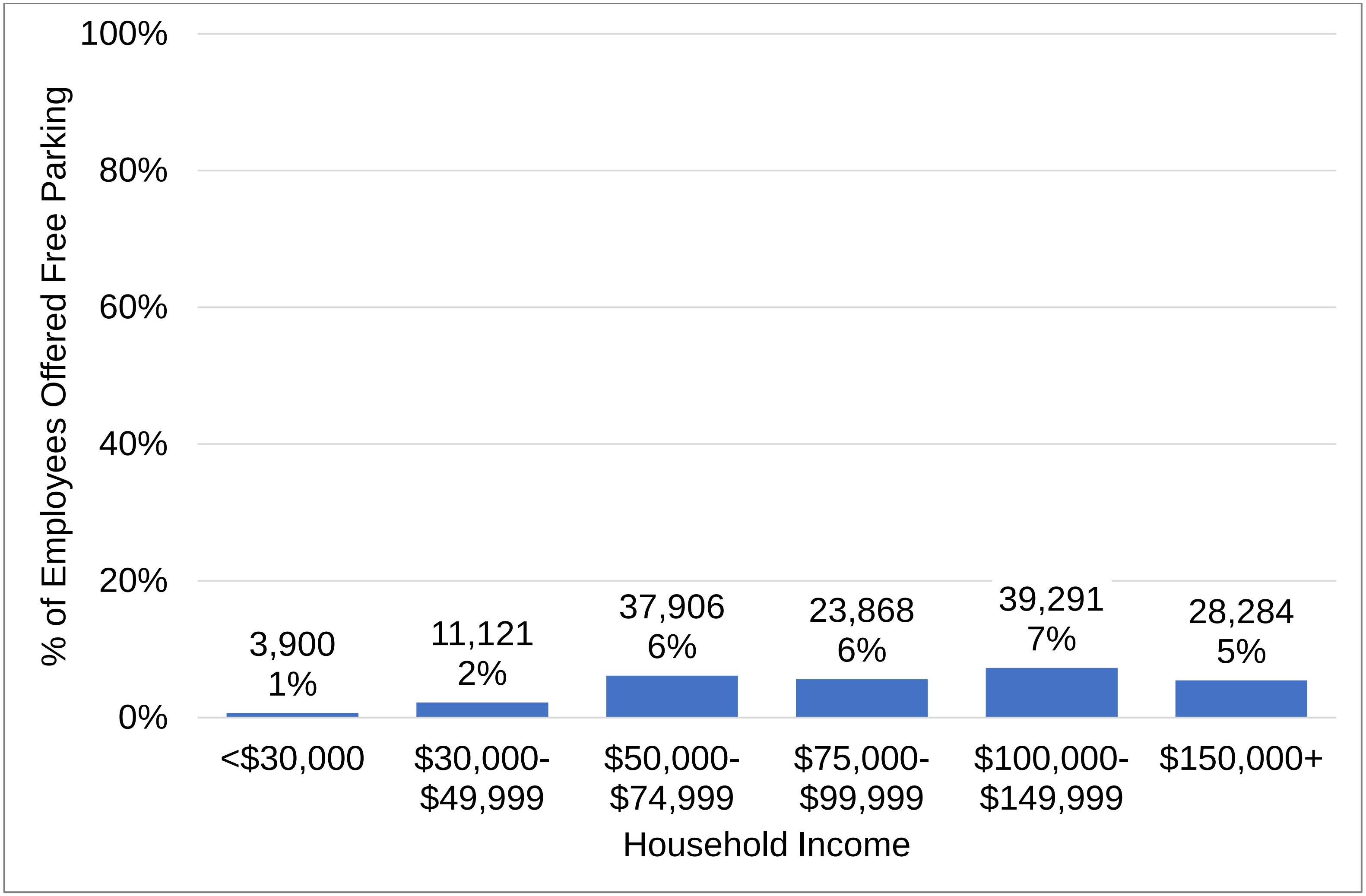
Bar labels represent the weighted number of employees in each income group offered transit benefits, followed by the weighted percentage of employees in that income group offered transit benefits. Transit subsidy here means employers pay any amount to employee monthly transit fares.

Data for the New York City region (figure 21 and figure 22) shows sparse parking and transit benefits offerings across income groups. With respect to free parking benefits, figure 21 shows a slight skew toward higher-income levels, although the difference seems to plateau after $50,000. Pearson's Chi-square test revealed that the lowest income group (here, this is household incomes <$30,000) is significantly less likely to be offered free parking compared to all higher income groups combined, across all sectors.[51] Similar with analysis of other cities, any policies that expand the baseline number of employees considered for benefits beyond just employees receiving free parking (e.g., Scenarios 3–5) will have positive equity implications overall here.

With respect to the offering of transit benefits, although figure 22 generally seems to indicate a positive trend between income and transit benefits overall, Pearson's Chi-square test revealed that the lowest income group is significantly less likely to be offered transit benefits compared to all higher income groups combined within the "Agriculture, Utilities, Construction, Manufacturing, Transportation" and "Finance, Information, Professional Services, Management" sectors.[52] Policies that provide subsidized transit benefits (Scenarios 2–5, with Scenario 2 only being offered to employees also receiving free parking) would have positive implications for equity for these sectors especially.

[51] Agriculture, Utilities, Construction, Manufacturing, Transportation (χ^2 (1, N = 1,929) = 4, $p < 0.05$), Finance, Information, Professional Services, Management (χ^2 (1, N = 6,774) = 16, $p < 0.01$), Healthcare and Education (χ^2 (1, N = 5,783) = 38, $p < 0.01$), Public Administration (χ^2 (1, N = 971) = 5, $p < 0.05$), Retail, Wholesale, Real Estate, Entertainment, Food Services (χ^2 (1, N = 3,323) = 8, $p < 0.01$). Note, *Other* was not tested.

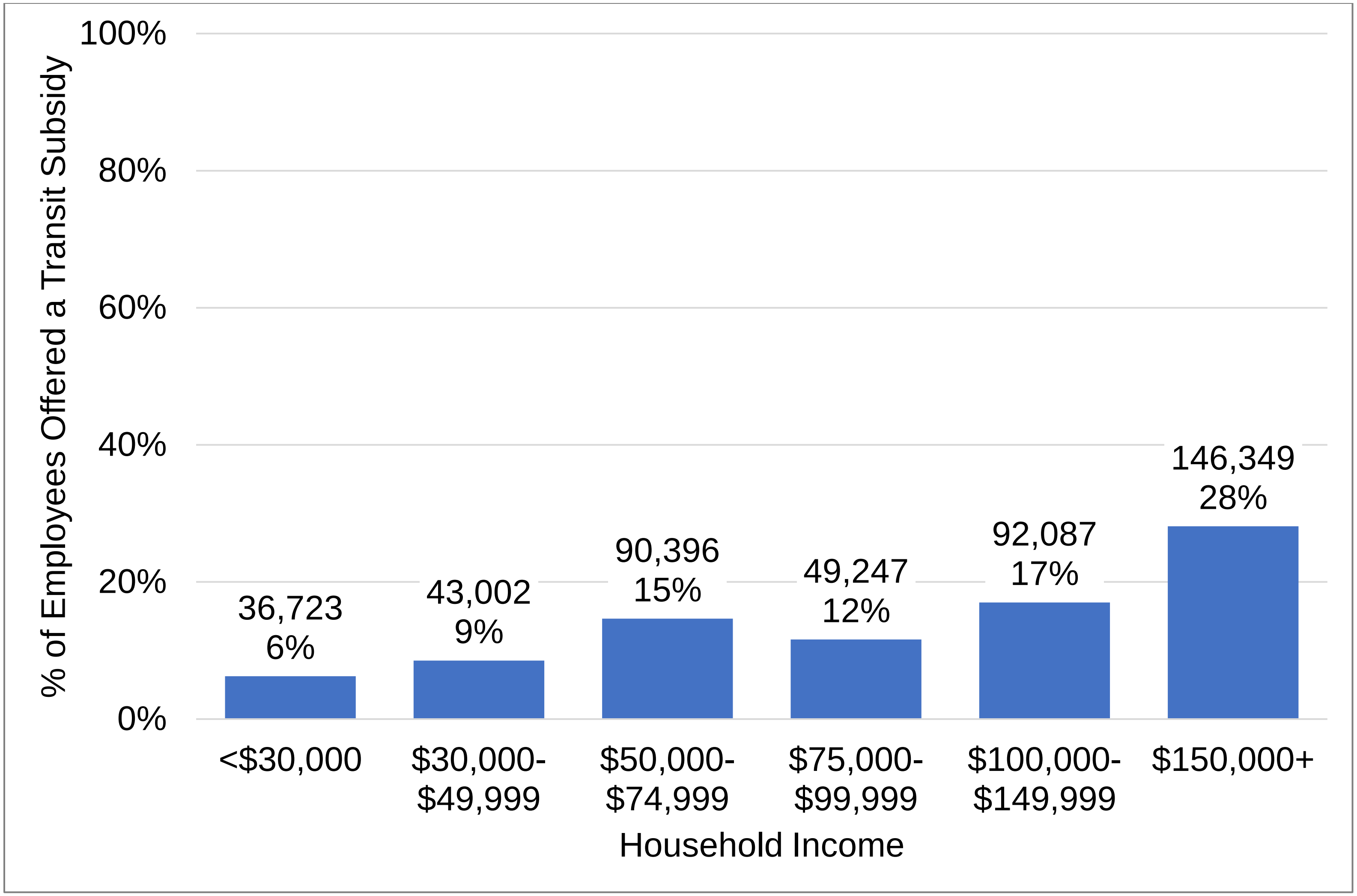
[52] Agriculture, Utilities, Construction, Manufacturing, Transportation (χ^2 (1, N = 1,929) = 5, $p < 0.05$), Finance, Information, Professional Services, Management (χ^2 (1, N = 6,774) = 7, $p < 0.01$)



Source: FHWA, based on 2010/2011 Regional Travel Survey Data (NYMTC, 2014).

Figure 21. Graph. New York City region income and free workplace parking distribution.

Bar labels represent the weighted number of employees in each income group offered free parking, followed by the weighted percentage of employees in that income group offered free parking. The HTS for NYC had a $30,000 cutoff versus a $25,000, as observed in the other figures.



Source: FHWA, based on 2010/2011 Regional Travel Survey Data (NYMTC, 2014).

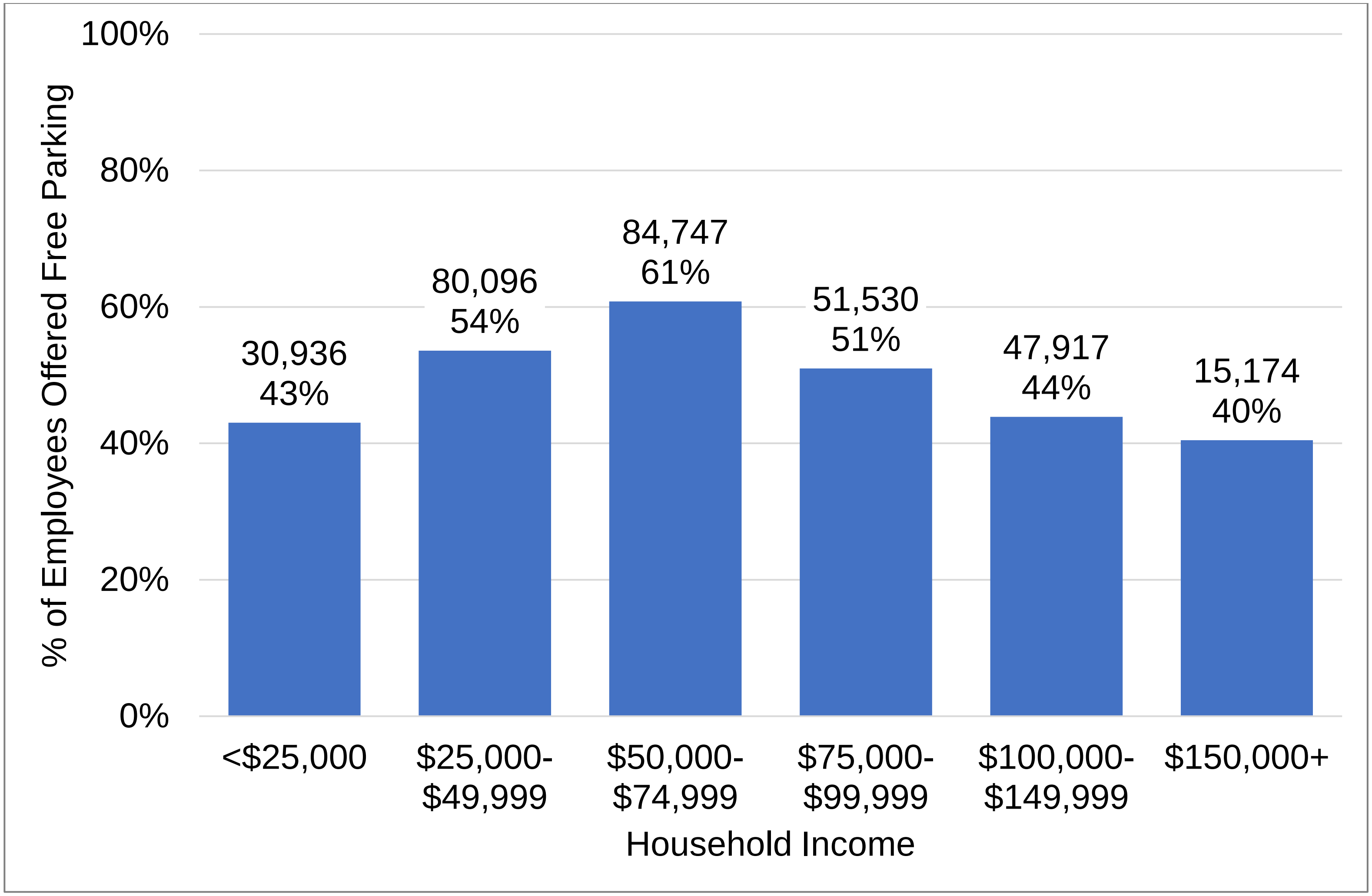
Figure 22. Graph. New York City region income and transit benefit distribution.

Bar labels represent the weighted number of employees in each income group offered transit benefits, followed by the weighted percentage of employees in that income group offered transit benefits. The HTS for NYC had a $30,000 cutoff versus a $25,000, as observed in the other figures.

Data on free parking and transit benefits for Philadelphia are displayed in figure 23 and figure 24, respectively. A U-shaped pattern appears for parking benefit provision, while transit benefits seem to increase with income overall, although with some deviations. Pearson's Chi-square test showed that the lowest income group is significantly less likely to be offered free parking compared to all higher income groups in the "Agriculture, Utilities, Construction, Manufacturing, Transportation" sector, but not in any others.[53] With respect to transit benefits, Pearson's Chi-square test did not reveal any significant relationship between income and transit benefits in any sectors. As such, the various tested scenarios may not enhance equity of benefits offerings between income groups and industries, at least to the degree observed in some other cities. However, Scenario 3 through Scenario 5, which offer benefits to all commuters versus just those receiving free parking, will still be more impactful here by expanding the baseline number of employees eligible for some benefit.

Data on free parking distributions in Indianapolis are displayed in figure 25. Note that the Madison County Council of Governments – Heartland in Motion 2014 (National Renewable Energy Laboratory 2017) HTS, on which Indianapolis analysis is based, includes data weights—such that the weighted distribution presented in figure 25 is representative of the region—but does not provide expansion weights; as such, population estimates are not provided in figure 25. Due to small samples that occur when grouping employees by industry and then comparing subsidy levels in this survey, Person's Chi-square testing was not separately conducted for each industry. Instead, testing compared free parking offerings across all industries, aggregated by income. When comparing free parking offerings by income level for all industries together, Pearson's Chi-square test did not reveal any significant relationship between income and free parking offerings.

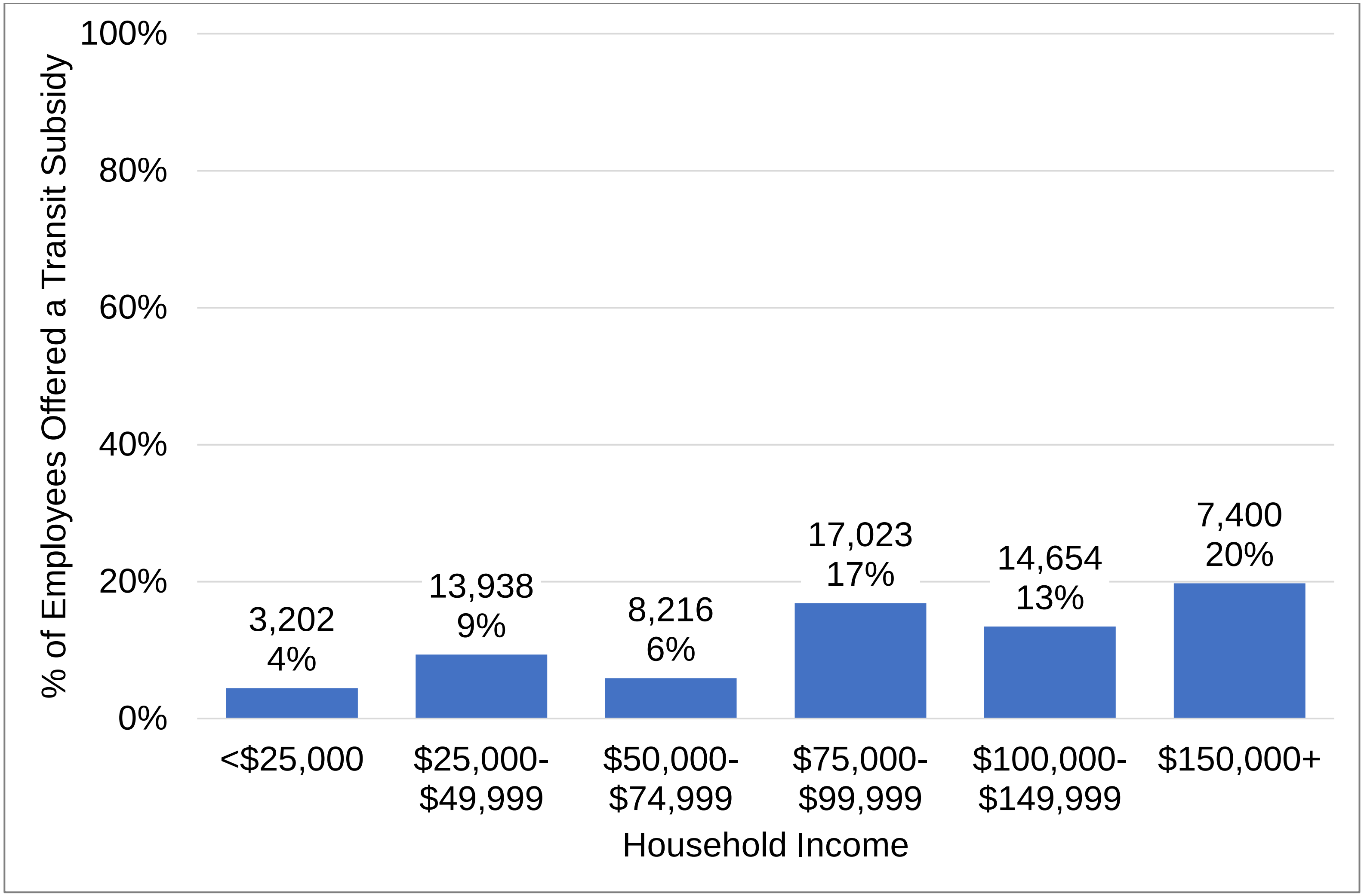
[53] Agriculture, Utilities, Construction, Manufacturing, Transportation (χ^2 (1, N = 148) = 13, p <0.01)



Source: FHWA, based on 2012-2013 Household Travel Survey Data (DVRPC, 2016).

Figure 23. Graph. Philadelphia income and free workplace parking distribution.

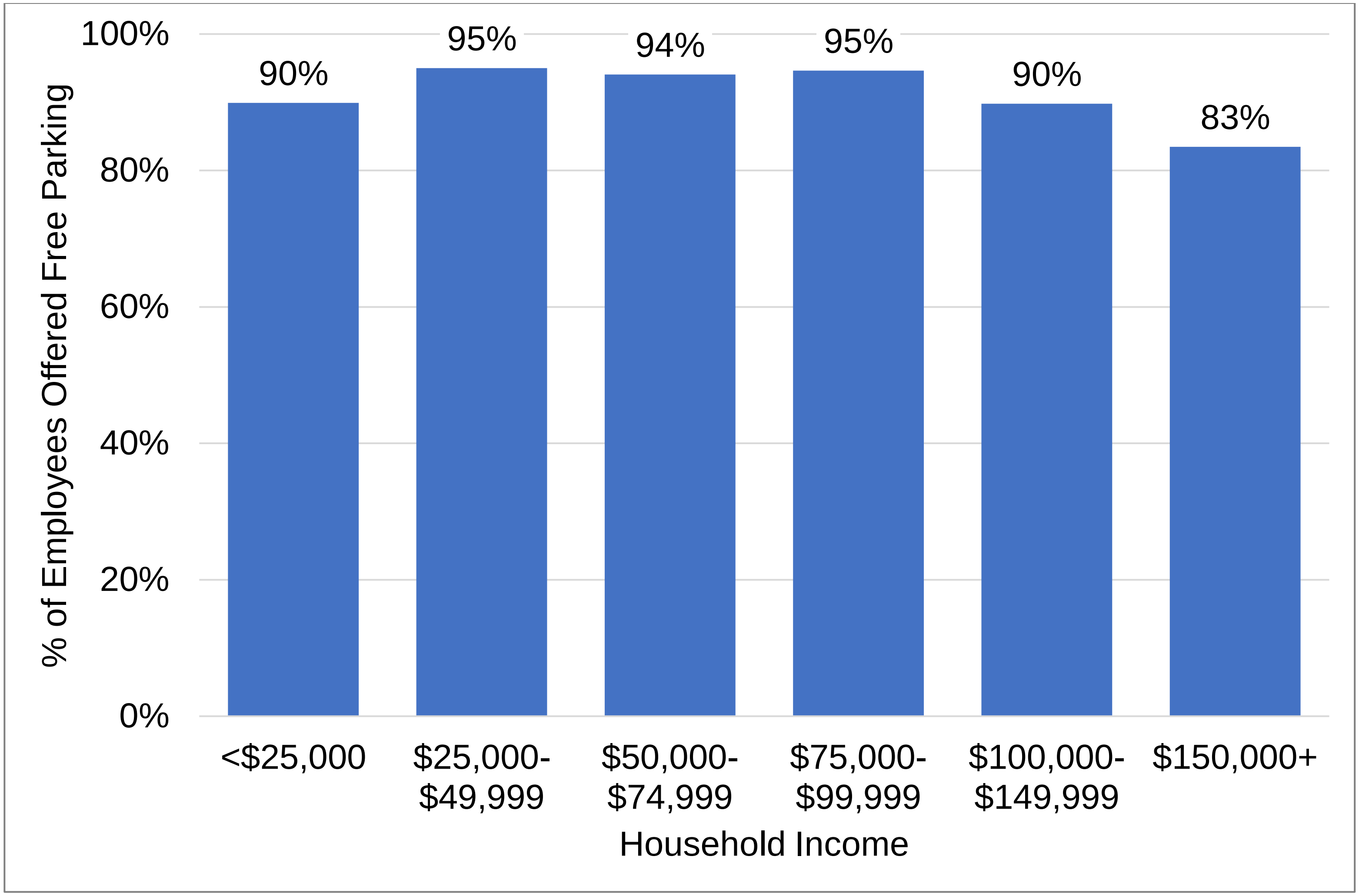
Bar labels represent the weighted number of employees in each income group offered free parking, followed by the weighted percentage of employees in that income group offered free parking.



Source: FHWA, based on 2012-2013 Household Travel Survey Data (DVRPC, 2016).

Figure 24. Graph. Philadelphia income and transit benefit distribution.

Bar labels represent the weighted number of employees in each income group offered transit benefits, followed by the weighted percentage of employees in that income group offered transit benefits.



Source: FHWA, based on Madison County Council of Governments – Heartland in Motion 2014 data (National Renewable Energy Laboratory 2022).

Figure 25. Graph. Indianapolis income and free workplace parking distribution.

Bar labels represent the weighted number of employees in each income group offered free parking, followed by the weighted percentage of employees in that income group offered free parking. Weights adjust distributions only (see note in preceding paragraph).

Additional Considerations

There are a few key measures not explored in this section, described below. These areas present key opportunities for future data collection and research efforts.

Differences in Benefits Offerings by Employer Size

No identified datasets allowed the research team to examine distributions of employees receiving subsidized parking or transit benefits by income level and the size of their employer. Some regional surveys provide limited insights on these factors. For example, MWCOG's 2019 State of the Commute Survey Report shows that 28 percent of Washington, D.C., regional employees working for employers with 1–100 employees receive subsidized transit or vanpool subsidies, compared to 44 percent of employees working for employers with 101–250 employees, 55 percent of employees working for employers with 251–999 employees, and 67 percent of employees working for employers with 1,000+ employees. Free parking offerings seem to follow a reverse trend as related to employer size, with 62 percent of employees working for employers with 1–100 employees receiving free workplace parking, compared to 57 percent of employees working for employers with 101–250 employees, 47 percent of employees working for employers with 251–999 employees, and 47 percent of employees working for employers with 1,000+ employees.

Data from the Puget Sound Region (Commute Seattle, 2016), used to scale estimates for Scenarios 1A and 3A in this analysis, reveal that 46 percent of employees at firms with fewer than 20 employees receive free parking, compared to 44 percent of employees at firms with 20 or more employees. Additionally, in this region, 44 percent of employees at firms with less than 20 employees receive subsidized transit benefits, compared to 69 percent of employees at firms with 20 or more employees. Across the cities analyzed in this report, more than 80 percent of employees worked for employers with 20 or more employees.

While these datasets do not allow us to infer variance based on employee wage income levels and employer size (given they do not provide employee wage income[54]), the differences in offerings by employer size at least indicate that policies including employers of certain sizes and excluding others may have undesirable impacts related to equity and who is eligible to receive benefits. For example, if employees working for smaller employers tend to earn lower incomes, and a policy is focused exclusively on larger employers, an opportunity to enhance equity for the former could be achieved by expanding offerings regardless of employer size. Complementary strategies could be put in place to support smaller employers in their ability to comply with such policies, such as providing training or technical assistance related to implementation, including guidance on administering cash-out payments and benefits to employees, consideration on the use of third-party benefits providers, and guidance on monitoring and enforcement.

[54]The research team was not able to identify any data linking employee wage income, benefits, and firm size of the employees' employers for the current analysis. In the future, household travel surveys may be an appropriate avenue for collecting these three datapoints together, which would allow for additional scaling based on both firm size and income (and potentially industry, depending on sample size and other available data sources).

The Disproportionate Burden of Transportation Costs

A 2015 Brookings Metropolitan Policy Program report found that proximity to jobs fell for poor and non-white residents at higher rates than for non-poor and white residents (Kneebone and Holmes, 2015). Where these groups' homes are located farther from their workplace locations, commuting via certain modes (e.g., transit, walking, biking) may become more difficult (or impossible). As such, low-income households that do not own vehicles may rely on rides in privately owned vehicles to access employment (Tomer and Kane, 2014). Additionally, rising costs associated with transportation may have disproportionately negative impacts on lower-income households (Methipara, 2014). Higher-income households located centrally in urban areas may sometimes be better able to switch their commute mode to transit to take advantage of parking cash-out benefits than lower-income households. Further, in policy situations, like Scenario 5, some lower-income households that had free workplace parking would be negatively impacted by having to absorb the cost of paid parking if they are not able to switch commute modes. Still, all non-SOV commuters—which may reflect a lower-income group on average than those who drive alone to work—benefit from reduced driving (and subsequent benefits offerings (e.g., reductions in congestion, pollution, and improvements in safety).

Equity impacts should be considered in instituting parking cash-out policies. This does not mean that free parking is the most equitable situation. There is growing evidence that parking availability and VMT have a positive relationship (Currans, Abou-Zeid, and Iroz-Elardo, 2021). Wealthier households also contribute more to VMT than their lower-income counterparts (Howell et al., 2018), which has impacts for congestion, emissions, and crashes—the burden of which is shared across all income levels, regardless of who is responsible for contributing most to related VMT. As previously stated, Scenario 5 advances transportation equity by eliminating the false free cost of parking; free parking acts to subsidize automobile use, and can subsequently increase negative externalities related to congestion, pollution, emissions, and safety. Scenario five has the greatest VMT reduction potential, which will act to mitigate these externalities for the greatest number of people.

U.S. Department of Transportation
Federal Highway Administration
Office of Operations
1200 New Jersey Avenue, SE
Washington, DC 20590

Office of Operations Website
https://ops.fhwa.dot.gov

March 2023
Publication No. FHWA-HOP-23-023

U.S. Department of Transportation
Federal Highway Administration