

Advancing Tolling Equity for Caltrans

Requested by

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Executive Summary

Tolling is increasingly used to manage congestion and fund infrastructure projects. However, concerns about equity in tolling policies persist, particularly for low-income and disadvantaged communities. This report examines the implications of tolling equity and provides some recommendations for Caltrans to enhance fairness in toll implementation.

This literature review methodology involves selecting relevant studies, analyzing their quality, and synthesizing key themes and findings to summarize the current state of research and identify gaps for further exploration.

Key Equity Considerations

- Horizontal Equity – Ensuring similar groups are treated equitably in toll pricing and benefits.
- Vertical Equity – Adjusting toll policies to account for income disparities and provide support to disadvantaged populations.
- Procedural Equity – Improving public engagement and decision-making transparency.
- Spatial Equity – Addressing how toll road placement impacts housing, economic, mobility, and gentrification.
- Environmental Equity – Reducing negative environmental effects in low-income and minority communities due to tolling-related congestion shifts.

Summary of Key Findings

- Financial Burden on Low-Income Communities: Toll roads disproportionately impact lower-income travelers, as they pay a larger share of their income on tolls. Programs offering toll discounts, transit subsidies, and revenue reinvestment in public transportation can mitigate these effects.
- Impact on Other Vulnerable Populations: Seniors and disabled individuals face unique barriers due to tolling policies, including affordability and lack of transit alternatives.
- Public Resistance to Tolling: Opposition to tolling often stems from unclear revenue reinvestment and lack of public engagement. Increased transparency and communication strategies are essential for building public trust.
- Unclear Urban vs. Rural Impacts: Urban travelers can offset tolling costs with public transit and carpooling, while rural drivers, reliant on personal vehicles for longer trips, face higher per-mile toll expenses.
- Lack of Standardized Tolling Equity Assessment: There is no specific framework for measuring tolling equity, making it difficult to compare impacts across regions and policies.
- California is exploring a per-mile "Road Charge" to replace gas taxes for hybrid and electric vehicles, as directed by Senate Bill 339 (2021).

Research Needs for Caltrans

- Conduct targeted studies analyzing how tolling impacts various demographic groups, particularly minority, low-income, elderly, and disabled travelers. For example, congestion pricing, particularly HOT lanes in California, aims to manage roadway efficiency, but more research is needed to understand its equitable impacts on different income and demographic groups.
- Partner with universities and research institutions to collect disaggregated data on toll affordability, alternative transportation options, and transitioning from a gas tax to a road charge in California.

Recommendations for Caltrans

Expand Research on Toll Burden Disparities and Road Usage Charge (RUC)

Conduct studies on how tolling affects minority, low-income, elderly, and disabled travelers, and collaborate with universities to collect data on toll affordability and alternative transportation options. In addition, future RUC research needs to focus on real-world data, equity, freight impacts, and improving public acceptance.

Develop a Standardized Framework for Tolling Equity Assessments

Establish a Tolling Equity Assessment Framework to evaluate affordability, accessibility, and revenue reinvestment and implement a Tolling Equity Performance Dashboard to monitor data and provide annual reports on equity impacts.

Implement Toll Discounts and Relief Programs

Offer income-based toll discounts (e.g., Express Lanes START program in the Bay Area) and provide targeted toll waivers for essential workers, seniors, and low-income drivers.

Enhance Revenue Reinvestment Strategies

Allocate toll revenue toward public transit improvements, fare subsidies, and infrastructure projects benefiting disadvantaged communities and develop a Public Toll Revenue Tracking Portal to enhance transparency and accountability.

Expand Public Engagement and Outreach

Form Regional Tolling Equity Advisory Committees to include low-income communities in decision-making, conduct Equity Listening Sessions focused on tolling concerns and policy adjustments, and launch multilingual public awareness campaigns to educate communities about toll policies, relief programs, and revenue reinvestment.

Enhance Policy Implementation for More Equitable Tolling

Pilot income-based tolling models in key regions and monitor the effects of transportation costs on disadvantaged populations and collaborate with regional Metropolitan Planning Organizations (MPOs) to develop tolling policies that integrate equity considerations into transportation planning.

Implementation Mechanisms and Next Steps for Caltrans

- Pilot income-based tolling models in high-impact regions and monitor the impacts of transportation costs on low-income drivers.
- Develop a standardized equity framework to evaluate the impact of tolling and RUC on different demographic groups.
- Increase transparency through a publicly accessible Toll Revenue Tracking Portal displaying revenue allocations and investments.
- Collaborate with transportation agencies to integrate tolling policies with multimodal transit improvements.
- Improve public engagement strategies by forming Community Tolling Advisory Boards and expanding multilingual outreach efforts.
- Conduct long-term studies on tolling and RUC impacts, using real-time data collection methods such as Automated Vehicle Identification and Geolocation Tracking, while ensuring privacy safeguards.
- Regularly refine tolling and RUC policies through continuous monitoring and adjustments based on data-driven insights to maximize equity.

Detailed Findings

Background

Equity in this context refers to the fairness in the distribution of costs and benefits associated with tolled facilities among various population segments, ensuring that no group is disproportionately burdened or excluded from the benefits. Given the increasing reliance on tolling to fund infrastructure and manage congestion, understanding its equity implications is crucial for policy-making and planning. The findings are organized into thematic areas to provide a structured overview on equity for tolled facilities.

Definition and Conceptualization of Equity

Equity in transportation pricing is conceptualized through multiple dimensions, each addressing different aspects of fairness:

- **Horizontal Equity:** Ensures that similar groups (e.g., drivers with similar income levels) are treated similarly in terms of toll costs and benefits ([Litman, 2025¹](#)).
- **Vertical Equity:** Focuses on treating different groups differently based on their ability to pay or specific needs, particularly emphasizing support for low-income and disadvantaged populations ([Litman, 2025¹](#)).
- **Procedural Equity:** Concerns the fairness of the decision-making process, ensuring inclusive public engagement and transparency in toll policy formulation ([Litman, 2025¹](#)).
- **Spatial Equity:** A toll road construction may displace residents and businesses, leading to gentrification and pushing low-income populations further from economic centers. Toll infrastructure can lead to increased property values around tolled corridors, benefiting wealthier populations while creating economic divides. If transit services are not adequately integrated into toll corridors, lower-income individuals who rely on buses or other shared transportation modes may face longer travel times or reduced mobility options ([Prozzi et al, 2006²](#)).
- **Environmental Equity:** Toll roads can increase vehicle emissions in surrounding neighborhoods, particularly if traffic diversion leads to increased congestion on local streets. Increased traffic volumes on tolled and adjacent roads can elevate noise levels, affecting residents' health and well-being. Diverted traffic from tolled roads often increases congestion in low-income areas, leading to higher accident rates and pedestrian hazards. Highway runoff from toll roads can carry pollutants into nearby water bodies, disproportionately affecting nearby low-income and minority communities ([Prozzi et al, 2006²](#)).

In the context of tolled facilities, vertical equity is particularly relevant, as it addresses how tolls impact groups with varying economic capacities. For instance, studies like [How Fair is Road Pricing? Evaluating Equity in Transportation Pricing and Finance](#)³ discuss the need for pricing structures that consider income disparities to ensure fairness.

Table 1 aligns different types of tolling with various types of equity. This matrix addresses how tolling practices can impact fairness across different equity dimensions.

¹ <https://www.vtpi.org/equity.pdf>

² <https://library.ctr.utexas.edu/ctr-publications/0-5208-p2.pdf>

³ <https://bipartisanpolicy.org/download/?file=/wp-content/uploads/2019/03/BPC-Pricing-EquityFIN.pdf>

Table 1: Equity dimensions in tolling

Equity Type	Description	Examples of Tolling Considerations
Horizontal Equity	Ensures that similar groups (e.g., drivers with similar income levels) are treated similarly.	Flat Tolls: Equal toll rates for all drivers regardless of income, which may result in disproportionate financial burdens on low-income individuals.
		Distance-based tolls: More equitable for longer trips, but still doesn't account for income levels.
Vertical Equity	Focuses on treating different groups differently based on their ability to pay or specific needs.	Variable Tolls (Income-based Discounts): Reduced tolls for low-income groups or subsidies to make tolls more affordable.
		Exemptions for Vulnerable Groups: Allowing low-income, disabled, or senior citizens to travel at reduced or no cost.
Procedural Equity	Concerns fairness in the decision-making process, ensuring inclusivity and transparency.	Public Consultation: Ensuring that toll policies are developed with input from diverse communities, particularly low-income and marginalized groups.
		Transparent Decision-making: Clear communication about how toll rates are determined and allocated.
Spatial Equity	Examines how tolling affects geographic locations and mobility of disadvantaged populations.	Toll Location & Design: Ensuring tolls don't displace or negatively impact low-income neighborhoods.
		Integration with Public Transit: Providing equitable access to transit options along tolled corridors to avoid pushing low-income populations further from economic hubs.
Environmental Equity	Focuses on how toll roads may impact the environment, particularly in low-income or minority areas.	Diversion Effects: Minimizing traffic diversion that increases congestion in low-income neighborhoods.
		Green Tolls or Environmental Programs: Implementing tolls that fund environmental initiatives (e.g., congestion reduction, air quality improvements).

Impact on Low-Income Groups

The literature consistently highlights that tolls can have a regressive impact on low-income groups, as the cost represents a larger proportion of their income compared to higher-income groups. Key findings include:

- **Population and Demographic Shifts:** [Equity Impacts of Toll Roads in North Texas](https://mavmatrix.uta.edu/context/planning_reports/article/1021/type/native/viewcontent)⁴ highlights significant disparities linked to toll roads, with wealthier populations clustering around toll corridors and more disadvantaged populations around non-toll roads. This outcome is flagged as

⁴ https://mavmatrix.uta.edu/context/planning_reports/article/1021/type/native/viewcontent

an equity problem because it suggests that transportation infrastructure – which should serve all residents – may be contributing to social and economic divides.

- **Financial Burden:** [Regional Toll Roads and Median Income](#)⁵ study highlights that toll roads create economic barriers for lower-income communities, worsening regional transportation inequities. According to the Federal Highway Administration's [Low-Income Equity Concerns of U.S. Road Pricing Initiatives](#)⁶, while congestion pricing raises equity concerns, well-planned implementations can provide low-income individuals with better transportation choices and improved public transit. The biggest determinant of public acceptance is how toll revenues are used, with strong support when funds are allocated toward transit improvements.
- **Travel Time:** [Regional Toll Roads and Median Income](#)⁵ explores the relationship between toll roads and income levels, concluding that while toll roads help reduce congestion, they often exclude those who cannot afford the high fees, forcing them into longer, less efficient commutes. To address these disparities, policy changes such as income-based toll discounts, expanded transit options, and toll relief programs could make toll roads more equitable.
- **Behavioral Changes:** [I-405 Express Toll Lanes](#)⁷ are being used by a mix of income groups, not just the wealthy, and they deliver significant time savings and reliability improvements that many drivers find worth the cost. Higher-income users do use the lanes more often, but lower-income users gain substantial value on the occasions they choose to use the lanes, especially during rush hour. The facility as a whole provides a net positive benefit to the region in terms of travel time saved versus tolls paid. Policy tweaks, such as adjusting toll rate minimums or maximums, show potential to slightly increase efficiency or revenue without disproportionately harming lower-income users, indicating that careful toll policy design can maintain a balance between revenue generation, travel behavior, and equitable access.

Impacts on Other Vulnerable Groups and Rural Economic

Toll roads in rural areas of the U.S. have mixed impacts. They improve accessibility but can burden low-income residents with extra costs. Socially, toll roads can reshape communities, displacing landowners and altering local dynamics. Careful planning, community involvement, and mitigation strategies are essential to balance economic growth and accessibility.

The [Update and Expansion of Financial Impacts of RUC on Urban and Rural Households Study](#)⁸ examines the financial impact of replacing fuel taxes with a Road Usage Charge (RUC) across fourteen U.S. states. The study finds that rural households would generally benefit from a RUC, with those in Rural Independent areas projected to pay less, while urban drivers, particularly in Large Urban Dense areas, would see an increase. This shift is primarily due to fuel efficiency differences—rural drivers tend to own older, less fuel-efficient vehicles, whereas urban drivers use more hybrids and electric vehicles, which contribute less under the current fuel tax system. The study also highlights the growing adoption of electric and hybrid vehicles, with electric vehicle miles traveled increasing since the 2016-2018 period, widening the revenue gap between rural and urban areas. Although payment changes under a RUC would be relatively small in dollar terms, the transition could ensure a fairer, more sustainable

⁵ <https://digitalscholarship.tsu.edu/cgi/viewcontent.cgi?article=1068&context=theses>

⁶ <https://ops.fhwa.dot.gov/congestionpricing/resources/lwincequityrpi/>

⁷ <https://www.wsdot.wa.gov/publications/fulltext/design/ConsultantSrvs/I-405ExpressTollLanes.pdf>

⁸ https://caroadcharge.com/media/vktnxgu/rucamerica_urbrur_finalreport_2022-09-16.pdf

transportation funding system by aligning revenue with actual road usage. The findings suggest that states should consider RUC policies to address the long-term decline in fuel tax revenues due to increasing vehicle electrification while maintaining fairness across geographic areas.

For seniors living on fixed incomes (like Social Security) or others on tight budgets, paying daily tolls can force painful trade-offs. [The Impacts of Tolling on Low-Income Persons in the Puget Sound Region](#)⁹ projected that if multiple highways in a region were tolled at \$2 one-way, a household at the poverty line would spend about \$772 per year on tolls (4.4% of income) versus \$1,266 for a median-income household (1.8% of income). Among those who regularly drive on tolled routes, the burden balloons – potentially \$2,600 per year, which is 15% of a low-income driver's income. In short, tolls can take a disproportionate bite out of limited incomes, making driving significantly more expensive for vulnerable groups.

[Holguín-Veras et al. \(2020\)](#)¹⁰ examines user perceptions of the fairness of Time-of-Day (TOD) pricing and toll discounts for Electronic Toll Collection (ETC) users and frequent travelers at the Port Authority of New York and New Jersey (PANYNJ) and the New Jersey Turnpike Authority (NJTA). Surveys from over 1,000 users reveal strong opposition to peak-hour toll increases but greater acceptance of variable pricing and strong support for ETC discounts. Resistance is higher among fixed-schedule commuters, lower-income groups, and women, while frequent users, younger individuals, and those with flexible work options show more acceptance. The findings highlight that perceived fairness is crucial for public acceptance of toll pricing policies, emphasizing the need for transparent communication, targeted outreach, and well-structured discounts to gain support for congestion pricing. [A study](#)¹¹ which is in progress also analyzes the 2011 household travel survey for the Greater New York area to assess toll impacts on travel patterns. It compares toll users with alternative route users, examines employment center commutes, and evaluates disparities for low-income and minority travelers. Findings will inform USDOT policy.

[Equity Impacts of Toll Roads in North Texas](#)¹² does not explicitly analyze elderly or disabled persons, but its findings suggest they may face challenges related to housing affordability, transportation access, and economic mobility due to toll roads. Higher housing values and rents in toll road areas could displace these populations, especially those on fixed incomes. Since zero-car households are more common around non-toll roads, elderly and disabled individuals who rely on public transit may be excluded from toll road areas, where development is more car-dependent. Limited access to healthcare, jobs, and essential services could further disadvantage these groups. To address these issues, policies such as affordable housing initiatives, improved public transit, and toll discounts for vulnerable populations could help ensure equitable access to transportation and housing in North Texas.

Research specifically addressing other vulnerable groups, such as minorities, the elderly, or disabled persons, in the context of tolled facilities is limited. The [Equity in the built environment: A systematic review](#)¹³ includes transportation facilities but focuses more broadly, noting inequities in access and mobility for groups like minorities and people with health concerns. However, it lacks detailed analysis on tolled facilities, suggesting a research gap. This gap indicates a need for further investigation into how toll roads affect these groups, particularly in urban and rural contexts.

⁹ <https://www.wsdot.wa.gov/research/reports/fullreports/721.1.pdf>

¹⁰ <https://www.sciencedirect.com/science/article/pii/S0965856417314465?via%3Dihub>

¹¹ <https://cait.rutgers.edu/research/the-impact-of-tolls-on-access-and-travel-patterns-of-different-socioeconomic-groups-a-study-for-the-greater-new-york-metropolit-2/>

¹² https://mavmatrix.uta.edu/context/planning_reports/article/1021/type/native/viewcontent

¹³ <https://www.sciencedirect.com/science/article/abs/pii/S0360132323008545>

Policy Measures to Address Equity Concerns

Several policy measures have been proposed and implemented to mitigate equity concerns in tolled facilities, with varying degrees of evidence on effectiveness:

- **Toll Discounts and Waivers:** Programs like Express Lanes START in the San Francisco Bay Area offer 50% off tolls for low-income drivers alone and 75% off for carpooling, aiming to reduce financial burdens ([Reducing the Toll of Tolls on Low-Income Drivers](#)¹⁴).
- **Revenue Allocation:** Using toll revenues to fund public transportation improvements, as suggested in [Low-Income Equity Concerns of U.S. Road Pricing Initiatives](#)¹⁵, can provide alternatives for low-income groups, reducing reliance on toll roads. [Toll Programs and Tolling Equity](#)¹⁶ also examines the broader social and economic implications of toll roads, highlighting how tolling policies can restrict mobility for low-income groups. The study suggests targeted discounts and revenue reinvestment in public transit to mitigate these impacts.
- **Income-Based Pricing:** Proposals for income-based pricing or credits, discussed in [Income-Based Equity Impacts of Congestion Pricing—A Primer](#)¹⁷, aim to make toll roads more accessible by adjusting costs based on income levels. [Design of Income-Equitable Toll Prices](#)¹⁸ also demonstrates that multi-tier toll pricing for high-occupancy toll (HOT) lanes can be both financially viable and socially equitable. It provides a model for transportation planners to design tolling strategies that minimize inequities while maximizing efficiency and revenue.
- **Public Transportation Enhancements:** [Weinreich \(2021\)](#)¹⁹ highlights that some toll agencies, particularly state-owned entities and transportation authorities, use toll revenue to fund public transit. For example, the Pennsylvania Turnpike Commission is required to allocate funds to transit projects and Los Angeles Metro reinvests toll revenue from express lanes into transit subsidies and infrastructure. The study suggests that integrating toll roads within multimodal transportation agencies encourages investment in public transit, making transportation systems more equitable. The Los Angeles Metro Express Lanes Program is an example where toll revenue supports public transit, including subsidies for low-income users and grants for transit projects. [Low-Income Toll Program Study for I-405 & SR 167 Toll Lanes](#)²⁰ report also highlights public transportation enhancements to improve mobility and equity. Toll revenues support transit services, bike infrastructure, and multimodal improvements. Programs like LA Metro's toll credit for frequent transit riders and King County Metro's ORCA LIFT discounted fares aid low-income commuters. The I-405 Corridor Plan includes Bus Rapid Transit (BRT), new park-and-ride spaces, and new vanpools. These initiatives aim to reduce congestion, enhance accessibility, and integrate transit with toll corridors for a more equitable transportation system.

These measures require further evaluation to assess their impact on equity outcomes, particularly in diverse urban and rural settings.

¹⁴ <https://www.spur.org/news/2023-05-16/reducing-toll-tolls-low-income-drivers>

¹⁵ <https://ops.fhwa.dot.gov/congestionpricing/resources/lwincequityrpi/>

¹⁶ https://papers.ssrn.com/sol3/papers.cfm?abstract_id=4608858

¹⁷ https://rosap.nsl.bts.gov/view/dot/760/dot_760_DS1.pdf?

¹⁸ <https://www.tandfonline.com/doi/full/10.1080/03081060.2016.1160581>

¹⁹ <https://journals.sagepub.com/doi/full/10.1177/03611981211028597>

²⁰ <https://wstc.wa.gov/wp-content/uploads/2021/08/2021-WSTC-Tolling-Equity-Report.pdf>

Methodological Approaches

Toll Pricing & Equity

These studies focus on the fairness and socio-economic impacts of tolling policies, analyzing how different income groups experience and respond to tolling systems. [Making Congestion Pricing Equitable](#)²¹ policy paper explores how congestion pricing, while effective in managing traffic and generating revenue, raises equity concerns, particularly for low-income individuals. The authors examine different notions of equity and analyze the fairness of two main pricing models: cordon/area pricing and high-occupancy toll (HOT) lanes. While congestion pricing can be regressive, its impact depends on how toll revenues are used, such as funding public transit or providing tax rebates. The paper suggests strategies to improve equity, including revenue redistribution, discounts for disadvantaged groups, and incorporating equity in planning. However, these measures must balance fairness with the effectiveness of congestion pricing in reducing traffic. The authors conclude that integrating equity concerns into policy design and ongoing monitoring is key to making congestion pricing more just and publicly acceptable. [A Review of Transport Equity Literature](#)²² also reviews the theory and empirical studies on equity in road pricing, examining its potential inequities and proposed solutions. It concludes that while equity concerns exist, they can be mitigated through well-designed mechanisms that incentivize travelers and allocate revenues effectively, such as reducing other taxes and investing in infrastructure and services.

[A Theoretical Framework for Understanding the Politics of Equity in Transportation Finance](#)²³ examines how equity considerations shape transportation finance, particularly in surface transportation policies. It distinguishes between redistributive equity (favoring disadvantaged groups) and return-to-source equity (benefits proportional to payments). Historically, U.S. policies prioritize the latter, with redistributive concerns playing a secondary role, mainly in mass transit. The principle of "Do No Harm" has led policymakers to avoid projects that disproportionately harm disadvantaged communities. Road pricing, including congestion charges and HOT lanes, faces political resistance due to equity concerns, but cases in London, Stockholm, and select U.S. cities show that public acceptance increases when revenues fund transit improvements. Ultimately, the paper argues that while equity debates influence policy, they rarely drive major transportation finance decisions. [Toll Programs and Tolling Equity](#)²⁴ concludes that while tolling can be an effective transportation strategy, it requires careful policy design to ensure equity and minimize financial burdens on vulnerable communities. The study highlights that no single approach fits all scenarios, and agencies must tailor toll programs based on local conditions and stakeholder input.

Travel Behavior & Socioeconomic Impact

These reports analyze how different populations respond to tolling policies, examining factors like income, trip frequency, and awareness of toll charges. [Leungbootnak et al, \(2025\)](#)²⁵ investigate traveler awareness of toll pricing through survey data collection and statistical analysis. In 2022, the North Central Texas Council of Governments conducted a survey to explore the social equity and travel behavior of Texas residents using toll and managed lanes in the Dallas-Fort Worth area. The survey found that most of toll road users were unaware of how much they paid in tolls. Lower toll prices and employer subsidies made drivers less likely to be toll-aware, while having a toll tag and longer travel times increased awareness. Commuters on home-based work trips were more likely to know their toll,

²¹ <https://journals.sagepub.com/doi/pdf/10.3141/2187-08>

²² <https://www.tandfonline.com/doi/abs/10.1080/01441640903189304>

²³ <https://onlinepubs.trb.org/onlinepubs/sr/sr303Altshuler.pdf>

²⁴ https://papers.ssrn.com/sol3/papers.cfm?abstract_id=4608858

²⁵ <https://journals.sagepub.com/doi/10.1177/03611981241312921>

reflecting habitual routes and the importance of route planning. [Stewart \(2023\)](#)²⁶ also indicates that lower-income drivers adjust their travel behaviors to manage toll costs. Some drivers choose to use toll roads only on specific days in order to save money, while others opt to wait in traffic on non-tolled roads rather than paying daily tolls. Additionally, certain employers cover toll fees for their workers, particularly in specific industries. However, many low-income drivers are effectively excluded from using toll roads, which are intended to improve traffic flow, due to the financial burden the tolls impose.

[I-405 Express Toll Lanes](#)²⁷ report uses toll transaction data, speed and volume data, a survey, Census demographics, and traffic data to analyze I-405 express toll lane usage and equity. Key findings indicate that higher-income households use the facility more frequently but do not necessarily gain the most per trip. Lower-income users benefit more per trip due to their peak-hour travel habits, when time savings are greatest. The [Low-Income Toll Program Study for I-405 & SR 167 Toll Lanes](#)²⁸ examines the feasibility of implementing low-income toll discounts on the I-405/SR 167 toll lanes and explores their potential benefits and impacts. While few comparable programs exist nationwide, findings suggest that such discounts could enhance transportation access for low-income drivers by allowing them to better utilize toll lanes. However, these drivers have diverse mobility needs and face multiple barriers to program access, including cultural, physical, and financial challenges.

The [Improving Our Understanding of How Highway Congestion and Pricing Affect Travel Demand](#)²⁹ examines how congestion and road pricing influence travel behavior. It finds that travelers value reliability highly, perceive congested travel time as significantly longer than free-flow time, and often exhibit a psychological aversion to tolls. Factors such as income, car occupancy, and trip purpose influence willingness to pay for faster travel. The study highlights that drivers first adjust by changing routes or departure times before considering transit or relocation. Policy recommendations emphasize the importance of congestion pricing, improving travel reliability, and using advanced modeling techniques to enhance traffic forecasting and transportation planning.

The [Financial Impacts of RUC on Super-Commuters](#)³⁰ report examines how shifting from fuel taxes to a Road Usage Charge (RUC) would impact super-commuters—those who travel 90+ minutes one way to work via car, truck, or van. These commuters make up 3.7% of California's workforce and are concentrated in San Francisco and Los Angeles metro areas, often living in Central Valley counties or outer LA suburbs due to high urban housing costs. The study found that super-commuters are diverse in income and occupation, with high-income managerial workers driving fuel-efficient vehicles, while lower-income blue-collar workers tend to drive older, less fuel-efficient cars. Under RUC, those with fuel-efficient cars would pay more, while those with gas-guzzling vehicles would pay less compared to the current gas tax system. Overall, the transition to RUC is revenue-neutral, meaning most super-commuters won't see a drastic change in payments, though effects vary by income, race, and vehicle efficiency. Super-commuters are also more likely to carpool which could help offset costs. Policymakers need to consider the equity implications of RUC, as it could disproportionately affect different groups.

Modeling & Transportation System Performance

These reports use simulation models and empirical data to study how managed lanes impact traffic flow, commuter behavior, and revenue generation. The [Consumer Response to Road Pricing](#)³¹ report utilizes

²⁶ <https://digitalscholarship.tsu.edu/theses/63/>

²⁷ <https://www.wsdot.wa.gov/publications/fulltext/design/ConsultantSrvs/I-405ExpressTollLanes.pdf>

²⁸ <https://wstc.wa.gov/wp-content/uploads/2021/08/2021-WSTC-Tolling-Equity-Report.pdf>

²⁹ <https://nap.nationalacademies.org/catalog/22689/improving-our-understanding-of-how-highway-congestion-and-pricing-affect-travel-demand>

³⁰ https://www.caroadcharge.com/media/h3hjgdse/caltransrucamerica_supercommuters_finalreport_2024-01-11_ada-a11y.pdf

³¹ <https://rosap.ntl.bts.gov/view/dot/36942>

license plate data, American Community Survey (ACS) demographic data, and GIS spatial analysis to study travel behavior changes after converting high-occupancy vehicle (HOV) lanes to HOT lanes. Key analysis methods include socioeconomic modeling, GIS-based spatial joins, and macro- and micro-modeling approaches to assess lane usage trends. Mixed logit models estimate commuter decisions based on toll sensitivity and demographics, while heat maps and directional distribution ellipses visualize changes in travel patterns. The study links observed license plate data with census tract information using ArcGIS, providing a socio-spatial framework for evaluating managed lane policies.

[DeCorla-Souza \(2003\)](#)³² also evaluates tolling options for the Capital Beltway using quick-response analysis tools, specifically a modified version of the Spreadsheet Model for Induced Travel Estimation (SMITE), called SMITE-Managed Lanes (SMITE-ML). The SMITE model estimates induced traffic resulting from improved travel speeds, accounting for new trips, diverted trips, and shifts from other modes of transport. It does this by using demand elasticity with respect to travel time, iterating changes in travel demand and congestion until an equilibrium is reached. The study compares conventional highway expansion with pricing alternatives, analyzing traffic demand, mode shifts, and toll revenue impacts. A pivot point logit model estimates how travelers switch between solo driving, carpooling, and transit. The economic feasibility is assessed through cost-benefit analysis, considering factors like delay reduction, fuel savings, and social costs. The findings suggest that pricing strategies, such as dynamically priced lanes and toll credits, can reduce congestion, enhance mobility, and generate revenue more effectively than traditional highway expansion, making them a viable solution for addressing urban transportation challenges.

The [Understanding Changes in Travel Behavior due to Managed Lanes](#)³³ report examines how managed lanes impact travel behavior, focusing on the income effect and the accuracy of traditional welfare measures like Log-Sum (LS) and Rule of Half (RoH) compared to Compensating Variation (CV). Using stated preference survey data from Maryland the study finds that income effect significantly influences travel choices, contradicting the common assumption of a fixed marginal utility of income. The findings highlight the need for better welfare assessment tools to accurately evaluate the social and economic effects of tolling policies and managed lanes.

Spatial and Environmental Impacts

[The I-5 Managed Lanes Equity Study](#)³⁴ applies the STEPS (Spatial, Temporal, Economic, Psychological, and Social) framework to assess equity beyond affordability. Spatially, it identifies low-income, transit-dependent communities with limited transportation options, emphasizing the need for express lane transit integration. Temporally, it recognizes that rigid work schedules prevent many from avoiding peak toll rates, suggesting flat-rate pricing or discounts. Economically, tolls could disproportionately burden struggling households, prompting recommendations for subsidies and transit fare assistance. Psychologically, past highway projects have created distrust, making meaningful community engagement crucial. Socially, language barriers and cultural differences necessitate multilingual outreach and partnerships. The study underscores that true equity requires addressing financial, geographic, temporal, and social barriers together. [An empirical study](#)³⁵ also analyzes the impact of the 2018 opening of the I-75 Northwest Corridor (NWC) and I-85 Express Lanes in Atlanta, GA, on corridor-level energy use and emissions. Using vehicle throughput data and a difference-in-difference analysis, researchers found a significant increase in peak-period vehicle throughput on the NWC, particularly on I-

³² <https://journals.sagepub.com/doi/abs/10.3141/1839-06>

³³ <https://mti.umd.edu/sites/mti.umd.edu/files/documents/NTC2015-SU-R-09%20Cinzia%20Cirillo.pdf>

³⁴ https://dot.ca.gov/-/media/dot-media/district-12/documents/0q950-i-5-ml/ded-circulation-materials/technical-studies/i5_ml_equity_study_finaldraft_a11y.pdf

³⁵ <https://escholarship.org/uc/item/93j728pn>

575, due to reduced congestion (speed increases of up to 20 mph). While energy use and emissions also increased, their rise was smaller than the increase in vehicle throughput. Predicted CO concentrations remained low. Increased morning peak activity likely resulted from shifts in traffic patterns, but a lack of comprehensive control data prevents conclusions on regional traffic and emissions impacts. The I-85 corridor showed a smaller impact, with slight increases in energy use and emissions at certain locations, potentially short-term as traffic patterns evolve.

Other Pricing Strategies

These reports explore alternative pricing mechanisms and challenges beyond road tolls. [A feasibility study](#)³⁶ explores the potential for transit and toll agencies to collaborate on Bus Toll Lanes (BTLs) as a new transportation financing model. BTLs are dedicated highway lanes where transit agencies hold an equity stake, allowing them to share toll revenue generated by other vehicles using the lanes. BTLs would charge all non-transit vehicles, ensuring stable revenue generation while maintaining reliable bus service. The concept aims to create a sustainable funding stream for public transit operations and infrastructure expansion. However, the study highlights regulatory and financial challenges, including the need for policy changes to classify BTLs as fixed guideway transit to qualify for federal transit funding.

[Tiamiyu et al, \(2024\)](#)³⁷ present a reinforcement learning-based toll pricing strategy for express lanes, balancing revenue, congestion mitigation, and equity. Using deep reinforcement learning algorithms, the study optimizes toll rates dynamically while considering trade-offs between maximizing revenue and minimizing total system travel time and equity gaps. Findings indicate that while revenue-maximizing tolls widen the equity gap, implementing discounts can enhance fairness but significantly reduce revenue. A moderate discount achieves a better balance between revenue and equity than a higher discount which can lead to excessive congestion. Policy recommendations include personalized tolling, public-private partnerships to subsidize equity-focused pricing, and ongoing evaluation of traffic and revenue impacts. Future work suggests integrating additional objectives like environmental impact and refining user behavior models to enhance real-world applicability.

The [Evaluating Equity Issues for Managed Lanes](#)³⁸ examines how toll pricing on managed lanes impacts drivers of different income levels, highlighting significant equity concerns. It critiques conventional evaluation methods, such as Log-sum (LS) and Rule of a Half (RoH), for failing to account for the Income Effect (IE)—the disproportionate burden toll increases place on lower-income individuals. Using real-world survey data from Maryland drivers and a discrete choice model, the study demonstrates that traditional methods overestimate or underestimate the economic impact of toll policies. The findings emphasize the need for policymakers and transportation agencies to adopt more accurate, equity-focused models when assessing toll projects, ensuring that pricing strategies do not exacerbate social inequality.

The [Equitable Dynamic Pricing of Express Lanes](#)³⁹ examines the fairness implications of dynamic toll pricing, particularly its impact on low-income travelers. Using simulation-based optimization and reinforcement learning, the study finds that higher tolls and demand exacerbate delay disparities, disproportionately affecting lower-income groups. The report recommends integrating equity

³⁶ https://digitalcommons.usf.edu/cgi/viewcontent.cgi?article=1141&context=cutr_nctr

³⁷ https://www.ncat.edu/cobe/transportation-institute/catm/catm-documents/equitablepricing2_finalreport.pdf

³⁸ <https://www.morgan.edu/Documents/ACADEMIA/CENTERS/NTC/Equity%20Issues%20for%20Managed%20Lanes%20Final%20Report.pdf>

³⁹ https://www.ncat.edu/cobe/transportation-institute/files/pdfs/equitablepricing_report_2022-09-15ada.pdf

considerations into tolling policies and exploring personalized discounts to create a more just transportation system.

The [Estimating the Benefits of Managed Lanes](#)⁴⁰ explores the value of travel time savings (VTTs) on managed lanes. Using an internet-based survey, it examines how different survey designs impact VTTs estimation and how urgent travel situations influence travelers' willingness to pay for time savings. The study finds that traditional VTTs estimation methods underestimate the benefits of managed lanes, which could lead to underfunding such infrastructure. It highlights the need for improved survey designs and dynamic pricing strategies to reflect the true economic value of managed lanes and support better transportation policies.

Political Challenges

[An UCLA policy report](#)⁴¹ explores how road pricing can help California meet its climate goals by reducing greenhouse gas emissions and vehicle miles traveled (VMT). With targets to cut VMT by 25% by 2030 and 30% by 2045, the report examines strategies like highway tolling, cordon pricing, and parking fees to manage congestion, generate revenue, and shift travel behavior. Through interviews with transportation officials and case studies, the report finds broad support for road pricing's benefits but highlights political resistance, equity concerns, and the need for clear policy direction and public transparency. It recommends pricing existing lane capacity, increasing government transparency, and investing toll revenue into public transit and low-income mobility assistance. Ultimately, the report argues that road pricing, despite its political challenges, is essential for California's sustainable transportation future. The [Equity and Congestion Pricing report](#)⁴² also discusses political challenges related to congestion pricing. It mentions that while economic theory suggests tolls should be implemented optimally across roadways, practical implementations face significant political, technological, and public acceptance barriers. These challenges prevent congestion pricing from being applied as efficiently as economic models suggest.

The [Advancing Road User Charge \(RUC\) Models in California: Understanding Social Equity and Travel Behavior](#)⁴³ explores the transition from a gas tax to a mileage-based Road User Charge (RUC) system in California, focusing on its implications for social equity and travel behavior. The study combines expert interviews and a general population survey across different regions to assess the potential burdens and behavioral changes associated with RUC. Key equity concerns include the disproportionate impacts on low-income households, rural residents who drive longer distances, unbanked individuals who may face payment barriers, and people with disabilities who rely on costly accessible vehicles. Public perception remains a significant challenge, with many residents viewing RUC as an additional tax rather than a replacement for the gas tax. Privacy concerns related to location tracking and the need for flexible payment options were also highlighted. To address these issues, the study recommends targeted public education campaigns, flexible payment methods, income-based fee adjustments, and incentives for fuel-efficient vehicle adoption. Additionally, leveraging technology to streamline mileage tracking and integrating RUC with existing financial and tax systems could improve accessibility and compliance. Ultimately, the study concludes that while RUC could provide a sustainable alternative to the gas tax, its success depends on public buy-in, equitable design, and effective enforcement mechanisms.

⁴⁰ <https://rosap.ntl.bts.gov/view/dot/17706>

⁴¹ <https://escholarship.org/uc/item/273819w7>

⁴² https://www.rand.org/pubs/technical_reports/TR680.html

⁴³ <https://escholarship.org/uc/item/1pn404q5>

Based on the [Awareness and Perceptions of a Road Charge System Among Low-Income Individuals in California](#)⁴⁴, a significant worry is that a road charge would be implemented in addition to, rather than in place of, the existing gas tax, disproportionately affecting low-income commuters. Initial reactions were largely negative, but support increased when participants received more detailed information, particularly when the concept was reframed as a "Mileage-Based User Fee" rather than a "Road Charge." Participants had mixed preferences for mileage tracking and payment methods, with some favoring automated systems and others preferring manual reporting. Many suggested alternative solutions such as increasing vehicle registration fees or adding tolls instead of implementing a road charge. The report emphasizes the need for an extensive public education campaign to address misconceptions and build support, recommending outreach through DMV mailings, social media, and public service announcements to enhance transparency and understanding of the proposed system.

The diversity in methods highlights the need for standardized approaches to ensure comparability and robustness in equity assessments across studies.

Transitioning from A Gas Tax to A Road Charge

[The history](#)⁴⁵ of gas taxes in the U.S. started in 1919 when Oregon introduced the first state gas tax, followed by California in 1923. The federal gas tax was introduced in 1934. Over the years, both state and federal gas taxes have increased, especially during times of war and to fund transportation projects, like the Federal Aid Highway Act in 1956. California frequently raised its gas tax, reaching 18 cents in 1994. In recent years, California has explored new ways to fund transportation, including a road charge program.

Caltrans is conducting [a study](#)⁴⁶ to test a per-mile "Road Charge" to replace the gas tax, as hybrid and electric vehicles pay less in fuel taxes. Participants, who were selected and have already enrolled, will track their mileage and receive credits for gas taxes paid. The study is part of Senate Bill 339 (2021) to evaluate the feasibility of a new road charge system in California.

Senate Bill 339 (Wiener, 2021) directs the Road Charge Technical Advisory Committee (TAC) to design and evaluate a road charge pilot in California. The [TAC's recommendations](#)⁴⁷ focus on six areas: rate setting, participant design, privacy and data security, organizational structure, revenue collection, and enforcement. The bill also includes evaluation criteria in organizational readiness, rates and revenue generation, distributional impacts, and privacy.

California has partnered with academic institutions and state agencies to study the [potential effects of shifting from a gas tax to a road charge \(RUC\) system](#)⁴⁸, focusing on key communities. Studies have explored various impacts, such as the [financial consequences for super-commuters](#)⁴⁹ (those with long daily commutes), [social equity implications for underserved communities](#)⁵⁰, and [the effects on both urban and rural households](#)⁵¹. Research also delves into how [a road charge could affect commercial](#)

⁴⁴ https://www.caroadcharge.com/media/1wvg0kl4/2020_fccc_research_communications_disadvantaged_communities.pdf

⁴⁵ <https://caroadcharge.com/about/history/>

⁴⁶ <https://caroadcharge.com/projects/road-charge-collection-pilot/>

⁴⁷ <https://catc.ca.gov/-/media/ctc-media/documents/ctc-committees/road-charge/sb-339-road-charge-pilot-design-recommendations-report-a11y.pdf>

⁴⁸ <https://caroadcharge.com/projects/impacts-to-key-communities/>

⁴⁹ https://www.caroadcharge.com/media/h3hjdse/caltransrucamerica_supercommuters_finalreport_2024-01-11_ada-a11y.pdf

⁵⁰ <https://escholarship.org/uc/item/1pn404q5>

⁵¹ https://caroadcharge.com/media/vktnxcgu/rucamerica_urbrur_finalreport_2022-09-16.pdf

[vehicles](#)⁵², with an emphasis on economic and distributional impacts, including potential price increases for goods and services. Additionally, [the awareness and concerns of low-income individuals regarding RUC systems](#)⁵³ have been examined, particularly focusing on transportation funding, privacy, and their perceptions of the charge. Future research could explore ways to mitigate financial impacts and create a fairer implementation of road charges. There is also limited research on how shifting from fuel taxes to RUC would affect light-, medium-, and heavy-duty commercial vehicles.

Summary of Findings

Equity Programs Across Tolling Systems

- Equity-focused pricing models improve fairness: Agencies are moving beyond traditional tolling to progressive models that consider income levels.
- Targeted subsidies and transit funding mitigate inequity: Investing toll revenues into transit services, fare discounts, and community projects helps offset burdens.
- Programs require clear outreach and enrollment: Effective outreach and enrollment help toll programs function smoothly by ensuring users are informed, enrolled, and compliant, ultimately leading to better traffic management and infrastructure funding.

Types of Pricing Strategies

- Dynamic Pricing: Tolls adjust based on congestion levels in real time (e.g., [I-4 Express lanes](#)⁵⁴ and [I-77 Express](#)⁵⁵). Dynamic pricing ensures lane reliability but may disadvantage low-income users.
- Cordon Pricing: Charges vehicles entering a defined area ([Cordon charges are rare in the U.S.](#)⁵⁶, with NYC proposals since 2007 unimplemented). Cordon-based congestion pricing in U.S. cities faces financial, political, legal, and equity challenges. Public opposition, legal hurdles, traffic spillover, and transit limitations complicate implementation. Success requires strong public engagement, transit investment, and equitable policies ([Simeone & Thornton, 2023](#)⁵⁷).
- Time-of-Day Pricing: Higher tolls during peak hours (e.g., [SR-91 Express Lanes](#)⁵⁸, CA - Charges vary). Time-of-day pricing balances peak demand but requires strong public communication.
- Flat-Rate Tolls: Fixed price regardless of congestion levels (e.g., [New Jersey Turnpike](#)⁵⁹ - One set rate applies all day).

Challenges & Solutions

- Low-income users avoid tolled routes: Provide discounts, rebates, or transit alternatives.
- Public resistance to tolls: Transparent messaging on benefits and revenue reinvestment.

⁵² <https://www.metrans.org/research/economic-analysis-and-review-of-commercial-vehicle-road-user-charges>

⁵³ https://www.caroadcharge.com/media/1wvg0kl4/2020_fccc_research_communications_disadvantaged_communities.pdf

⁵⁴ <https://www.wusf.org/transportation/2025-02-25/interstate-express-lanes-orlando-begin-dynamic-toll-pricing-based-traffic-conditions>

⁵⁵ <https://www.i77express.com/pricing/toll-rates/>

⁵⁶ https://www.law.georgetown.edu/environmental-law-review/blog/cordon-pricing-an-underutilized-emissions-mitigation-tool/#_ftnref12

⁵⁷ <https://www.tandfonline.com/doi/full/10.1080/10962247.2022.2100510>

⁵⁸ <https://ecotoll.io/news/california-express-lane-91>

⁵⁹ https://www.njta.com/media/8085/2024_toll-schedule_tpk_c1.pdf

- Unpredictable pricing confuses drivers: Use apps and signage to provide real-time estimates.

Current Practices for Equitable Tolling Policies

- Addressing Socioeconomic Disparities and Flexible Payment Options: Programs offering discounted tolls, dynamic tolling, and flexible payment options for fairer pricing ensure affordability (e.g., [VDOT Toll Relief](#)⁶⁰).
- Revenue Reinvestment for Public Benefit and Integration with Public Transit: Toll revenues fund public transit and infrastructure improvements to support equity (e.g., [395 Express Lanes' contributions](#)⁶¹).
- Spatial and Environmental Considerations: Managed lanes should address spatial and environmental impacts ([Haobing Liu et al., 2024](#)⁶²).
- Data-Driven Tolling Strategies: Advanced algorithms can be used to optimize pricing for equity (e.g., [Tiamiyu et al, 2024](#)⁶³).

Transitioning to A Road Charge

- California is exploring a per-mile "Road Charge" to replace gas taxes for hybrid and electric vehicles.
- Senate Bill 339 (2021) directs Caltrans to evaluate this system.
- Future research can address economic implications and fairness for various vehicle classes.

Gaps in Findings

Socioeconomic Disparities in Tolling Impacts

Toll roads disproportionately impact low-income travelers, who often have fewer transportation alternatives and are more sensitive to price fluctuations. While some toll relief programs exist, there is limited empirical data on their effectiveness in reducing financial burdens for lower-income commuters. Additionally, research on behavioral responses to tolling—such as whether low-income drivers shift to public transit or carpooling—remains inconclusive. Minority and low-income communities tend to have higher exposure to toll roads but receive fewer benefits from toll revenue reinvestment, exacerbating socioeconomic disparities. Road Usage Charge (RUC) pilot programs also often overlook low-income households, unbanked individuals, and those without reliable internet, limiting their understanding of RUC's impacts. A more comprehensive study is needed to assess whether current related policies are equitable and how relief programs can be optimized to support vulnerable populations.

Urban vs. Rural Tolling Disparities

The impact of tolling varies significantly between urban and rural contexts, yet most policies do not account for these differences. Urban travelers have greater access to alternative modes of transport, such as public transit and carpooling, which can help mitigate the effects of tolling. In contrast, rural drivers rely more heavily on personal vehicles and often travel longer distances, leading to higher per-mile toll costs and a greater financial burden. Additionally, the reinvestment of toll revenue is

⁶⁰ <https://www.vdot.virginia.gov/travel-traffic/commuters/toll-roads/>

⁶¹ <https://expresslanes.com/transit>

⁶² <https://escholarship.org/uc/item/93j728pn>

⁶³ https://www.ncat.edu/cobe/transportation-institute/catm/catm-documents/equitablepricing2_finalreport.pdf

inconsistent—while urban toll revenues are often directed toward transit improvements, rural toll revenues are more commonly allocated for road maintenance, providing fewer direct benefits to rural residents. However, the study on a RUC finds that rural households generally benefit, while urban drivers face increased costs. This is due to rural drivers owning older, less fuel-efficient vehicles, while urban drivers often use hybrids and electric cars. The shift could create a fairer transportation funding system, addressing declining fuel tax revenues. Future tolling and RUC strategies should consider these geographic disparities to ensure fairer cost distribution and benefit allocation.

Lack of Standardized Tolling Equity Assessments

One of the biggest challenges in tolling research is the lack of a standardized framework for evaluating equity, making it difficult to compare findings across different studies. Current research uses varying methodologies and equity metrics, with some focusing on income disparities while others assess congestion reduction or revenue allocation. Additionally, most assessments rely on aggregate census data, which does not capture individual travel behaviors or real-time toll usage disparities. The lack of transparency in how toll revenue is allocated further complicates efforts to evaluate whether tolling systems are equitable. Developing a unified set of standards for tolling equity assessments would improve comparability, enhance accountability, and provide policymakers with more reliable data for decision-making.

Unclear Long-Term Behavioral and Economic Impacts

The long-term impacts of tolling policies remain poorly understood, as most studies focus on short-term effects rather than sustained behavioral changes. There is little research on whether toll roads encourage permanent shifts in commuting patterns, such as increased public transit use, reduced car ownership, or economic mobility effects. Additionally, price elasticity—how different income groups adjust their travel behavior in response to changing toll rates—is not well-documented, limiting policymakers' ability to design fair and effective pricing strategies. The effects of dynamic pricing models, where toll rates fluctuate based on demand, are also unclear, particularly regarding affordability for low-income travelers. Most studies also focus on passenger vehicles, neglecting commercial transport. Longitudinal studies are necessary to track these trends over time and assess whether tolling policies achieve their intended equity goals.

Public Perception and Acceptance of Tolling

Public opposition to tolling policies is a major barrier to their implementation, yet research on public attitudes remains limited, particularly among low-income and rural populations. While tolling proposals frequently face resistance, there is little understanding of the specific reasons behind this opposition and how better public engagement strategies could improve acceptance. Additionally, political and institutional barriers to implementing equity-focused tolling programs are not well-documented, making it difficult to address concerns effectively. A better understanding of public perception, combined with transparent communication about toll revenue reinvestment, could help build trust and increase acceptance of tolling policies.

Next Steps

- **Expand Research on Toll Burden Disparities:** Future studies should focus on how toll roads disproportionately impact low-income and minority travelers, analyzing financial strain, access to alternatives, and relief program effectiveness. More disaggregated data will help policymakers design fairer tolling systems.
- **Develop a Standardized Framework for Tolling Equity Assessments:** A unified equity assessment framework is needed to ensure comparability across studies. Standardized metrics can measure affordability, accessibility, revenue reinvestment, and behavioral shifts, improving accountability and data-driven decision-making.
- **Increase Transparency in Toll Revenue Reinvestment:** Clear reporting on toll revenue allocation is essential to build public trust. Agencies can implement Toll Revenue Transparency Dashboards, showing investments in transit, infrastructure, and community benefits to ensure fair distribution.
- **Conduct Long-Term Behavioral Studies on Tolling Impacts:** Longitudinal studies can track how tolling affects commuting patterns, economic mobility, and vehicle ownership. Understanding sustained shifts will help refine policies that promote both equity and efficiency.
- **Improve Public Engagement and Communication Strategies:** Public resistance to tolling often stems from poor communication. Agencies can hold town halls, launch educational campaigns, and establish Community Tolling Advisory Boards to involve residents in decision-making and increase acceptance.
- **Enhance Policy Implementation for More Equitable Tolling:** Tolling policies can include income-based discounts, rural travel relief programs, and affordability-focused dynamic pricing models. Collaboration with community organizations and policymakers will ensure fairness while maintaining congestion management goals.
- **Future research on Road Usage Charge (RUC) systems:** Future research in this area can focus on refining models with real-world data, assessing impacts on diverse populations, and enhancing equity for low-income groups. It can also explore RUC effects on freight, tailor solutions for urban and rural areas, and improve public acceptance through effective communication and privacy-preserving technologies.

Implementation Mechanisms

Expand Research on Toll Burden Disparities

By institutionalizing equity-focused toll burden studies, Caltrans can ensure that future tolling policies address financial inequalities and provide targeted relief where necessary. This would require thorough data collection on how tolling affects different income groups, particularly those with limited transportation alternatives. In addition, research specifically addressing other vulnerable groups, such as minorities, the elderly, or disabled persons is limited, and Caltrans needs further investigation into how toll roads and Road Usage Charge (RUC) systems affect these groups (particularly in rural contexts).

Develop a Standardized Framework for Tolling Equity Assessments

To create a consistent method for evaluating toll equity, Caltrans can develop a statewide Tolling Equity Assessment Framework that can be applied across managed lane projects, express lane expansions, and congestion pricing initiatives. This framework can define key metrics such as affordability, accessibility, revenue reinvestment, and travel behavior shift among various income groups. The results can be reported through a Tolling Equity Performance Dashboard, allowing for greater transparency and accountability. By standardizing equity assessments, Caltrans can better evaluate the effectiveness of tolling policies and ensure that toll road impacts are fairly distributed across different communities.

Increase Transparency in Toll Revenue Reinvestment

Public skepticism about tolling often stems from a lack of transparency regarding where toll revenues are reinvested. To address this, Caltrans can provide clear revenue allocation guidelines and establish a Public Toll Revenue Tracking Portal that would allow residents to see how toll revenues are being allocated. Ensuring that revenue reinvestment is both transparent and equitable would help build public trust and strengthen support for tolling policies.

Conduct Long-Term Behavioral Studies on Tolling Impacts

While short-term tolling data is available, there is little research on how tolls affect travel behavior, mobility, and car ownership in the long run. Caltrans can launch a long-term tolling impact study, tracking how tolls influence commuting patterns, affordability, and access to transportation options across different demographic groups. Additionally, real-time data collection can be expanded using Automated Vehicle Identification and Geolocation Tracking (with privacy safeguards) to assess behavioral shifts over time. Collaborating with regional Metropolitan Planning Organizations (MPOs) and local authorities will also ensure that statewide tolling research is comprehensive and leads to evidence-based policy adjustments.

Improve Public Engagement and Communication Strategies

Caltrans can enhance community outreach and engagement efforts. For example, establishing Regional Tolling Equity Advisory Committees in toll-affected areas would ensure that low-income and underrepresented communities have a voice in tolling decisions. Additionally, launching educational campaigns to reframe express lanes as equity-driven mobility solutions—emphasizing reinvestments in transit, congestion relief, and affordability programs—could help shift public perception. Expanding Caltrans' Equity Listening Sessions to specifically address tolling concerns would further demonstrate a commitment to inclusive decision-making.