UCLA
Reports

Title

TRACtion: A Research Agenda for Just and Sustainable Transportation

Permalink

https://escholarship.org/uc/item/05z2g51r

Authors

Matute, Juan
Engelhardt, Chase
Pugh, Carolyn
et al.

Publication Date

2024-03-20

eScholarship.org Powered by the California Digital Library
University of California

UCLA Sustainable LA Grand Challenge

UCLA Institute of Transportation Studies

March 2024

TRACTION

TRANSFORMATIVE RESEARCH & COLLABORATION

A Research Agenda for Just and Sustainable Transportation

TABLE OF CONTENTS

FOREWORD 4

EXECUTIVE SUMMARY 6

TRACTION: MOVING TOWARDS AN EQUITABLE RESEARCH AGENDA 14

Plans and the Role of Research 16

Research Gaps 17

The Divide Between Transportation Research and Decision-Making 18

TRANSPORTATION AND SUSTAINABILITY IN LOS ANGELES 20

Greenhouse Gas Emissions 22

Air Pollution 24

Traffic Safety 25

Public Attitudes Towards Transportation in Los Angeles 27

Transportation Expenditures 29

Key Actors and The Decision-Making Process 30

Further Readings on Transportation in Los Angeles 31

DEVELOPING A RESEARCH AGENDA 32

Cross-Cutting Themes 36

Decision-Making Processes 37

Institutional Effectiveness 39

Access and Public Space 41

Determinants of Individual Behavior 43

Environment and Health 45

Does Existing Transportation Research Reflectthe Priorities of the TRACtion Working Groups? 46

The Sustainable LA Grand Challenge and Institute of Transportation Studies at UCLA acknowledge the Gabrielino/Tongva peoples as the traditional land caretakers of Tovaangar (the Los Angeles basin and So. Channel Islands). As a land grant institution, we pay our respects to the Honuukvetam (Ancestors), 'Ahiihirom (Elders) and 'Eyoohiinkem (our relatives/relations) past, present and emerging.

2023 TRACTION RESEARCH AGENDA 48

How Public Officials Make Decisions 49

Models and Their Design 51

Institutional Effectiveness 52

Improving Safety Through Design and Programming 54

Safety Beyond Policing 56

Fareless Public Transit 58

Aggressive Driving 60

Electric Vehicle Incentives and Policy Lock-In 61

Mitigating Emissions and Health Impacts of Electric Vehicles 62

Auto Dependency and Resilience 63

Transportation in a Changing Climate 66

IMPLICATIONS FOR POLITICS AND POLICYMAKING 68

Political Processes to Address Values Gaps 70

CONCLUSION 72

ACKNOWLEDGMENTS 74

FOREWORD

Throughout my career in transportation, as General Manager of the Los Angeles Department of Transportation (LADOT) and now as Chief Innovation Officer for Metro, I have held a firm belief: true progress requires innovative thinking, and innovation takes root when we ask fresh questions. Traditionally, transportation research has followed established trajectories, often disconnected from the realities of what moves people — literally and figuratively.

At LADOT, we began asking hard questions about women's experiences using Los Angeles' transportation system. These conversations opened new avenues of inquiry and community research. It became clear that a just and sustainable transportation network would demand more than just data. To get at the heart of the barriers, we needed to ask people in our communities directly about their lived experiences.

The ***TRACtion*** collaborative exemplifies this spirit of direct engagement. This report does not just identify academic issues — it is informed by the lived experiences of communities. It challenges us, as academics, practitioners, and changemakers alike, to rethink the fundamental ways we approach transportation research. Through the ***TRACtion*** process, new and vital research questions have emerged, shaped by the people who depend on our transportation systems.

And yes, some of these questions are inherently challenging. The ***TRACtion*** Report delves into the "values gaps" and political intricacies that can block our path. This honest confrontation is essential. The pursuit of equity and sustainability isn't simply a technical problem. It's about how we collectively prioritize issues like safety, access, and the complex realities of urban life.

As a longtime member of the UCLA Institute of Transportation Studies Advisory Board, I've witnessed the potential of rigorous research. My hope is that the ***TRACtion*** Report can become a springboard for the bold collaboration we need. Researchers, community-based organizations, government agencies — we must partner in ways that center the perspectives and needs of everyday Angelenos. This report marks a pivotal shift towards such an approach.

I encourage you to engage deeply with the research agenda outlined in this report. The work isn't easy, but it's an invitation to build a future where our transportation systems truly serve everyone.

Seleta J. Reynolds

EXECUTIVE SUMMARY

This report proposes a new research agenda for transportation sustainability. This agenda emerges from ***TRACtion***: Transformative Research and Collaboration, a new approach to community-researcher collaboration that seeks to match UCLA's academic expertise with the wisdom and perspectives of community groups and advocacy organizations. It is a partnership between the Sustainable LA Grand Challenge (SLAGC) and the UCLA Institute of Transportation Studies (ITS).

While local and global scholars produce a torrent of transportation research, progress towards an equitable, low-carbon transportation system in Southern California has been patchy at best. In some areas, substantial improvements have been made. Most notably, emissions standards for new vehicles have dramatically reduced the region's infamous smog. But in other areas — climate change, traffic safety, mobility justice — progress has been slower or nonexistent. ***TRACtion*** identifies how and where research can help address these challenges.

Researchers generally know what a researchable question is: a gap in existing research that can be closed through systematic analysis. But researchers don't necessarily know what knowledge is important to advancing a policy agenda. By contrast, advocates often understand power dynamics at play in policy decision-making and can identify the importance of knowledge gaps, such as when decision-makers disagree about the understanding of problems or solutions. Through ***TRACtion***, researchers and advocates collaboratively explore the intersection of future research and knowledge that is important for advancing a policy agenda (see Figure ES-1).

TRACtion aims to create a deeper, shared understanding of transportation sustainability and equity challenges facing Los Angeles and the opportunities to address them. The approach, which values both community and academic knowledge, can be described as "reverse research translation." Rather than simply taking ideas from academia and translating them to make the results relevant to communities and government agencies, ***TRACtion*** also seeks to identify research ideas that originate with community-based thinkers and develop them into cross-disciplinary scholarly projects. To this end, ***TRACtion*** organizers explicitly sought to include representatives from organizations that were involved in direct service delivery, political organizing, and community-based projects and programs.

TRACtion also recognizes that not every important transportation problem involves a knowledge gap or a lack of translation (in either direction). Rather, in many cases there is a gap between the different political priorities or values of different community members, staff and/or elected officials. At the same time as developing a research agenda, ***TRACtion*** therefore explores options for closing knowledge gaps that don't require new research.

Figure ES-1. An Overview of the *TRAC*tion Process

*TRAC*TION BROUGHT TOGETHER COMMUNITY BASED LEADERS AND ACADEMIC RESEARCHERS

5 WORKING GROUPS OF:

1. Phasing out Fossil Fuels
2. Access to Opportunities
3. Reimagining Transportation
4. Resilient Transportation
5. Safe and Healthy Transportation

Collaborative meetings to identify barriers to just and sustainable transportation

THE SYNTHESIS MEETING YIELDED 5 FINALIZED CROSS-CUTTING THEMES

1. DECISION-MAKING PROCESSES
2. INSTITUTIONAL EFFECTIVENESS
3. ACCESS AND PUBLIC SPACE
4. DETERMINANTS OF INDIVIDUAL BEHAVIOR
5. ENVIRONMENT AND HEALTH

The research agenda is rooted in the outputs of five working groups convened by ***TRACtion*** organizers and consisting of UCLA faculty, researchers, and community partners. The working groups were charged with identifying key issues, research gaps and barriers to a "just transition" for transportation over a series of five meetings. Five cross-cutting themes emerged from the working groups, reflecting different types of barriers to a transition to just and sustainable transportation in Los Angeles:

1) **Decision-Making Processes: how and why transportation agency staff and elected officials arrive at their decisions.**
2) **Institutional Effectiveness: institutions' capacity to implement their intended policies and programs.**
3) **Access and Public Space: the factors that drive inclusion and exclusion from public space.**
4) **Determinants of Individual Behavior: cultural and other factors that influence individual behavior.**
5) **Environment and Health: consequences of the transportation system, particularly its effects on air quality and public health.**

This report translates these themes into a research agenda based on the priorities and issues identified by the working groups. It identifies specific research questions that can be taken forward by researchers, community-focused research partnerships, or transportation agencies and elected officials, along with several core messages.

First, in many areas of policy, sufficient credible technical information already exists for agencies to make informed decisions. The most pertinent questions, then, relate to how and why these decisions are made, particularly when they perpetuate inequities and/or environmental degradation.

Second, there are still many areas where basic knowledge gaps remain. Some of these relate to engineering questions, such as cost-effective systems to inventory sidewalk quality. Others — for example, aggressive driving or contracting by public agencies — are the domain of psychology, sociology, economics and public administration.

Third, some themes that are central to many federal and state calls for research proposals, such as traffic congestion and transportation infrastructure, do not emerge as priorities from the ***TRACtion*** process. Another little-emphasized theme is technology. Throughout the working group process, participants highlighted the ways that technology can provide solutions to pressing transportation problems, but also highlighted the ways that it can create problems when pursued for the sake of novelty. Indeed, one fertile area for research relates to the potential unintended consequences of new technologies, such as the safety and emissions impacts of electric vehicles, whose greater weight amplifies the risk to pedestrians and increases particulate emissions from road and tire wear.

Fourth, much of this ***TRACtion*** research agenda is of national or international relevance. Other parts, however, are more salient in the specific context of Southern California. For example, the region's high housing costs mean that income inequality also manifests in unequal access to opportunities.

Fifth, public administration research suggests that public agencies can take a more strategic approach to more effectively address policy and implementation challenges rooted in values gaps. This report contains modest suggestions for public sector leadership to consider for using planning processes and pilot projects, framing transportation decisions, and communicating broadly about transportation change.

Sixth, the report concludes by acknowledging that much of the work of policy change is inherently political. Policymakers can navigate political and values gaps through strategic use of the planning process, coalition building, expanding the focus of transportation decision-making, and demonstrative pilots.

Finally, ***TRACtion*** is at heart a process to develop a community-driven research agenda for sustainable and equitable transportation. Many working group participants' priorities are related to issues that represent values gaps or political gaps between different groups of people. This leads us to another potential research question: How effective is transportation research in influencing policymaker decisions? Additionally, fields traditionally viewed as separate from transportation studies, like political science, social psychology and sociology, have emerged as important to organizations engaging in the work of addressing values and political gaps in transportation. Transportation researchers may have an opportunity to collaborate in more broad and unique ways that creates research centered on shifting governance, culture and behavior towards community visions of equity and their needs.

RESEARCH AGENDA ITEMS

TRACtion involved a robust community-engaged process to develop over 50 knowledge gaps affecting transportation justice and sustainability.

How Public Officials Make Decisions

1. How does transportation affect local politics? How influential are transportation controversies on the outcomes of local elections? What motivates elected officials to make difficult transportation decisions? Many transportation decisions are non-partisan; how does this shape policy choices?
2. Who benefits from the status quo of transportation, either politically or economically? How do these groups or individuals influence public opinion and decision-makers?
3. Who is not served well by the existing system? Do these groups have knowledge that they're not well off? How can these groups influence transportation outcomes?
4. How can transportation agencies incorporate lived experiences and a people/services-focused perspective in their decision-making processes?

Models and Their Design

5. While the burgeoning literature is showing that incorporating equity into activity-based models is a critical tool for inserting it into the transportation planning process, more research is needed to understand if reported transportation benefits truly produce desired societal outcomes for equity communities.
6. Qualitative research would illuminate the context of models and better understand individual decision-making, barriers, opportunities, potential benefits and societal outcomes from a perspective centered on community and equity.
7. It is unclear whether prior data collection is representative of low-income communities of color. It is also unclear whether those communities have the power to self-determine or define benefits or the desirability of outcomes. As a way to address this, Participatory Action Research (PAR) could be used in conjunction with activity-based models. PAR is a process between collaborators who agree to work together on solving a jointly identified problem. Including qualitative PAR in activity-based modeling has the potential to transform traditional planning organizations and their practices in a way that could disrupt planning's racist history and change planning institutes from within, rather than replicating the white supremacist structures already in place.

Institutional Effectiveness

8. When should agencies contract and when should they develop skills and capacity internally?
9. How do contracting decisions impact how well projects meet an agency's goals, particularly any equity commitments?
10. How does contracting for community engagement affect agencies' relationships with the communities they serve?
11. To what extent do staff versus governing board members guide transit policy agenda?
12. Does contracting for infrastructure project delivery have greater long-term costs than building internal project management skills?
13. How do previous contracting relationships drive future decisions (e.g., with fare collecting services or policing contracts)?
14. To what extent does fear of political backlash influence administrative decision-making?

15. To what extent is planning used as a placeholder for action — agency staff deferring a decision through undertaking further study?
16. How do local political conditions affect agency structure and decision-making?
17. To what extent do decision-makers respond to new challenges or public concerns with additional regulations or internal requirements, even when their goals might be better achieved by streamlining existing regulation or practices?
18. What are the most effective approaches to comprehensive revisions of laws, policies and procedures, such as zoning codes, street design manuals or agency contracting requirements?

Improving Safety Through Design and Programming

19. How effective are bystander intervention campaigns in influencing safety on public transportation?
20. How does infrastructure that increases thermal comfort impact safety?
21. How effective are strategies that combine design, first/last mile permeability and social programs to promote safety?
22. What is the impact of busking, street vending and similar community-facing activity on safety near transit?
23. Is there safety in numbers? For example, how does transit ridership correlate with perceived safety and reports of crime and anti-social behavior?
24. Could design and/or programming that incorporates the perspectives of LGBTQ identities increase the presence of users from these groups? If so, what would be the impact on safety? More generally, how does incorporating more diverse stakeholders' perspectives into design and programming impact perceptions of safety?

Safety Beyond Policing

25. Since 2020, cities such as Berkeley and Los Angeles have removed police from traffic enforcement or hired consultants to research the issue. What has been the effectiveness of these initiatives on both traffic safety and racial justice?
26. Vision Zero is a European-created traffic safety framework that has been increasingly embraced by cities in the United States. One of the key components of Vision Zero is "enforcement." After the 2020 racial reckoning, have cities changed their approaches to Vision Zero? If so, how?
27. Can legal and urban planning scholars work together to center a critical race theory in transportation scholarship? Currently, legal scholarship focuses on civil rights issues or public accommodations, while urban planning literature covers design-oriented topics.
28. Is community-engaged research that documents traffic safety agencies' investments, evaluates their efficacy in reducing traffic fatalities, and develops community-led alternatives more effective in creating safety outcomes than traditional approaches?

Fareless Public Transit

29. How will fareless transit affect service quality? Each rider can board faster if they can use all of a bus's doors and don't have to pay a fare, but large ridership increases can slow down transit and increase crowding.
30. Historically, what has been the net fiscal impact on transit agencies, and how have agencies paid for fareless transit initiatives? Is there a tradeoff with service? What different models could be used to fund and implement fareless transit? What are the costs of administering fare collection?
31. How will fareless transit affect perceptions of safety and the number of safety incidents on transit? How does fareless transit affect disruptive or anti-social behaviors on buses and trains? Does fareless transit reduce other conflicts, such as fare disputes, or increase safety by increasing the presence of other riders at transit stops?

32. What are the broader, long-term implications of fareless transit? For example, does it affect people's long-run decisions about where to live, how many cars to own, or what jobs to take? Are there health and educational benefits to people making trips they could not or would not have otherwise made, or would have made by car?

33. How will fareless transit affect people's long-term perceptions of transit, and how does this affect their willingness to use transit?

34. How do riders and the broader public think about the ways fareless transit initiatives relate to racial justice within the transportation system?

Aggressive Driving

35. Local, state and national governments often implement awareness campaigns to reduce aggressive driving. Do these campaigns draw on the evidence base from psychology and public health through, for example, targeting messages to young men or other key audiences? Why or why not? If so, to what extent? How effective are these campaigns?

36. Cities have targeted specific behaviors, like speeding, with road design. How might road design influence aggressive driving overall? Are there road designs that reduce other aggressive driving behaviors (e.g., cutting people off), in the same way that road diets reduce speeding?

37. How effective is automated enforcement of aggressive driving? Would public opinion support this practice? What methods of automated enforcement exist (e.g., speed cameras), and how effective are they?

38. How effective might a campaign addressing the intersection of toxic masculinity and aggressive driving be? What messages might have the greatest impact on aggressive driving in young men? Have any local governments attempted to address this issue?

Electric Vehicle Incentives and Policy Lock-In

39. What is the relationship between government spending on EV incentives and infrastructure and spending on public transportation? How many greenhouse gas reduction pledges, laws and funds dedicated more money to private vehicle electrification instead of transit? Is there a relationship between spending on incentives for EVs and spending on public transportation or infrastructure for bicycles and pedestrians?

40. What is the potential for policy lock-in? Is EV-friendly infrastructure design in conflict with infrastructure that incentivizes biking and using public transit?

Mitigating Emissions and Health Impacts of Electric Vehicles

41. How does EV design, including size, weight and noise level, influence the risk of injury or death for pedestrians and cyclists?

42. What are the technological barriers to the electrification of heavy duty trucks, and how do potential unintended consequences from brake, tire and road wear compare to potential benefits?

43. What are the health and equity effects of non-exhaust emissions from EVs? What policy solutions are effective in mitigating those effects?

44. EV production creates environmental and social impacts globally, particularly from mining. What are the socio-economic impacts of metal extraction and use, particularly in lithium-rich areas? How should decision-makers factor in those impacts when making decisions around EV incentives and policy?

Auto Dependency and Resilience

45. How can government agencies meet the emergency transportation requirements of groups with specific needs (e.g., people with visual or hearing impairments, people with limited mobility, those with certain medical conditions, seniors, people without cars, residents of rural areas, monolingual or Limited English Proficiency speakers)?
46. How should cities prepare to rebuild or re-envision major pieces of transportation infrastructure in the wake of a disaster?
47. How can transitioning from car-centric systems to multi-modal transportation systems improve resilience, especially among vulnerable populations or those without access to cars? For example, are cooling centers better utilized in areas accessible by transit?
48. How can transportation design and planning support human and social connectivity, and what impact could that have on the transportation system's resilience?

Transportation in a Changing Climate

49. To what extent do resilience and adaptation plans promote transit, walking and cycling, both today and in a hotter, wetter and more volatile future climate? This could include assessing the extent to which plans focus on the need to decommission or reroute infrastructure due to flooding and sea level rise, and the implications of the resulting shifts in transportation dynamics.
50. How does climate change affect bike and pedestrian mobility, and how can cities adapt? How can shade, cool pavements, and other design strategies be employed to best reduce climate impacts?
51. How are climate adaptation resources and amenities, such as shade structures, distributed throughout cities, and what are the equity implications? Will climate adaptation reinforce racial and income-based disparities?

*TRA*CTION:

MOVING TOWARDS AN EQUITABLE RESEARCH AGENDA

A vast volume of new research on transportation and sustainability is published each year. In January 2024, more than 5,000 presentations were made at the largest conference in the field, the Transportation Research Board Annual Meeting. The journal Transportation Research was established in 1967, with 24 articles published in its first year. Since then, that journal has divided itself into six separate journals, from Part A (policy and practice) to Part F (traffic psychology and behavior). In the transportation field as a whole, 104 journals are counted by the Institute of Transportation Studies library at UC Berkeley.

Research has undergirded many of the important advances in transportation sustainability in Los Angeles. At the California Institute of Technology, experiments by chemistry professor Arie Jan Haagen Smit[1] were instrumental in attributing the region's pervasive smog to tailpipe emissions from motor vehicles. More recently, decades of research by UCLA professor Donald Shoup[2] helped bring about state legislation to eliminate minimum parking requirements — which impede housing affordability and encourage car ownership and travel — for new construction near public transit.

In some cases, transportation research might provide practical guidance that informs the policies that elected officials and community-based organizations and advocates are exploring and championing. For example, how does street design affect extreme heat? How do protected bike lanes get more people safely riding their bikes? Such research is often funded by state and federal agencies, and in some cases, by regional and local organizations too.

But transportation research can also change the discourse and the sense of possibility, pushing decision-makers out of their political and institutional comfort zones. This type of reimagining may not be a high research funding priority for transportation agencies or city staff. But it may speak more directly to the issues faced by those — disproportionately low-income people and people of color — who bear the brunt of air pollution, dangerous streets, and slow or infrequent transit service.

TRACtion is a new approach to community-researcher collaboration that seeks to match the university's academic expertise with the wisdom and perspectives of community groups and advocacy organizations.

TRACtion is a new approach to community-researcher collaboration that seeks to match the university's academic expertise with the wisdom and perspectives of community groups and advocacy organizations. Both SLAGC and ITS recognized a common goal of understanding transportation sustainability and equity challenges facing Los Angeles, along with the opportunities to address them, and designed ***TRACtion*** to connect university researchers and faculty with community partners.

SLAGC AND UCLA ITS' GOALS WITH *TRACTION* ARE TO:

1. **Encourage cross-sector knowledge transmission;**
2. **Co-develop use-inspired research agendas;**
3. **Mobilize UCLA knowledge and innovations to accelerate impact in the region;**
4. **Illuminate the scale and complexity of transportation challenges and the multidisciplinary nature of their solutions; and**
5. **Create an overarching research agenda or framework to illustrate how individual research projects can make an incremental contribution toward closing critical transportation sustainability and equity knowledge gaps.**

Plans and the Role of Research

Government agencies at all levels have no shortage of aspirations for transportation, reflected in over 450 statewide, regional and local goals, strategies, objectives and transportation targets. These range from grand visions ("Advance equity through institutional transformation to eliminate disparities," put forth in Los Angeles Metro's 2020 Long Range Transportation Plan[3]) to small-scale but concrete steps ("Inspect and repair 200 crosswalks on the High-Injury Network," a milestone in the city of Los Angeles' 2019 Green New Deal sustainability plan[4]).

To back up their plans, governments have great capacity to affect transportation because they plan, fund, build, operate and regulate public streets, transit systems and often parking. However, much of this capacity for change is unrealized or underutilized due to competing priorities or disagreement about the overall vision.

Academic researchers have a critical role in shaping these visions and their implementation. Most obviously, government agencies turn to research to inform technical questions on modeling, technologies, and policy effectiveness. But researchers can have a much deeper role through helping to set policy agendas, framing issues, and revealing the structural constraints to sustainable transportation systems.

Research Gaps

Before embarking on a new research program, a foundational question to begin with is, "What are the gaps in our understanding of the field?" Researchers, policymakers, and community groups are likely to have different views as to what constitutes a "gap" in transportation research. And the nature of the gap should inform the appropriate ways to bridge it — in some cases, starting a major research study, but in other cases, a simple telephone call or a targeted briefing for policymakers. The ***TRACtion*** team developed the following categories to facilitate discussion and acknowledge the variation in approaches to addressing different types of gaps.

KNOWLEDGE GAPS

Knowledge gaps in policymaking occur when decision-makers lack relevant knowledge that would inform their decisions. Of course, not every policy issue results from a knowledge gap, and not all knowledge gaps require new research to address — there may be an existing body of evidence with which policymakers are unfamiliar. Some knowledge gaps can be closed with a productive conversation between decision-makers and university-based experts. The challenge is then relational and logistical: connecting the right people at the right time.

Other knowledge gaps can be closed with limited new work, such as an issue brief that synthesizes existing literature or the translation of prior research to a current context. However, some policy challenges include epistemological uncertainty that requires new research to address.

POLITICAL AND VALUES GAPS

Many gaps in policy development and implementation don't result from knowledge gaps. Addressing such gaps with new academic research without acknowledging the political and social dimensions often leads to frustration for both academics and knowledge users. Values gaps occur when people lack consensus over the government's adopted goals and objectives. Political gaps occur when decision-makers agree on values but think the economic or political costs of a course of action are too high. In many instances, research based in political science, sociology, psychology and other fields can illuminate these gaps and a path forward.

Advocacy groups and community-based organizations are on the front lines of addressing political and values gaps. Academics can also play a role in addressing gaps that don't arise from knowledge deficits by supporting advocates and policymakers with helpful research, taking public positions through op-eds or media engagements and teaching content related to contentious issues.

Knowledge gaps in policymaking occur when decision-makers lack relevant knowledge that would inform their decisions.

Often, transportation researchers ask questions and produce knowledge without understanding how to use this research to influence policy decision-making.

The Divide Between Transportation Research and Decision-Making

Scholars have noted a divide between research and practice. A study[5] by Marsden and Reardon demonstrates that transportation researchers assume an overly-simplistic model of policymaking called the "technical-rational" model, in which there is a direct line between research and policymaking. The technical-rational model assumes that "solutions are created in response to a particular policy problem and that the best technical solution will be the one that is taken up in policy."

However, Marsden and Reardon assert that the practice of transportation planning is far more complex, and often more fraught than questions of engineering.[5] In the garbage can model of organizational decision-making, problems, solutions and decision-makers accumulate over time and are in flux until a choice opportunity — such as a compounding problem or a new balance of power — allows leaders to pick or modify a pre-existing solution to apply to a problem.[6] John Kingdon developed a model for public policy decision-making that is further strained by the realities of governance: ambiguous goals, shifting attention and priorities, limited time and information and non-linear decision-making.[7]

Researchers know a researchable question is one that can be addressed via accessible methods and data, and hasn't yet been addressed in the research literature. Community advocates understand political power, but not necessarily research literature or what is researchable. Often, transportation researchers ask questions and produce knowledge without understanding how to use this research to influence policy decision-making. This means that the field is "missing many critical advances in the understanding of policy which have been made elsewhere in political science."[5] In addition to lacking a connection to the political realm, this research is often disconnected to communities' experiences on the ground. Researchers might have greater impact through a co-production model in which "politics shapes knowledge" and "scientific and expert knowledge contribute[s] to the construction of political reality."[8]

TRACtion's Approach Versus Traditional Transportation and Sustainability Research Agendas

Transportation connects people, and impactful transportation research requires the same: transdisciplinary connections between academics and community members outside of the academy. Connections between academics, policymakers and community members create a foundation for impactful, relevant research, providing multiple actors with knowledge that can create choice opportunities and lead to research-informed solutions. Bringing researchers and community members together to co-create a research agenda aims to very intentionally build this connection.

Because it is so essential to people's daily lives, transportation research touches on nearly every academic field: psychology and neuroscience, sociology and anthropology, law and policy, economics and business, public health and clinical medicine, civil engineering, and urban planning. The subject of transportation provides an opportunity to develop a community-informed, transformative interdisciplinary research agenda. Such an agenda will give academics, communities and government the tools to act on transformative change toward sustainable transportation.

Photo Credit: Midjourney

TRANSPORTATION AND SUSTAINABILITY IN LOS ANGELES

Transportation connects people with opportunities. Whether the opportunity is a job, spending time with loved ones, shopping, going to school, going out, seeing a doctor, or pursuing another activity, transportation is the key to facilitating the connection.

Though transportation provides many economic and social benefits, our current systems also create adverse effects, ranging from the inconvenience of competing with other drivers for road space or parking, to deaths, injuries and illness from traffic collisions and air pollution. Motor vehicle crashes are the fourth leading cause of premature death in Los Angeles,[9] and petroleum refineries in Los Angeles are the top emitters of hazardous gasses, including ammonia and hydrogen cyanide.[10] Transportation is also responsible for roughly 40% of greenhouse gas emissions in Los Angeles[11] and in California as a whole.[12]

The transportation system is intertwined with and reinforces racial and socioeconomic inequities. People of color are more likely to live near high-volume roadways and fossil fuel infrastructure,[13] [14] and experience negative health impacts as a result.[15] [16] In Los Angeles County, low-income people, Black people, recent immigrants, and older adults are all less likely to have access to a car, which in turn limits their access to opportunities.[17] For example, in Los Angeles, driving gives people access to nearly 70% more jobs within a 30-minute commute compared to riding transit.[18] Challenges to housing affordability and security in Los Angeles and Southern California further exacerbate disparity in access to opportunities.

The problems of income inequality and environmental injustices, combined with a political will to take significant action on environmental sustainability and climate change have made California and Greater Los Angeles a national model for advancing justice through sustainability policy.[19]

GREENHOUSE GAS EMISSIONS

Transportation is one of the largest contributors of greenhouse gas emissions in both Los Angeles County and in California as a whole. In both places, passenger cars and trucks account for nearly 40%of emissions (Figures 1 and 2).[11][12] In Los Angeles County, energy industries, including petroleum refining (included within the Stationary Energy sector in Figure 1), account for around 12% of emissions.[11]

Figure 1. 2018 Greenhouse Gas Emissions for Los Angeles County by Sector[11]

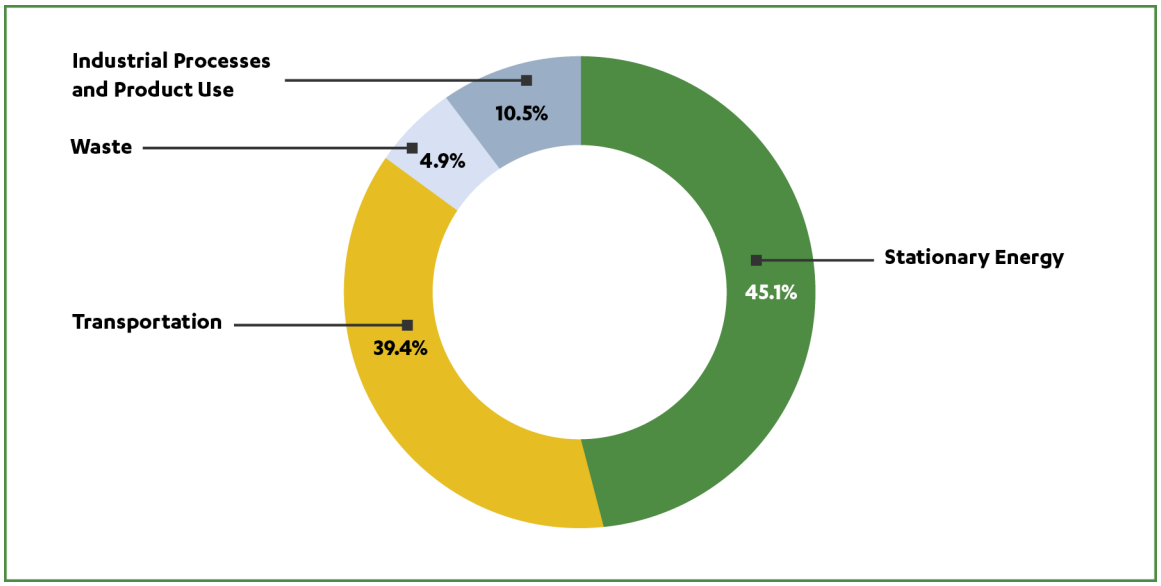
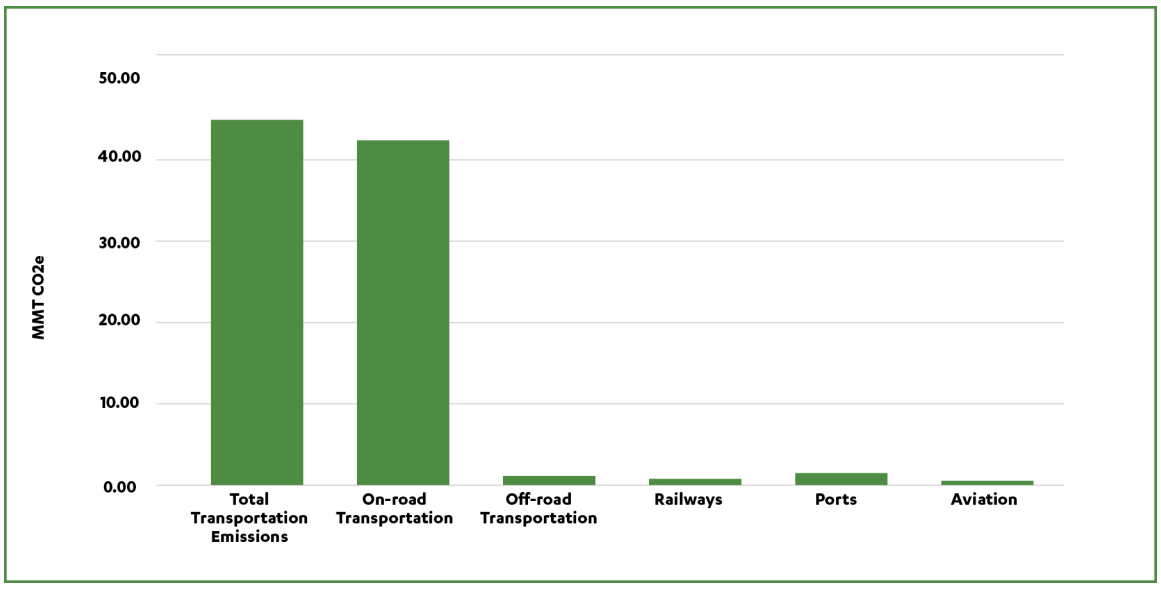


Figure 2. 2018 Greenhouse Gas Emissions for Los Angeles County by Transportation Subsector (Million Metric Tons CO2e)[11]



Local governments in Los Angeles aim for sizable reductions in emissions. The County Climate Action Plan set a goal of carbon neutrality by 2045.[20]

In the city of Los Angeles, the Green New Deal set a series of non-binding targets working towards the end goal of achieving a zero carbon grid, zero carbon transportation, zero carbon buildings, zero waste and zero wasted water by 2050.[4] Since then, the City Council has voted to transition to 100% clean energy by 2035, advancing the timeline by 10 years compared to the L.A. Green New Deal.[21]

So far, however, transportation remains far from the zero-carbon vision, and emission reductions have been modest compared to other sectors (Figure 3). Carbon emissions from the city's electricity generation decreased 46% from 2014 to 2021.[22] Transportation emissions only fell by 7% from 2014 to 2019, although the covid pandemic caused a sharp decrease in 2020 (Figure 4).[22]

Figure 3. City of Los Angeles Emissions by Sector, 2014–2021 (Million Metric Tons CO2e)[22]

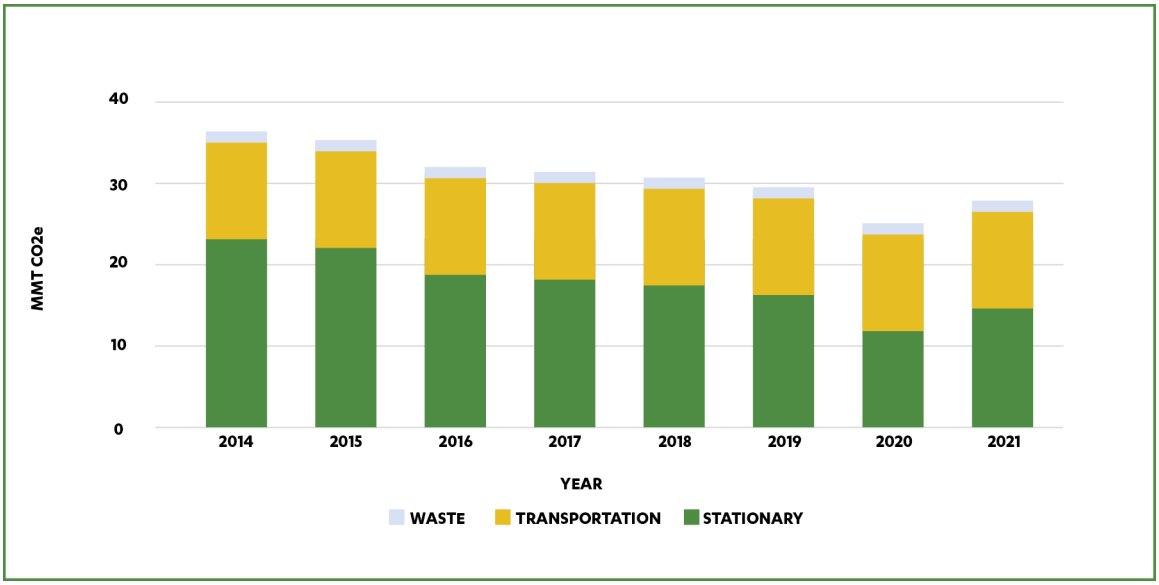
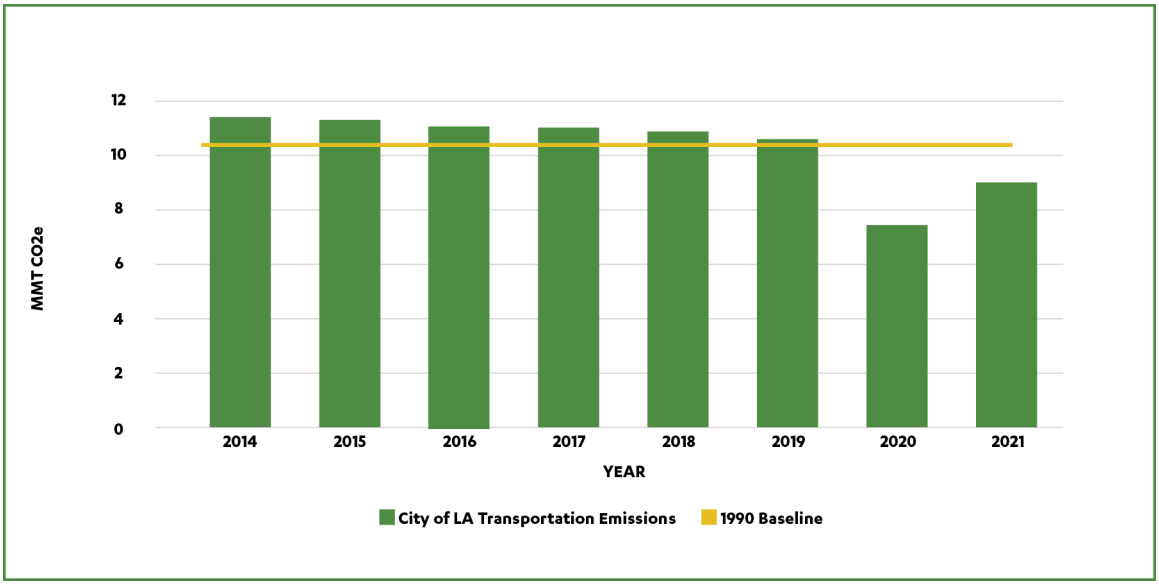


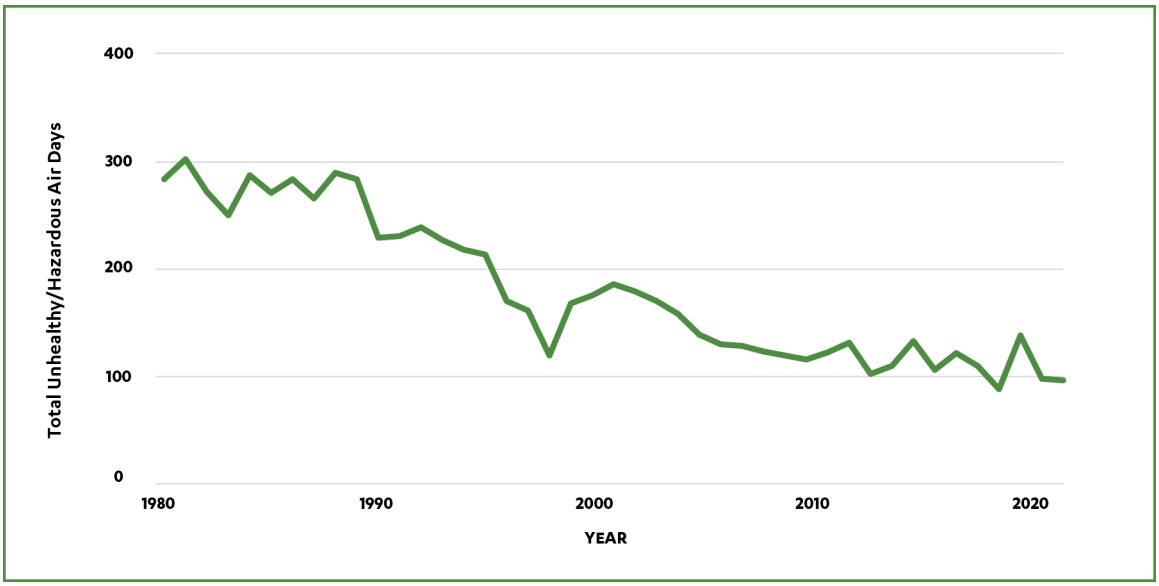
Figure 4. City of Los Angeles Transportation Emissions, 2014–2021 (Million Metric Tons CO2e)[22]



AIR POLLUTION

Los Angeles is infamous for its smog (ground-level ozone) and poor air quality, thanks to a combination of its topography and high levels of vehicle emissions. The region's air quality has improved greatly since the implementation of the Clean Air Act (Figure 5) but it is still some of the worst in the country.[23] Los Angeles fails to meet federal and state standards for several air pollutants, including ozone and PM2.5 (particulate matter smaller than 2.5 micrometers).[24] Climate change will make air quality worse. Hot sunny days tend to produce more ozone, and wildfires are a major source of particulate matter.

Figure 5. Total Unhealthy/Hazardous Air Quality Index Days in Los Angeles[25]



Transportation, especially trucking and shipping, is the primary source of air pollution in Southern California, given its extensive goods movement and supply chain networks and ports.[24] The importance of reducing trucking and shipping emissions has grown as power generation, factories and passenger cars have become cleaner. Communities near the ports of Los Angeles and Long Beach are particularly impacted by pollution caused by trucks and diesel locomotives, as well as ships. Rerouting trucks, transitioning freight trucking to electric vehicles, and strengthening the enforcement of polluting facilities are key to addressing harm from diesel emissions.[26]

Air pollution is a public health issue. Air pollutants such as nitrogen oxides and PM2.5 increase the risks of cardiovascular disease, asthma, preterm birth, dementia and cancer.[27 28 29] Air pollution is also a racial justice issue. People of color, particularly Black and Latino communities, are disproportionately exposed to air pollution, and are more likely to live near highways, freight corridors, rail yards and ports,[13 30 31 32 33] due in part to a legacy of redlining and other racially discriminatory housing and land use policies.[30] The racial disparities in Los Angeles are among the highest in the country, with low-income neighborhoods of color experiencing over 40% more exposure to nitrogen dioxide compared to high-income predominantly white neighborhoods.[34]

TRAFFIC SAFETY

Motor vehicle crashes are a major cause of death and injury nationwide, and the fourth leading cause of death in Los Angeles County.[35] While both the city and the county have Vision Zero goals to eliminate traffic fatalities by 2025[36] and 2035[37] respectively, fatal crashes increased by nearly 50% in the city between 2015 and 2022, and remain high in the county (Figure 6).[38] The reasons for this spike in fatalities are still unclear.

Pedestrians and cyclists are particularly vulnerable in collisions, and as of 2015, Los Angeles ranked second in the nation for the number of pedestrians killed by motor vehicles.[39] California's pedestrian fatality rate (pedestrian deaths per 100,000 people) is roughly 25% higher than the national average.[40] Traffic mortalities are also a leading cause of death for young people in Los Angeles County.[41]

People of color are disproportionately killed and injured in vehicle crashes. In the U.S., Black people have the highest fatality rates per mile traveled, followed by Latinos.[42] Black cyclists are disproportionately harmed by collisions; the national fatality rate per mile traveled for Black cyclists is estimated to be over four times the rate for white cyclists.[42] These disparities hold true in L.A. as well; Black and Latino victims are overrepresented among walking and bicycling victims, with one in four fatalities being a Black or Latino pedestrian.[43] Populations experiencing homelessness are also disproportionately affected by traffic injury deaths.[44]

Figure 6. Number of Vehicle Crashes with Fatalities/Serious Injuries in the City and County of Los Angeles, 2013–2022[38]

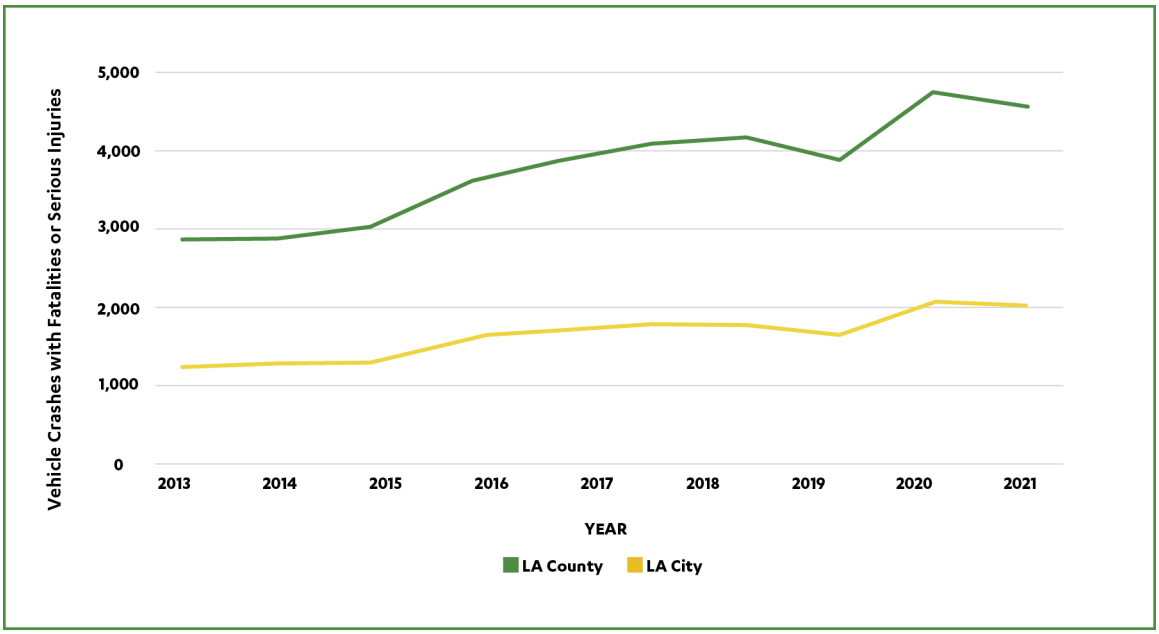


Figure 7. Pedestrian and Cyclist Fatalities and Injuries in Los Angeles County, 2013–2022[38]

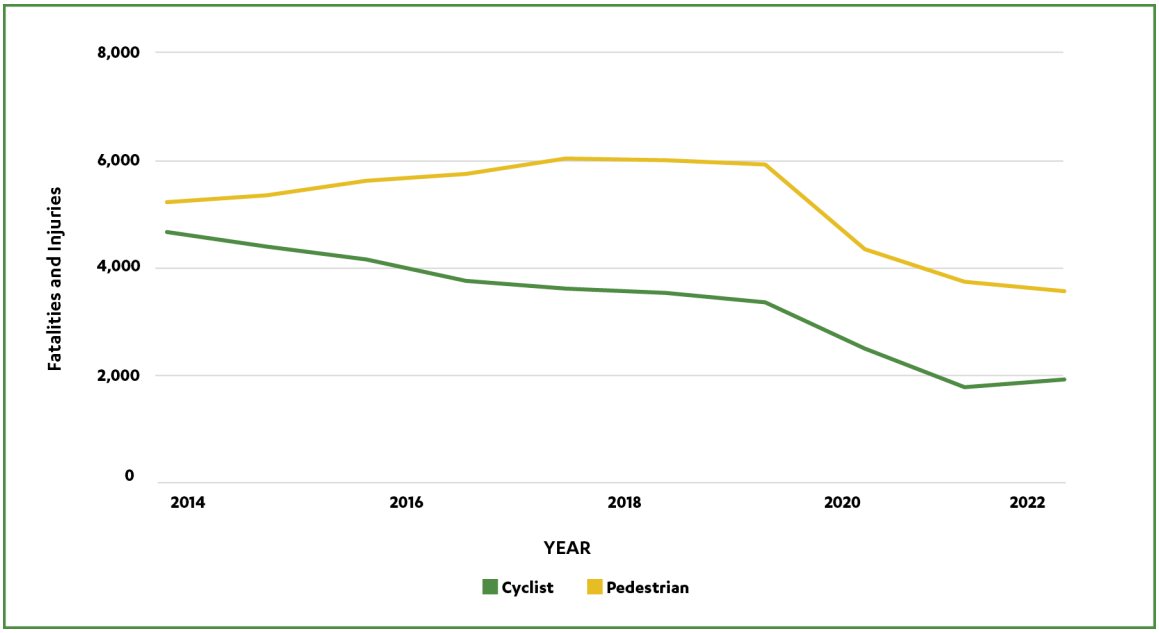


Photo Credit: iStock

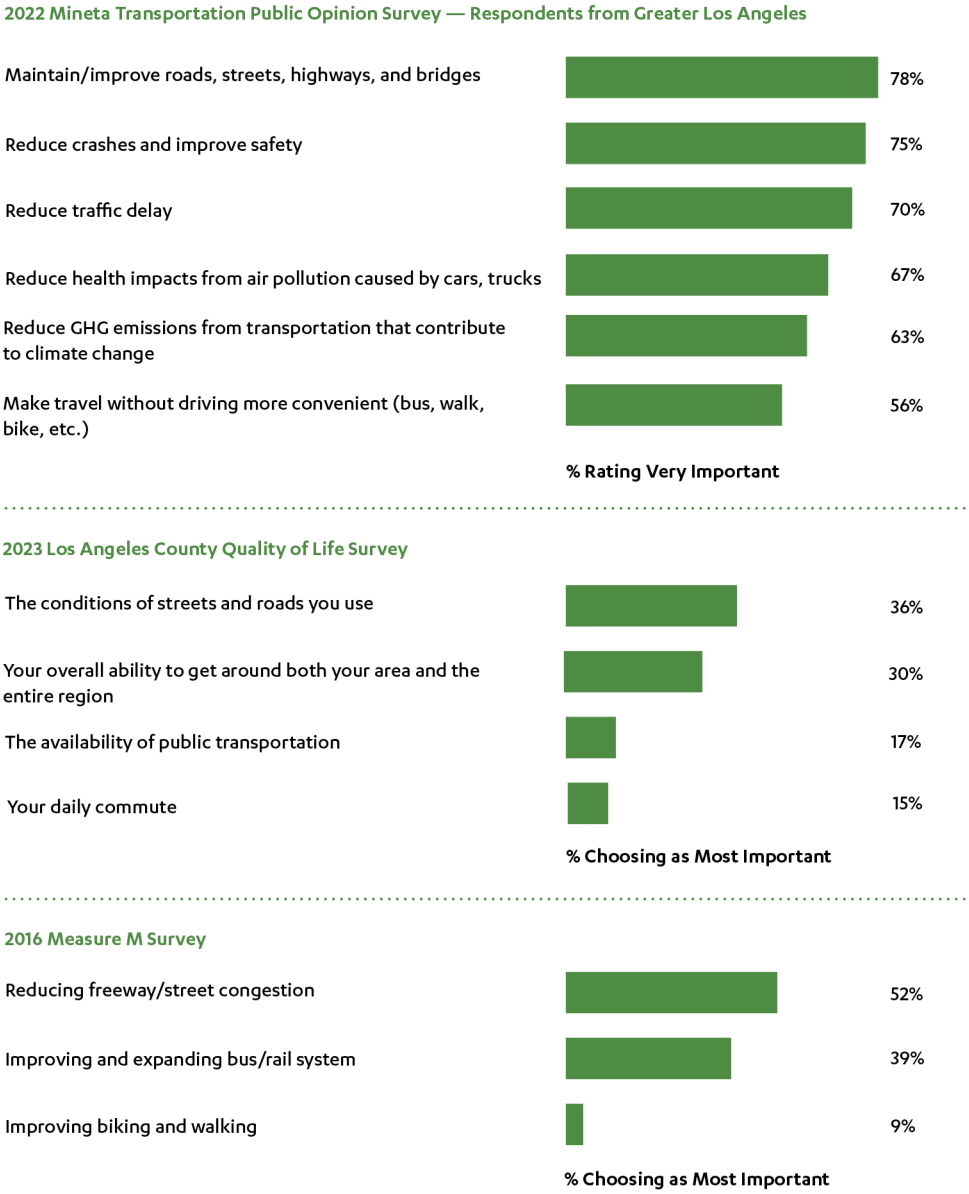
PUBLIC ATTITUDES TOWARDS TRANSPORTATION IN LOS ANGELES

Residents of Los Angeles County recognize that the current transportation system isn't meeting their needs. The 2023 Los Angeles County Quality of Life Survey found that transportation is among the lowest rated categories of residents' quality of life.[45] Additionally, a 2016 survey of Los Angeles County adults found that transportation was the second most commonly cited response to an open-ended question about the biggest issues facing the county, behind only concerns about housing.[46]

Recent surveys have consistently found that people in the Los Angeles region rate congestion and the condition of streets and roads as being the most important aspects of the transportation system to improve (Figure 8).[45] [46] [47] While improving driving conditions is a clear public priority, past interventions like freeway widening have not delivered their intended benefits, in part due to the "induced demand" phenomenon in which increased road capacity attracts new drivers through temporarily faster speeds, eventually nullifying any temporary improvements in congestion.[47]

The Los Angeles public supports promoting alternatives to driving, in some cases stating support for actions that would require money or space to be reallocated away from private vehicles. A fall 2013 survey of registered voters in Los Angeles County found that 85% of respondents rated sidewalks, paths or walking routes as very important, 74% rated local bus or rail transportation as very important, and 60% rated bike lanes or paths as very important. The same survey found that respondents would generally support redirecting current transportation spending towards specific projects designed to improve active transportation, and that support was even higher among Black and Latino respondents.[48] Additionally, a 2018 survey of residents of unincorporated areas of Los Angeles County who live in communities with high rates of traffic collisions found that 92% of respondents supported implementing projects to improve traffic safety in their communities, and that 87% of respondents stated they were even willing to increase their commute time to reduce crashes, injuries and deaths.[49] Beyond public opinion polling, the success of ballot measures such as Measure M, which raise sales taxes in Los Angeles County to finance public transit improvements, have demonstrated high support for increasing funding for sustainable transportation alternatives to driving.[46] However, opposition to reallocating street space from cars is strong in some Los Angeles County communities, with Culver City voting to remove some elements of a project that prioritized safety and efficiency for people on bikes and transit over those in cars.[50]

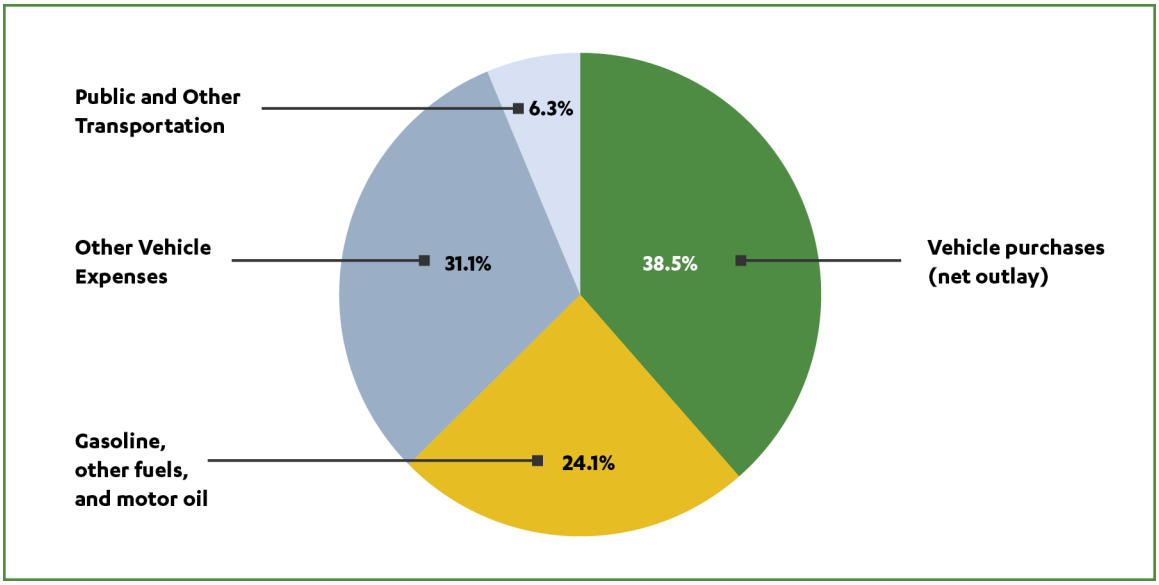
Figure 8. How the Los Angeles Public Prioritizes Transportation Issues



TRANSPORTATION EXPENDITURES

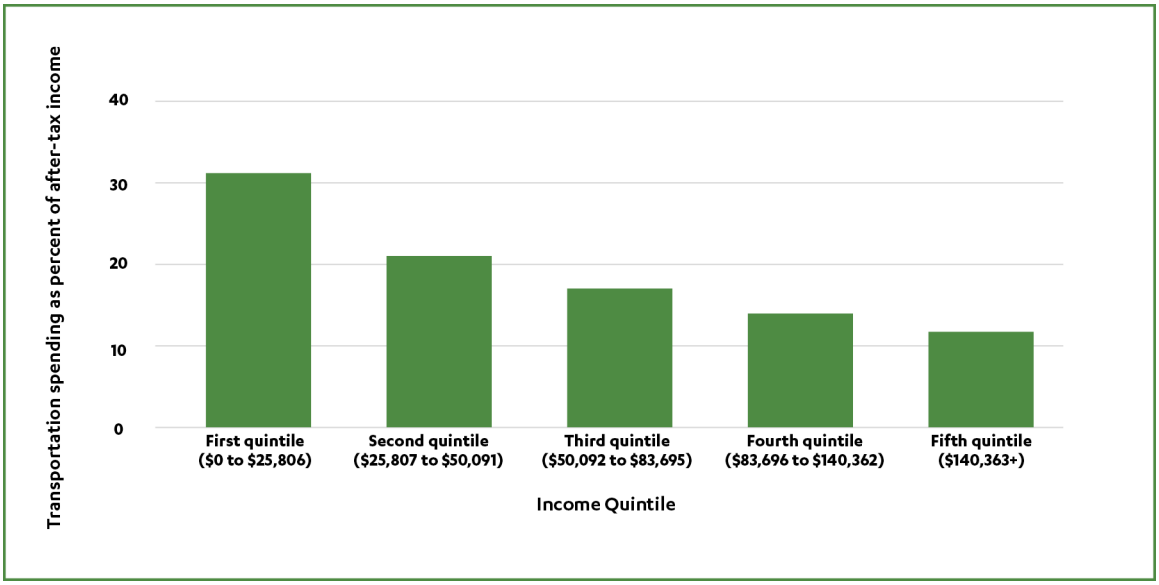
In the 2021–22 fiscal year, consumers in the Los Angeles metropolitan area spent an estimated 12.8% of their total household expenditures on transportation.[51] Access to vehicles is the single largest consumer transportation expenditure, with vehicle purchases constituting nearly 9% of household spending.

Figure 9. Breakdown of Household Expenditures on Transportation



While the Bureau of Labor Statistics does not publish consumer expenditures by income quintile for the Los Angeles metropolitan area, nationally, households in the lowest 20% of incomes spend 2.6 times as much of their incomes on transportation as households in the highest 20% of incomes.[52]

Figure 10. Transportation Spending as Percent of After-Tax Income vs. Income Quintile (2022)



These $84 billion in private expenditures vastly exceed the approximately $2.5 billion spent to maintain streets[53] and roads,[54] as well as over $3 billion spent to construct[56] public transportation in Los Angeles County and $4 billion to operate it.[58]

KEY ACTORS AND THE DECISION-MAKING PROCESS

Multiple governmental and private actors are involved in making decisions about transportation. How these actors work together — or don't — to make decisions has reverberations for the mobility of people, households, firms, and the entire region.

DECISION-MAKING EXAMPLE: SPEEDING UP BUSES

The planning and funding of transportation projects — from bus shelters to bicycle lanes — is the responsibility of an overlapping constellation of public agencies and elected officials. This web of decision-making allows for a greater range of stakeholder input, but makes projects more expensive and slower to implement, or even stops them altogether. For example, speeding up buses, perhaps through redesigning streets to create a dedicated lane, involves a complex network of distinct and overlapping responsibilities and decision-makers.

1) **Planning**

Street redesigns involve an iterative process of suggesting multiple alternatives and adapting them based on public feedback. Transportation planning is primarily handled by a city or county. In many cases, bus routes will run through multiple jurisdictions, which can complicate the politics behind planning processes. In addition to local planning efforts, regional and state plans influence transportation planning agencies through goals and mandates. These goals can be very broad (e.g., improving bus speeds and experiences for users) or more specific (e.g., a requirement to analyze and reduce vehicle miles traveled for transportation planning itself). In many cases, a bus operator, such as the Los Angeles County Metropolitan Transit Authority (Metro), will have a planning department that is either entirely responsible for planning, or collaborates with transportation agencies within local jurisdictions.

The power of decision-makers can vary substantially, but each exerts influence by approving or rejecting proposed plans, and influencing the proposed alternatives through collaboration or applying pressure on planners within the bureaucracy.

2) **Funding**

Funding comes from a wide variety of sources, with the largest sums of money coming from the states, either through internal revenues or from the federal government. Local jurisdictions have been able to raise funding through ballot measures (e.g., Measure M in Los Angeles), but still rely heavily on state funds, especially for large capital projects. Funding involves decisions about using existing funds or applying for additional sources, and creates leverage for actors with access to the funding needed for projects. Choosing not to apply for state or regional funding is an example of how department heads and elected officials can exert soft power over issues like speeding up bus service.

3) **Political/Public Decision-Making**

Political influence can be used to impact which projects are approved or rejected, how fast they are constructed and how they are designed. This can be a critical issue when multiple jurisdictions with different priorities are involved. For example, bus lanes are most useful along congested routes, but therefore often provoke opposition from motorists. Those with the most direct power over speeding up bus travel are local elected officials whose jurisdictions direct the agencies planning and designing new transportation infrastructure, and can ultimately influence whether a project is approved.

4) **Operational Changes**

While elected officials are the formal decision-makers, career staff at cities and other agencies have considerable influence. For example, they determine which options are "feasible" and the bounds of possibility for a project. Staff also make decisions on hiring, budgeting, scheduling and other factors that impact the availability of transportation operators, which in turn can affect the potential success of projects like speeding up buses.

Figure 11. Key Actors and the The Decision-Making Process

1) Planning	2) Funding	3) Decision-Making	4) Operational Changes
1. Local City 2. Local County 3. Metropolitan Planning Agencies 4. Transportation Operator	1. Caltrans 2. Local City 3. Local County 4. Transportation Operator	1. City Council/ County Supervisors 2. Mayors 3. City Appointed Commissioners 4. Heads of State Departments	1. Transportation Authority 2. Caltrans District

Further Readings on Transportation in Los Angeles

To understand Los Angeles' culture is to understand the history of transportation in the region. The immense wealth that transportation has enabled is evident in three of the county's premier cultural institutions: the Getty Center (named for petroleum magnate John Paul Getty), the Huntington Library, Art Museum and Botanical Gardens (named for railroad mogul and land speculator Henry Huntington) and the Broad Museum (named for homebuilder Eli Broad) each highlight how the region was built on the wealth of petroleum exploration and transportation-enabled real estate speculation. The following books, articles and reports provide a starting point to understanding the history and evolution of transportation in Greater Los Angeles.

Martin Wachs, Peter Sebastian Chesney, and Yu Hong Hwang. 2020. ***A Century of Fighting Traffic Congestion in Los Angeles: 1920-2020.***[57]

RAND. 2008. ***Moving Los Angeles: Short-Term Policy Options for Improving Transportation.***[58]

Ethan Elkind. 2014. ***Railtown.***[59]

Adonia Lugo. 2018. ***Bicycle/Race: Transportation, Culture, & Resistance.***[60]

Scott Bottles. 1991. ***Los Angeles and the Automobile: The Making of the Modern City.***[61]

Jacob Wasserman et al. 2022. ***The Future of Transportation and Urban Planning: A California 100 Report on Policies and Future Scenarios.***[62]

DEVELOPING A RESEARCH AGENDA

The transportation justice and sustainability challenges in Los Angeles are significant, but so are the opportunities for research to inform the identification of problems and solutions. ***TRACtion*** aims to co-create a research agenda, through bringing together UCLA researchers and community-based organizations. This approach connects the development of a research agenda with those who will use the research, and foregrounds the priorities of community-based organizations that do not often have a seat at the table in the creation of plans and policy agendas.

TRACtion aims to co-create a research agenda, through bringing together UCLA researchers and community-based organizations.

TRACTION FOLLOWED A FOUR-STEP PROCESS:

Framing Document. ***TRACtion***: An Introduction[63] was released in January 2023 to frame key issues and provide a high-level summary of transportation challenges from publicly adopted plans and agenda documents.

Kickoff. Participants first came together in person at UCLA for a half-day of speakers, discussions and relationship building. A panel on "The Future of Transportation in Los Angeles" was followed by keynote speaker Toks Omishakin, secretary of the California State Transportation Agency, who spoke on California's vision for the future of transportation.

Working Groups. The five working groups were the heart of the ***TRACtion*** process. They met five times in the spring of 2023, as described briefly below and in greater detail in the "***TRACtion*** Working Group Synthesis Report."[64]

2023 UCLA Arrowhead Symposium on Transforming Transportation. At an October 2023 gathering of 160 public officials, academics, consultants and advocates, ***TRACtion*** organizers introduced themes that emerged from the working groups as starting points for discussion by speakers and attendees.

The five ***TRACtion*** working groups were composed of UCLA academic researchers and external partners from community-based organizations and advocacy groups. In order to allow for more candid conversation, the involvement of public agencies and private-sector organizations was deferred to the subsequent step of the discussion series. Historically, the field of transportation research has relied on government and industry stakeholders to identify priority areas for research, which has contributed to inequities in who receives the benefits and bears the burdens of transportation systems.

In seeking to identify and understand problems that concerned communities and advocates, ***TRACtion*** organizers explicitly sought to include representatives from organizations that were involved in direct service delivery, political organizing, and community-based projects and programs. ***TRACtion*** organizers hypothesized that these representatives would bring different viewpoints or more context to ideas that had emerged through the government process of setting research priorities.

PARTICIPANTS SPLIT INTO WORKING GROUPS BASED ON FIVE MAIN TOPIC AREAS, DEFINED AS FOLLOWS:

Phasing Out Fossil Fuels: Addressing environmental injustice and mitigating climate change; anticipating and mitigating the unintended consequences of transitioning away from fossil fuels.

Access to Opportunities: Meeting mobility needs for low-income communities, communities of color, and different age groups.

Reimagining Transportation: Addressing the problem of sociocultural values and ways of understanding from which transportation-related harm can arise, as well as the lack of imagination or bureaucratic/administrative capacity to deliver on ambitious transportation goals.

Resilient Transportation: Addressing the vulnerabilities and fragility present in the existing transportation system, including the ways in which car culture and social infrastructure affect resilience. The group's use of the term "resilience" included but was not limited to the context of climate change.

Safe and Healthy Transportation: Addressing safety issues for vulnerable roadway users as well as gender and racial discrimination in transportation spaces.

EACH OF THE WORKING GROUPS WAS GIVEN THE FOLLOWING CHARGE:

1. **Further scope and define their theme;**
2. **Engage in discussion to determine the important barriers and solutions within the working group's theme for a just transportation transition in Los Angeles;**
3. **Identify knowledge, political, and values gaps or barriers between today and a transformed future;**
4. **Begin to identify research questions that might flow from these gaps; and**
5. **Assess and prioritize these gaps or barriers.**

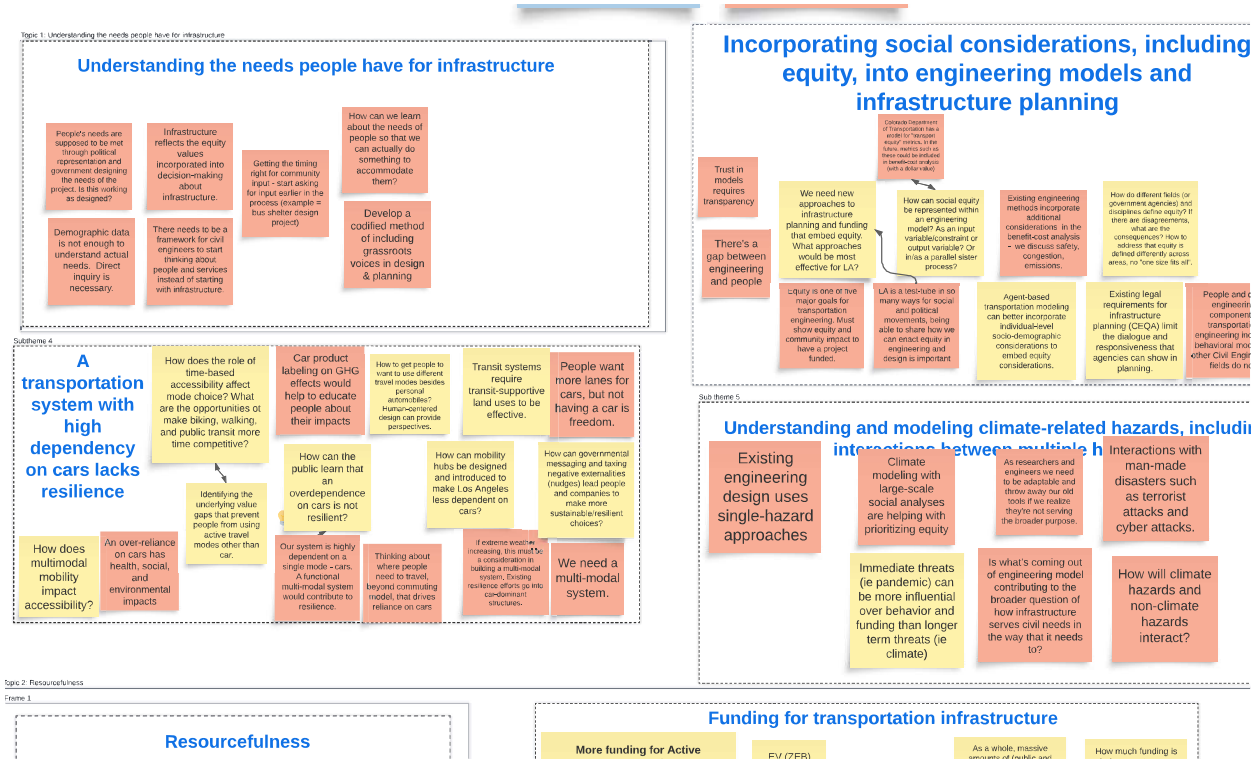
Each working group convened four times between January and April 2023, followed by an all-group synthesis meeting in May 2023 (Figure 12). During these meetings, community-based and advocacy partners engaged in group conversations with researchers, allowing each to explore each others' understanding of transportation sustainability and justice challenges in Los Angeles. Between each of these conversations, ***TRACtion*** notetakers would summarize the discussions from previous meetings and graduate researchers would synthesize research literature on specific topics to inform working group members as they discussed and prioritized barriers. Through this iterative process of summarizing discussions, synthesizing related literature and presenting and discussing these interpretations, ***TRACtion*** organizers sought to ensure that their interpretations accurately reflected the collective input of the working group.

Figures 12 and 13 give insight into the process followed during the meetings: brainstorming, prioritizing issues, and identifying cross-cutting themes. *A separate Working Groups Synthesis Report* — an interim milestone of the ***TRACtion*** process — provides a comprehensive description of the working group process and outputs, which can be used by those who intend to adapt the ***TRACtion*** process.[64]

Figure 12. Working Group Process

Meeting 1	Meeting 2	Meeting 3	Meeting 4	Synthesis Meeting
Introductions and Scoping Working groups participant introductions Groups discuss coping decisions	**Brainstorming** Introduce the gaps assessment framework Identify barriers or gaps to achieving future vision	**Classifying Barriers** Revisit gaps from Meeting 2 Discuss and classify gaps or barriers as knowledge, political or values	**Prioritizations** Revisit progress from meetings 1-3 Propose new barriers Prioritize barriers identified in previous meetings	**Intersections** All groups meet jointly to identify and discuss cross-cutting themes and priorities

Figure 13. Excerpt from Sample LucidSpark Board



Cross-Cutting Themes

Five cross-cutting themes emerged from the working groups, reflecting different types of barriers to a transition to just and sustainable transportation in Los Angeles:

1) **Decision-Making Processes:** How and why transportation agency staff and elected officials arrive at their decisions.
2) **Institutional Effectiveness:** Institutions' capacity to implement their intended policies and programs.
3) **Access and Public Space:** The factors that drive inclusion and exclusion from public space.
4) **Determinants of Individual Behavior:** Cultural and other factors that influence individual behavior.
5) **Environment and Health:** Consequences of the transportation system, particularly its effects on air quality and public health.

The tables below divide each theme into a series of sub-themes and identify potential research areas that emerged from the ideas of the working groups. Note that these research questions were not necessarily directly contributed by working group members.

Following each theme are relevant goals, targets and objectives sourced from seven applicable plans reviewed by the ***TRACtion*** team prior to the working groups process. These plans represent the formally adopted aspirations and planned actions of those government agencies responsible for envisioning and achieving a sustainable transportation future for Los Angeles, and serve as examples of government policy in each of these thematic areas.

Photo Credit: UCLA

Decision-Making Processes

What factors encourage or prevent institutions from making decisions that would support the creation of a just transportation system in Los Angeles? This theme covers barriers associated with who has power in decision-making processes; what is valued, measured and optimized through decision-making processes; how decisions about trade-offs are made; and how accountability within processes can be improved.

SUB-THEME	POTENTIAL AREAS FOR RESEARCH
Beneficiaries of Status Quo	Understanding the ways in which beneficiaries of fossil fuel extraction and dependence influence public opinion and the opinions of decision-makers, and how those actors influence academic research. Investigating reasons why some jurisdictions are influenced to prioritize cars and others are not.
Better Modeling and Metrics	Identifying metrics and models for transportation planning and engineering that better capture important impacts on factors like social equity, long-term resilience, and life cycle impacts.
Centering People Instead of Infrastructure	Evaluating how transportation agencies incorporate lived experiences and perspectives focused on people and services in their decision-making processes.
Non-Police Approaches to Safety	Investigating the frameworks decision-makers use to think about increasing safety in transportation environments.
Data Gaps	Evaluating the effectiveness of existing government agencies' qualitative data collection efforts. Identifying data gaps and scalable, cost-effective methods of capturing that data (e.g., strategies to inventory the quality of sidewalks and other infrastructure).
Educating/Persuading Public Officials	Providing insight on how policymakers form their opinions on transportation, and how those opinions are influenced by different actors and stakeholders.
Funding Priorities	Investigating transportation finance and budgeting reforms that could more equitably distribute money between and within different modes (e.g., shifting money from capital expenses to operational expenses within transit). Understanding financial decision-making and funding gaps at the bureaucratic level (e.g., When and why do agencies leave federal/state money on the table?).
Influence on Private Decision-Makers	Understanding the factors that influence companies and other private decision-makers in their thinking about transportation issues (e.g., cleaner trucks, reducing parking).
Repairing Harms From Injustices	Investigating and forming a policy framework for reparations in transportation. Understanding how to quantify harms, authentically ascertain community demands and implement solutions for reparations.
Transition to Clean Infrastructure	Understanding energy transition trade-offs, and how a transition would affect labor, equity, public health, energy sources, and ratepayer costs.

RELEVANT GOALS FROM APPLICABLE PLANS

Caltrans California Transportation Plan 2050 (CTP 2050)

Prioritize investments in disadvantaged communities to improve mobility and access to jobs, education, health care, services, and recreation. Ensure that investments are aligned with community-identified transportation needs and paired with anti-displacement policies.

Establish a statewide advisory committee tasked with expanding action around racial equity and transportation. Task the committee with developing a racial equity analysis framework to guide investment decision-making.

Expand active transportation funding specifically for marginalized communities and center communities in the planning and decision-making process.

Remove barriers to participation in transportation planning and decision-making within marginalized communities.

Expand outreach and coordination to better understand and address varying transportation safety needs across race, ethnicity, age, income, gender, sexual orientation, and ability.

Caltrans Strategic Management Plan 2020–2024

Use operational strategies and incentives to reduce vehicle miles traveled (VMT) through increased high occupancy modes, active transportation, and other Transportation Demand Management (TDM) methods.

Los Angeles Metro 2020 Long Range Transportation Plan (LRTP)

Create and implement an equity assessment tool.

Develop and advance a Racial and Socio-Economic Equity Action Plan.

Los Angeles Metro Vision 2028

Use best practices to assess the full life-cycle costs of infrastructure and service investments.

Identify and share information about trade-offs.

Institutional Effectiveness

In contrast to "Decision-Making Processes," this theme concerns institutions' ability and capacity to implement priorities that emerge from these decision-making processes effectively. This theme covers institutional capacity, inter-agency coordination, and trust between people and government.

SUB-THEME	POTENTIAL AREAS FOR RESEARCH
Accountability	Researching and evaluating existing models for agency accountability that empower marginalized communities, and determining what these models need to succeed.
Agency Priorities	Understanding the core components that successful long-term programs and infrastructure plans have in common, and how they survive transfers of power.
Community-Driven Decisions	Identifying examples of public engagement that allow people to express their desired outcomes without the need to weigh in on engineering-level decisions or have high degrees of expertise. Investigating how agencies could accomplish deeper community engagement and develop cultural competency, community driven metrics and accessible spaces for public input.
Community Trust	Investigating how trust in government varies across transportation agencies and levels of government. Researching the ways community-government relations have been repaired and strengthened in the past.
Inter-Agency Coordination	Understanding how complex transportation organization structures can be improved and/or consolidated, and how solutions including the consolidation of many agencies or operators have worked in practice. Identifying best practices from different jurisdictions for inter-agency coordination, and defining guidelines for performance outcomes of transportation networks.
Legal Constraints	Understanding the legal barriers that have the most constraining effect on policy and project implementation. Identifying potential reforms needed for planning and environmental review laws to enable collaborative planning approaches that more meaningfully engage communities.
Management Approaches	Understanding the barriers to hiring and retaining frontline staff in transportation, considering not only compensation, but issues like safety, benefits, housing availability, and access to public bathrooms.
Staff Knowledge	Understanding the training, experiences and personal perspectives of agency staff and decision-makers, and to what extent these perspectives affect their decisions and agency cultures.

RELEVANT GOALS FROM APPLICABLE PLANS

Caltrans California Transportation Plan 2050 (CTP 2050)

Increase statewide coordination to reduce transportation related pollutants in accordance with National Ambient Air Quality (NAAQ) standards and National Pollutant Discharge Elimination System (NPDES) standards.

Caltrans Strategic Management Plan 2020–2024

Foster a work environment that welcomes everyone and resembles the communities we serve.

Support career progression through professional and leadership development.

Inspire a values-based culture through an innovative performance-driven workforce.

Clearly communicate and align expectations at all levels.

Improve internal and external relationships to create beneficial solutions aligned with Statewide Goals and Objectives.

Improve, update or adopt new strategies to advance equity in recruitment, hiring and promotions.

Accelerate CalSTA and CAPTI action plans, engaging with communities most impacted by the climate crisis.

Los Angeles Metro Vision 2028

Provide responsive, accountable and trustworthy governance within the Metro organization.

Align all of Metro's business processes, resources, plans and tools with its strategic plan vision, goals and initiatives.

Develop community engagement strategy in alignment with equity framework.

Los Angeles Metro 2020 Long Range Transportation Plan (LRTP)

Provide responsive, accountable and trustworthy governance within the Metro organization.

Deliver projects through alternative delivery models, including Public-Private Partnerships, as appropriate.

Access and Public Space

What are the factors that drive inclusion and exclusion from public space? This theme is broad and considers transportation systems both as ways of accessing public spaces, and as public spaces in and of themselves. It also addresses various systems of oppression (e.g., race, class, etc.) that "determine" individual behavior by restricting mobility options, and how the politics and design of public spaces can either build community resilience or reproduce exclusion.

SUB-THEME	POTENTIAL AREAS FOR RESEARCH
Accessibility	Understanding the relationship between multimodal transit and accessibility, and what factors impact the prioritization of universal design and mobility services for people with disabilities.
Discrimination in Policy and Design	Considering how to design public transit for people who have not traditionally been centered in transportation planning, and investigating the unintended consequences of policies and technological innovations that have focused on increasing comfort and ease-of-use for middle class "choice riders."
Fare Payments	Exploring the potential of fareless transit, including co-benefits, best practices for implementing various models, potential revenue sources and funding structures, impacts on safety and perceptions of safety, and opportunities for transit agencies to act as public banks.
Safe Systems Approaches	Identifying root causes of stress and lack of safety in transportation environments, as well as positive interventions. This could include studying the holistic effects of police presence on transit, the effectiveness of positive safety solutions, the impacts of different types of traffic enforcement, and alternatives to traffic stops.
Transit Amenities	Understanding barriers to — and strategies for — providing more accurate and widespread information to riders about real-time arrivals and transit availability. Looking at how the lack of basic amenities at transit stops impacts riders, along with the challenges to addressing this and potential solutions. This could include studying decision-making processes and ways to create cultural shifts within agencies.
Transportation-Land Use Interaction	Understanding how to resolve barriers to a multi-racial, context-specific land use system that addresses mobility justice, gentrification, high housing costs and urban sprawl in Los Angeles. These solutions could include addressing sources of community opposition to public transit in their neighborhoods, reducing housing costs in neighborhoods close to frequent public transit, and adopting best practices from other cities and metro areas.

RELEVANT GOALS FROM APPLICABLE PLANS

Caltrans Strategic Management Plan 2020–2024

Eliminate race-based disparities in transportation safety outcomes.

Advance equity and livability in all communities, prioritizing investment in historically harmed and segmented communities.

Caltrans California Transportation Plan 2050 (CTP 2050)

Provide subsidies to transit agencies that offer free or reduced fares to low-income, underserved, students, and/or other transit-dependent riders.

Los Angeles Metro 2020 Long Range Transportation Plan (LRTP)

Prioritize improved access to opportunities for Equity Focus Communities.

Implement Transit to Parks Strategic Plan with high equity focus and high feasibility routes for Transit to Parks across the county.

Expand Low Income Fare is Easy (LIFE) program.

Build affordable housing near transit.

Photo Credit: iStock

Determinants of Individual Behavior

How do cultural and other factors influence individual behavior? While "Access and Public Space" is focused on the mobility choices available to individuals, this theme is focused on the motivations for choices made within those constraints, such as car culture and aggressive driving.

SUB-THEME	POTENTIAL AREAS FOR RESEARCH
Aggressive Driving	Understanding the psychology of street racing and best practices for addressing it, such as effective interventions outside of enforcement.
Effects of Extreme Weather	Understanding how mobility behavior will change during the types of extreme weather events expected to increase in frequency in a climate-impacted Los Angeles, and identifying effective policy and planning responses.
Shifting Car Preferences	Exploring the incentive structure and psychology behind car culture, and strategies to shift mode choice towards more resilient options. This could include best practices for transitioning certain areas away from car dependence, the effectiveness of nudge campaigns on mode choice, the influence of the built environment on car culture, disaggregated reasonings for driving among different groups (e.g., gender, race, socioeconomic status), and the potential role of electric vehicle incentives in perpetuating car culture.

RELEVANT GOALS FROM APPLICABLE PLANS

Caltrans Strategic Management Plan 2020–2024

Partner to reduce speeding-related fatalities and serious injuries.

Caltrans California Transportation Plan 2050 (CTP 2050)

Invest in non-auto travel options along corridors subject to roadway pricing to provide people with viable alternatives to driving.

Expand education and countermeasures to reduce distracted and impaired driving.

Reduce driving speeds through infrastructure design.

Expand statewide campaigns to encourage active transportation and educate both active transportation users and drivers about safety.

Study the economic, equity and travel impacts of a variety of policies and incentives to reduce VMT and promote telework.

Photo Credit: iStock

Environment and Health

How does the transportation system affect the health of people and ecological systems? This theme is primarily focused on the *consequences* of the transportation system, including its effects on air quality and public health.

SUB-THEME	POTENTIAL AREAS FOR RESEARCH
Compounding Hazards	Identifying multi-hazard vulnerabilities in Los Angeles that could have the greatest impacts on the transportation system, and strategies to prepare for them.
Ecological and Health inequities	Exploring how to motivate action on environmental justice and advance resilient, multimodal transportation focused on public health. This could include research on ethical or political considerations that may cause inadequate response to environmental justice impacts. Research might also consider transit funding allocations and the public health impacts of access to different transit types, including the potential for mode shift to reduce traffic fatalities and increase physical activity.
Non-Emissions Impacts	Understanding unintended consequences of the transition to electric and alternative-fuel vehicles, and how to mitigate them. This could include understanding sources of pollution that will continue to exist if heavy-duty vehicle tailpipe emissions are eliminated (e.g., particulate matter from brakes/tires), and how to make decisions about distributing or minimizing burdens. It could also include research related to the extent that incentivizing electric vehicles could lock in car dependence and hinder a shift to transit, walking and biking.
Resilient Infrastructure	Analyzing how extreme weather will impact transportation demand, travel patterns and infrastructure, how prepared current systems are to handle extreme weather events, and how to design more resilient infrastructure. This includes topics like the role of green infrastructure in making rights of way more resilient to extreme heat and flooding, and the ways in which multi-modal transit can offer more adaptability than car-centric transportation.

RELEVANT GOALS FROM APPLICABLE PLANS

Caltrans California Transportation Plan 2050 (CTP 2050)

Develop a statewide repository of location-specific adaptive strategies that can be incorporated into infrastructure maintenance and rehabilitation projects.

OurCounty Los Angeles County Sustainability Plan

Build shade structures at major transit stops, such as those identified in Metro's Active Transportation Strategic Plan, prioritizing communities with high heat vulnerability.

Collaborate with the city of Los Angeles and others to develop a "Just Transition" plan and task force that examines the impact of the transition to a cleaner economy on disadvantaged workers, identifies strategies for supporting displaced workers, and develops recommendations for ensuring inclusive employment practices within growth sectors of the economy.

Conduct a countywide climate vulnerability assessment that addresses social vulnerability, and use it to guide priorities for investments in public health preparedness, emergency preparedness, response planning and community resiliency.

Los Angeles Metro 2020 Long Range Transportation Plan (LRTP)

Increase shading and cooling at transit stations.

Improve bus shelter amenities in partnership with local jurisdictions.

SB 535

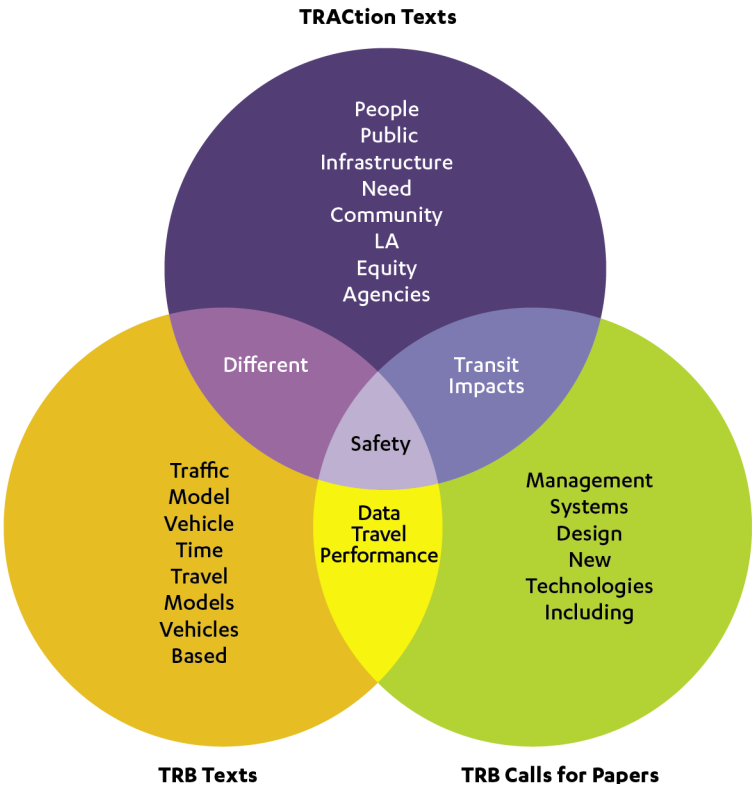
Requires Greenhouse Gas Reduction Fund investments to fund projects that benefit state-designated disadvantaged communities.

Does Existing Transportation Research Reflect the Priorities of the TRACtion Working Groups?

In January 2023, more than 5,000 presentations were made at the largest conference in the field, the Transportation Research Board (TRB) Annual Meeting. We compare the abstracts of these presentations, along with TRB's calls for papers, with the notes and virtual whiteboards from ***TRACtion*** working group meetings.

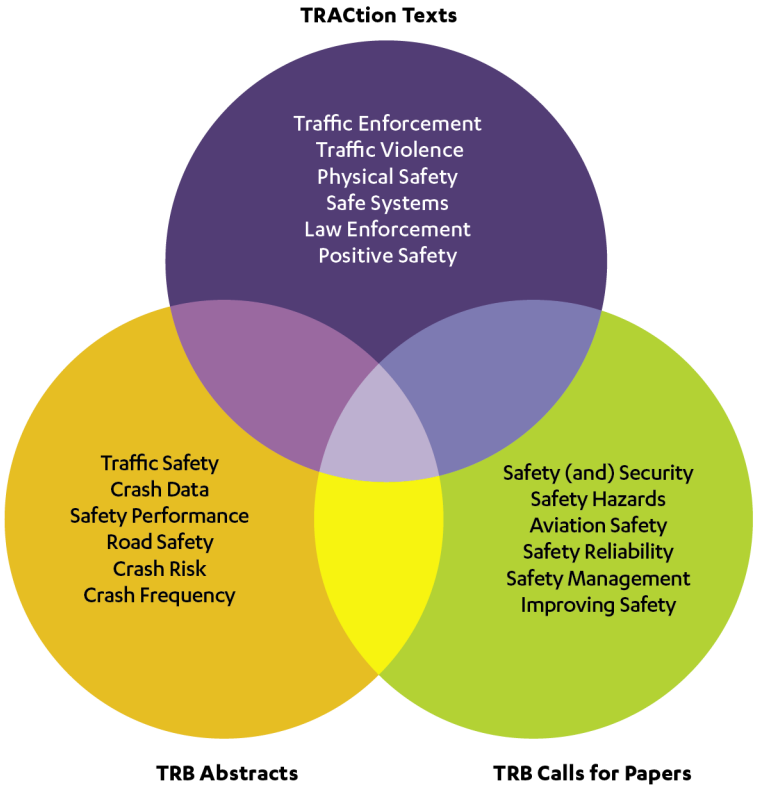
The TRB's calls for papers emphasize the production of new research focused on emerging technologies and innovations ("new" and "technologies") and transportation management ("management"). The TRB abstracts are dominated by words associated with transportation engineering, most often using words that are associated with traffic management (e.g., "traffic," "vehicles," "time") and modeling ("model," "models") (Figure 14). In comparison, the ***TRACtion*** documents demonstrate a focus on people ("people," "public," "communities") and equity ("equity").

Figure 14. Most Frequent Terms in Each Document Group (Descending Order of Frequency)



As a notable exception, all document groups frequently reference safety ("safety"), although in different contexts, as evidenced by the most frequent two-term phrases containing safety-related words in each document group (see Figure 15). The TRB abstracts most frequently mention safety-related words in reference to traffic collisions ("traffic safety," "crash data," "road safety," "crash risk," "crash frequency"), while the ***TRACtion*** process most frequently mentions safety-related words around police enforcement approaches ("traffic enforcement," "law enforcement"), for example, in the context of racial discrimination in traffic stops and fare enforcement on public transit. This divergence reflects the way ***TRACtion*** emphasizes the social science and governance challenges associated with transportation problems over the design and engineering aspects of these problems.

Figure 15. Most Frequent Two-Word Phrases Containing "Safe," "Crash," "Enforcement," or "Violence" in Each Document Group (Descending Order of Frequency)



The ***TRACtion*** process produced a set of research priorities centered on people, behavior and multi-modal public transportation. For example, research questions related to public decision-making, community trust and government accountability, agency processes, educating and influencing public officials and private decision-makers, human-centered and accessible design, and shifting preferences and culture were core parts of what emerged from ***TRACtion***. This reflects the need for an increased focus on social science and governance in transportation research.[5 65]

2023 TRACTION RESEARCH AGENDA

The working groups raised numerous *issues* with transportation in the Los Angeles region, from racial justice and policing on public transit to the air quality implications of electric vehicles. These issues, however, do not necessarily represent *knowledge gaps*. In some cases, the issue may represent a *values gap*, for example regarding the rights of unhoused people on transit and in public space. In other cases, say, the ridership impacts of fare-free transit, existing research may provide robust evidence, indicating a need for synthesis and translational research.

The following pages dive into some of the priority topics identified by the working groups on **Decision-Making Processes, Institutional Effectiveness, Access and Public Space, Determinants of Individual Behavior, and Environment and Health**, and review and synthesize the state of the research literature. For each topic, we identify what existing research tells us, the questions where ample research already exists and the open questions where future research may be most fruitful.

HOW PUBLIC OFFICIALS MAKE DECISIONS

This topic touches on all aspects of transportation and was discussed widely across the working groups, especially in the Access to Opportunities and Reimagining Transportation groups. Some examples of questions raised by working group members include: "There are still plans to widen highways in L.A. County. How does the research-based knowledge that this isn't a good idea reach public agencies?" and "How do you persuade public officials? Given the channels we've identified, how do you intervene most effectively?" This topic also emerged as part of a cross-cutting theme: Decision-Making Processes.

In making transportation decisions, public officials face budget constraints, pressure from voters and interest groups, and coordination challenges across myriad overlapping jurisdictions. Given competing voices and priorities, how do city council members, transit agency board members and other officials make decisions on questions from freeway widening to transit fares? How much weight do they give to community demands, lobbyists, and wider public sentiments? To what extent does transportation research influence their decisions? And what motivates elected officials to take political risks by making potentially unpopular decisions that may cost them the next election?

WHAT EXISTING RESEARCH TELLS US

Influence of Advocacy Groups: Policymakers seek the support of advocacy groups when they are faced with political pressure, for example on controversial issues. Elected politicians are more prone to seek out opposing viewpoints than are non-elected policymakers.[66] Advocacy groups tend to outperform individuals in influencing policy, but measuring the efficacy of advocacy can be challenging due to the broad set of activities it might encompass, and the difficulty of establishing how a public official would have behaved in its absence.[67] [68] The efficacy of advocacy is conditional on both the strategies used by advocacy groups and the broader political context, which creates windows of opportunity for policy change and rewards different strategies under different conditions.[69] [70]

Influence of Individuals: Politicians are responsive to the preferences of their voters; after all, they usually want to be (re-)elected.[71] However, this responsiveness varies across policy domains and locations of decision-making within government.[72] Affluent voters, compared to average voters, tend to have greater influence with their elected representatives.[73] [74] Biases in representation can be pronounced at the local government level, where homeowners exercise particular influence.[75] Organizing into groups can help increase political influence, but mass public-based groups still are at a disadvantage relative to business groups.[76] Government also has a status quo bias that can pose an additional hurdle for organizations or people who are advocating for policy change.[77] Finally, local politics has not escaped the partisan division that has

come to overwhelm all of American politics.[78] [79] Within this broader context, advocacy organizations aim to amplify the voices of low-income residents or disadvantaged parts of communities. They often encourage their members to phone or meet in person with public officials, as these high-touch interactions are more influential than mass emails.[80] [81] Personal interactions may also help to correct public officials' misperceptions about the attitudes of their constituents.[82]

Role of Research: Past research has illustrated broader societal trends of directional motivation (e.g., confirmation bias) in public thinking, as well as a growing mistrust of science.[83] [84] Some literature suggests that policymakers reflect these biases, for example, by ignoring research or only using it to justify, rather than inform decision-making.[85] [86] More recent studies, however, reject this idea, showing that decision-makers have motivations to update their beliefs when exposed to new research.[87] [88] [89] Studies on how research is used and communicated illustrate that direct meetings between researchers and decision-makers — and to a lesser extent, dissemination through the media — can make staff and elected officials more likely to act on research findings.[90]

Lobbying: While lobbying is something that both businesses and nonprofit organizations engage in, businesses tend to lobby more, and with greater success.[90] This may be due largely to the fact that lobbying influence is often related to how much money is spent on the effort.[91] However, nonprofits that contract with the government have a greater degree of influence.[92] Similarly, nonprofit and advocacy coalitions that show broader diversity in the types of groups they represent are able to increase their influence.[93]

Future Research

Decision-making by public officials is much better studied at the federal level, and to a degree, the state level. Less research exists on local decision-makers, especially within specific policy domains that have their own governing structures and configurations of interested stakeholders. Thus, a priority for future research is to examine, adapt and apply existing knowledge to local-level transportation decisions. For example:

1. **The Politics of Transportation**
    a. How does transportation affect local politics? How influential are transportation controversies on the outcomes of local elections? What motivates elected officials to make difficult transportation decisions? Many transportation decisions are non-partisan; how does this shape policy choices?
2. **Power Dynamics in Transportation Decision-Making**
    a. Who benefits from the status quo of transportation, either politically or economically? How do these groups or individuals influence public opinion and decision-makers?
    b. Who is not served well by the existing system? Do these groups have knowledge that they're not well off? How can these groups influence transportation outcomes?
    c. How can transportation agencies incorporate lived experiences and a people/services-focused perspective in their decision-making processes?

MODELS AND THEIR DESIGN

This topic was discussed in the Access to Opportunities and Resilient Transportation working groups. Some questions and comments from working group members included: "How can social equity be represented within an engineering or similar decision-making model?" and "Agent-based transportation modeling can better incorporate individual-level socio-demographic considerations to embed equity considerations." This topic also emerged as part of the cross-cutting theme of Institutional Effectiveness.

A model is a useful tool for simplifying how planners understand travel behaviors and predict the future.[94] [95] When using models, transportation planners first determine what transportation behavior they want to explain or predict.[96] They then collect data related to the travel behavior they wish to analyze. After cleaning that data, a planner can statistically estimate parameters for their model.[96] Finally, a planner can then manipulate different relevant variables in the model to analyze and predict travel behavior under different scenarios.[96] There are two major types of models used for transportation planning: trip-based and activity-based models.

WHAT EXISTING RESEARCH TELLS US

Benefits and Drawbacks of Traditional "Trip-Based" Models: Traditionally, models were trip based and used four steps to estimate travel patterns in a given "zone" or area: 1) trip generation; 2) trip distribution; 3) modal split; and 4) network assignment.[97] [98] This approach treats each trip as a separate event without factoring in underlying activities or other trips. While this approach is simpler, there are drawbacks.[99] For example, interactions between trips are disregarded.[100]

Newer "Activity-Based" Models Capture Individual Behavior: Newer-generation activity-based models disaggregate trips and consider individual behavior, allowing them to capture population demographics and other travel contexts (e.g., economic, land use, social, cultural, etc.).[96] Activity-based models allow planners to understand how these constraints on mobility and participation in different activities impact people on the individual level, rather than trip-based aggregate analysis.[96] Ben-Akiva and Bowman provide a framework for activity-based models.[101] The framework deals with the complicated ways in which urban dynamics (e.g., locations of housing, infrastructure, etc.) and the ways that individuals make activity and travel decisions at the household level (e.g., mobility and lifestyle, activity and travel scheduling, implementation and rescheduling) combine to impact transportation system dynamics.[96] [101] Activity-based models "focus on individual activities in space and time as the foundation for understanding human mobility as well as broader human-environmental systems such as cities."[96]

Accounting for Negative Externalities: As planners start to focus more on addressing negative externalities from transportation due to increased "concerns about air quality, energy, and the quality of life...," activity-based approaches have proved valuable in incorporating variables to understand how travel behavior and planning decisions can address those concerns.[96] [102] With activity-based models, planners are able to account for population heterogeneity and the complex and multidimensional travel choices people make[99] in ways that will facilitate equitable and inclusive policy and decision-making.

Addressing Equity Considerations: Activity-based models help planners understand the equity impacts of transportation plans at the individual level. However, they still have limitations, including limited exploration in public practice, the inability to capture transportation impacts comprehensively on the individual level, and insensitivity to different communities' travel experiences.[103] To aid in overcoming these challenges, Bills, Sall, and Walker have created a three-step equity analysis framework that helps planners think through using models for justice and assessing equity. First, planners should ask questions about the transportation priorities for different groups of people. Then, they should ask questions to determine which model is best suited to understanding the travel behavior differences between groups of interest. Finally, planners must ask questions about which equity indicators should be utilized to assess equity impacts, and how to represent those indicator measurements.[103]

Future Research

Research on modeling and creating transportation equity metrics must expand to be more inclusive of different methodologies, and better connect models to desired societal outcomes for low-income communities and communities of color, who are often underserved by traditional modeling techniques.

1. While the burgeoning literature is showing that incorporating equity into activity-based models is a critical tool for inserting it into the transportation planning process,[103] more research is needed to understand if reported transportation benefits truly produce desired societal outcomes for equity communities.[103]
2. Qualitative research would illuminate the context of models and better understand individual decision-making, barriers, opportunities, potential benefits and societal outcomes from a perspective centered on community and equity.
3. It is unclear whether prior data collection is representative of low-income communities of color. It is also unclear whether those communities have the power to self-determine or define benefits or the desirability of outcomes. As a way to address this, Participatory Action Research (PAR) could be used in conjunction with activity-based models. PAR is a process between collaborators who agree to work together on solving a jointly identified problem.[104] Including qualitative PAR in activity-based modeling has the potential to transform traditional planning organizations and their practices in a way that could disrupt planning's racist history and change planning institutes from within, rather than replicating the white supremacist structures already in place.[105]

INSTITUTIONAL EFFECTIVENESS

This topic emerged from the Reimagining Transportation working group, and was touched upon in many other working groups as well. Some sample statements from working group members include: "Build[ing] capacity to capture the expertise of marginalized groups and implementing that knowledge into transit operations," and "Having so many agencies responsible for the public right-of-way in Los Angeles makes infrastructural projects take a very long time, increase[s] costs, and limit[s] approvals."

The effectiveness of a government's agencies and institutions deeply impacts the delivery of services and projects. Failing to deliver services and projects erodes trust in government, which can be difficult to repair. Better understanding what makes institutions effective or ineffective, and how to improve them, could create pathways to better outcomes for transportation. Legislative or legal action to address improvements like sidewalk repairs and new bus shelters can put pressure on responsible departments, but not understanding the administrative barriers (e.g., needing eight different departmental approvals or the ability of one neighbor to veto the project) will likely prevent those improvements from being as successful as they could be. Therefore, it is essential to investigate the common issues surrounding institutional effectiveness and ask how institutions can improve.

WHAT EXISTING RESEARCH TELLS US

Heuristics and Biases in Agency Decision-Making: Staff and leadership at public agencies, like all people, are subject to cognitive biases, which means that the decisions they make can be skewed by filters of personal experiences and preferences. The top three biases that impact decision-making at public agencies are the "availability heuristic" (prioritizing infrequent events based on recency and vividness), the "loss aversion bias" (prioritizing the fear of losses much more strongly than the desire for gains) and "overconfidence" (overestimating one's own knowledge or skill around a topic).[106]

Theories of Public Administration Management: Several theories of public management explain why agency staff make decisions that do not align with the goals of political leaders or do not take into account research findings or data.[107] "Principal-agent models" underscore that public sector staff (agents) often possess a knowledge advantage over elected officials (principals), which allows them to pursue their own goals and priorities.[107] [108] "Organizational theory" discusses the concept of bounded rationality, where individuals make less than ideal decisions due to constraints like time or cognitive bias. In institutions and organizations, the prevalence of standard operating procedures acts as an influence on decision-making.[109] [110] "Garbage can models" highlight organizational biases where decision-makers do not follow a systematic or rational approach to solving problems. Instead, they may pick up problems and solutions almost randomly, often influenced by their own interests, personal biases or the pressure of the moment.[111] In this model, solutions are not developed in response to problems, but rather, problems are found to meet existing solutions or the expertise available to an organization.[112]

Procurement and Contracting Efficiency: There is disagreement as to whether public agencies should be contracting out services (the "buy" approach) or building internal capacity to deliver them in-house (the "build" approach).[113] There is more agreement, however, that even if an agency contracts for services, it needs a certain level of capacity to be able to contract effectively,[114] and that contracting capacity appears to have diminished at the local government level over the past several decades.[115] Some recommendations from the literature on improving contracting for government services and projects are:

- • Invest in long-term contracting and evaluation capacity.
- • Write contracts with market incentives for performance.
- • Have clear policy goals from the outset of contracts.[115]

Future Research

The broad base of theory and evidence in public administration is relevant to many day-to-day decisions in transportation agencies, but few researchers have made the links to practical questions of contracting decisions. For example, less is known about the following questions:

1. When should agencies contract and when should they develop skills and capacity internally?
2. How do contracting decisions impact how well projects meet an agency's goals, particularly any equity commitments?
3. How does contracting for community engagement affect agencies' relationships with the communities they serve?
4. To what extent do staff versus governing board members guide transit policy agenda?
5. Does contracting for infrastructure project delivery have greater long-term costs than building internal project management skills?
6. How do previous contracting relationships drive future decisions (e.g., with fare collecting services or policing contracts)?

Another set of open research questions is about the extent to which fear of political backlash influences administrative decision-making (e.g., widening freeways despite a state mandate not to). For example, to what extent is planning used as a placeholder for action with agency staff deferring decisions by undertaking further study? And, how do local political conditions affect agency structures and decision-making?

The complexity of the regulatory and policy environment is a third area of open research. To what extent do decision-makers respond to new challenges or public concerns with additional regulations or internal requirements, even when their goals might be better achieved by streamlining existing regulation or practices? What are the most effective approaches to comprehensive revisions of laws, policies and procedures, such as zoning codes, street design manuals or agency contracting requirements?

IMPROVING SAFETY THROUGH DESIGN AND PROGRAMMING

This topic was primarily discussed in the Safe and Healthy Transportation working group. Some example comments from working group members include: "Many positive safety solutions (such as those advocated for by ACT-LA) have not yet been elevated or vetted through the academic process," and "A cultural shift at Metro is necessary for the agency to provide basic amenities at transit stops." This topic also emerged as the cross-cutting theme of Access and Public Space.

Safety on and around public transit is not just about police enforcement. The design and programming of public space, including the addition of lighting, gathering spaces and cultural programming that enable natural surveillance, can discourage anti-social behavior, reduce crime and increase people's perception of safety. Both rail and bus customers cited safety as a top-five concern in Metro's 2022 customer experience survey, with women citing safety as a number-one concern for both modes.[116] The proportion of riders surveyed who identified as women fell from 53% to 49% among bus riders and 46% to 44% among rail riders between 2020 and 2022.[116]

WHAT EXISTING RESEARCH TELLS US

The Over-Policing Mentality and Approaches to Safety: Criminalizing fare avoidance, littering and other nonviolent behaviors has had a negative impact on transit safety, in particular, for Black and Latino riders.[117] Being able to differentiate crimes that directly threaten other riders (e.g., assault) successfully from anti-social behaviors and nonviolent crimes (e.g., talking loudly, littering, playing loud music) allows planners and policymakers to more successfully design public space and tailor public programs to improving safety.[118] [119] [120] An intersectional understanding of safety is critical for transportation and related public spaces. Factors like class, gender, sexuality and race influence the experiences people have with transportation, as well as how they interpret their surroundings in the urban environment.[121] [122] [123] Because of the unique experiences that marginalized groups face, people have different definitions of what safety means for them. For example, gendered violence shapes the experiences of women on transportation and affects both their real and perceived safety.[124] Similarly, anti-Black racism has shaped Black transportation users' experiences with surveillance and enforcement on transportation.[117]

Community Culture Reinforcing Safety: Positive transportation habits (e.g., refraining from littering) can be socially enforced among the public without explicit policy enforcement.[124] [125] [126] For example, Bogotá, Colombia substantially reduced violent crime, in part, through unconventional social programs, such as using mimes instead of police to control vehicle traffic and encouraging people to call out disruptive public behavior using red cards like soccer referees.[124] [127] In Chicago and Baltimore, programs that recruit and train community members as ambassadors to encourage changes in social interactions helped to reduce gun violence.[128] [129] In England and Wales, communications campaigns around anti-social behaviors on buses helped discourage littering and playing loud music.[120]

Community Demands for Safety Programming: Movements that have formed in response to police violence have proposed a number of alternative methods of creating and maintaining neighborhood safety.[119] [130] Examples include creating identity-specific affinity spaces of healing for victims of state and interpersonal violence, as well as participatory processes for defining safety and best addressing safety issues.[124] These spaces can be organized by community-based organizations, or physical environments can be adapted to acknowledge history and culture through signage and monuments. Additionally, targeted engagement of different identity groups can lead to specific planning interventions. For example, in the U.K., an Arup study found that LGBTQ individuals who responded to an engagement process expressed interest in comfortable semi-private areas in public places deemed "cozy corners," which could be created by placing benches and other infrastructure in configurations that allow users to see their surroundings without being at the center of the public eye.[131]

Designing for Safety: Both the aesthetics and designs of public spaces have impacts on safety. For instance, adding green space to public spaces appears to reduce anti-social behavior and crime.[132] Cleanliness and maintaining a state of good repair have also been shown to improve safety in transit stations and public environments.[126 133 134] Conversely, environmental factors such as heat have been shown to increase aggression in individuals, and violent crime is correlated with extreme heat days.[135] One study found that neighborhoods with more green space tend to have less crime, even when controlling for income.[136]

Counterproductive Effects of "Hostile" Design: "Crime Prevention through Environmental Design" is a school of thought that emphasizes "defensible space" and restricting movement in order to prevent crime. However, defensible space can have a counterproductive effect on preventing crime and anti-social behavior, given that urban permeability (e.g., allowing for a larger number of connections from small streets to metro stations) increases safety.[137 138 139] While some aspects of "defensible space," like lighting and the elimination of potential hiding places, appear to be effective in violent crime reduction, other design features, like fences, have counterproductive effects.[126 140 141] Similarly, removing benches and other street furniture in an effort to discourage unhoused people from using particular spaces has knock-on effects of making public spaces less accessible and attractive to people with disabilities, parents, women and other groups.[123 142 143] Designs intended to discourage particular users simply tend to shift social problems around rather than addressing them, and make for less accessible public spaces in the process.[143]

Future Research

While many novel approaches to improving safety on public transit have been implemented, at least on small scales, there is little empirical evidence about their effectiveness on crime, perceived safety, and gender and racial equity. Pertinent questions include:

1. How effective are bystander intervention campaigns in influencing safety on public transportation?
2. How does infrastructure that increases thermal comfort impact safety?
3. How effective are strategies that combine design, first/last mile permeability and social programs to promote safety?
4. What is the impact of busking, street vending and similar community-facing activity on safety near transit?
5. Is there safety in numbers? For example, how does transit ridership correlate with perceived safety and reports of crime and anti-social behavior?

Another avenue of future research relates to diversity and equity. Scholars have noted that public space primarily centers heterosexual, white, male users to the detriment of women, people of color, members of the LGBTQ community and other marginalized groups.[142 144 145] Could design and/or programming that incorporates the perspectives of these identities increase the presence of users from these groups? If so, what would be the impact on safety? More generally, how does incorporating more diverse stakeholders' perspectives into design and programming impact perceptions of safety?

SAFETY BEYOND POLICING

This topic was primarily discussed in the Safe and Healthy Transportation working group. Some examples of comments and questions from working group members include: "The presence of police is a barrier to accessing public space (including public transportation), particularly for Black and brown riders," and "What are the root causes of people's stress and lack of safety, and how do we fix those?" This topic also emerged as the cross-cutting theme of Access and Public Space.

Transportation planning has been used to police the mobility of people, specifically people of color, throughout history. Black and brown people are often most harmed by transportation decisions that arrest their mobility and police their movement, yet law enforcement agencies continue to be trusted partners in traffic safety approaches.[146] ***TRACtion*** participants were inspired by, and repeatedly referenced work that bases transportation in a justice framework.[147] Specifically, there was a desire to use data to acknowledge and evaluate approaches to safety that criminalize certain behaviors and over-police people for transportation related offenses (e.g., jaywalking, bicycle violations, fare evasion).

Moreover, "safety" is experienced differently by different populations. For example, existing practices of enforcement and policing that are intended to make people feel safe, such as having a strong police presence on transit, instead harm many of the most vulnerable populations.

WHAT EXISTING RESEARCH TELLS US

Traffic Enforcement: Much of the research on the criminological approach to safety in transportation focuses on cars, much like many aspects of transportation planning. As cars became more popular in the United States, policing power was expanded. This resulted in traffic stops becoming an increasingly common setting for people to have police interactions.[148] In more recent years, research has focused on the policy and advocacy movement to take police out of traffic stops with non-policing alternatives. These include, but are not limited to, creating new agencies or departments, automated traffic enforcement, and more training and oversight for officers.[149] Much of the policing alternatives research is focused on automated traffic enforcement. However, this approach raises surveillance concerns and other equity issues.[150]

Walking and Biking: There is a growing body of literature on policing specifically tied to walking and biking. Research has examined the disproportionate number of stops for Black and brown people when walking and riding bicycles.[151] Recently, Charles Brown introduced the concept of "arrested mobility" to refer to "transportation related policies and practices across jurisdictions that limit mobility, opportunity and access for Black Americans and other people of color."[152]

Transit: Research on policing on public transit focuses on the racial discrepancies in enforcement.[153] There is also a growing body of research on what it would mean to reimagine policing on transit,[154] including in Los Angeles.[155] This research identifies particularly vulnerable groups (e.g., riders experiencing homelessness, riders with disabilities, riders with mental illness diagnoses) and looks to provide alternatives that focus on resources for these communities.


Photo Credit: iStock

Future Research

Policing research has gained popularity since the uprisings in the summer of 2020. Much of the research — and advocacy — focuses on policing reform and alternatives or abolition. Yet more work needs to focus on the intersection of policing and transportation. Some potential topics include:

1. Since 2020, cities such as Berkeley and Los Angeles have removed police from traffic enforcement or hired consultants to research the issue. What has been the effectiveness of these initiatives on both traffic safety and racial justice?
2. Vision Zero is a European-created traffic safety framework that has been increasingly embraced by cities in the United States. One of the key components of Vision Zero is "enforcement." After the 2020 racial reckoning, have cities changed their approaches to Vision Zero? If so, how?
3. Can legal and urban planning scholars work together to center a critical race theory in transportation scholarship? Currently, legal scholarship focuses on civil rights issues or public accommodations, while urban planning literature covers design-oriented topics.
4. Is community-engaged research that documents traffic safety agencies' investments, evaluates their efficacy in reducing traffic fatalities, and develops community-led alternatives more effective in creating safety outcomes than traditional approaches?

FARELESS PUBLIC TRANSIT

This topic emerged from the Access to Opportunities working group, which focused on improving public transit service quality and ensuring that everyone has an equal ability to access services. Providing fareless transit was a high priority area for the group. This topic also emerged as the cross-cutting theme of Access and Public Space.

Transit fares can create financial burdens and prevent people from being able to get to the places that they want or need to go. Fares have a large impact on household finances in Los Angeles, where about 83% of Metro riders have a household income below $49,000 and 72% are Black or Latino.[156] Reduced fare programs, like discounts for seniors, students or low-income riders, can only partially meet these riders' needs. Additionally, eligibility-based programs, particularly means-tested programs for low-income riders, can be expensive to administer and often miss a substantial fraction of eligible participants due to lack of awareness, burdensome enrollment processes, and the difficulty for riders to navigate different reduced fare programs across the many separate transit agencies serving Los Angeles County.[157] Thus, fareless transit may be a well-targeted way to provide financial relief to low-income transit riders.

Fareless transit would also remove the need for fare enforcement. Assault on bus operators, which is a growing problem for transit agencies, often stems from confrontations over fare payment.[158][159] Additionally, enforcement disproportionately targets Black riders, in some cases, leading to police violence.[155]

Critics of fareless transit often cite concerns about safety and service quality. Fareless transit may increase the number of disruptive riders, and fare elimination could reduce service quality, particularly if transit agencies choose to reallocate money away from other operational expenses to fund fareless transit.

WHAT EXISTING RESEARCH TELLS US

Ridership: A substantial volume of research concludes that all else equal, eliminating fares increases transit ridership. While the magnitude of the ridership response can vary based on the characteristics of the transportation system, the built environment, and the demographics of existing and prospective riders, fareless transit implementations have generally increased ridership by 20% to 60% in the short term.[160][161] Ridership responses are generally larger in the long term and for lower-income riders, which may lead to greater increases for systems with very high percentages of low-income riders, such as L.A. Metro.[161]

Fiscal Impacts: Most obviously, transit agencies lose fare revenue from fareless transit. Agencies may also need to add costly services to accommodate new riders. But fares are also expensive to collect and enforce, and these costs are often close to, or above fare revenues for agencies that receive a small share of their operating funds from fares.[161][160] Fiscal impacts will therefore be different at each agency and few independent estimates exist. However, fare elimination will generally have a smaller fiscal impact for agencies that receive less of their operating funds from fares, such as L.A. Metro. In fiscal year 2024, only 6.2% of Metro's operations budget is anticipated to come from fares.[162]

Future Research

Many impacts and benefits of fareless transit are less well understood. Particular questions include:

1. How will fareless transit affect service quality? Each rider can board faster if they can use all of a bus's doors and don't have to pay a fare, but large ridership increases can slow down transit and increase crowding.
2. Historically, what has been the net fiscal impact on transit agencies, and how have agencies paid for fareless transit initiatives? Is there a tradeoff with service? What different models could be used to fund and implement fareless transit? What are the costs of administering fare collection?
3. How will fareless transit affect perceptions of safety and the number of safety incidents on transit? How does fareless transit affect disruptive or anti-social behaviors on buses and trains? Does fareless transit reduce other conflicts, such as fare disputes, or increase safety by increasing the presence of other riders at transit stops?
4. What are the broader, long-term implications of fareless transit? For example, does it affect people's long-run decisions about where to live, how many cars to own, or what jobs to take? Are there health and educational benefits to people making trips they could not or would not have otherwise made, or would have made by car?
5. How will fareless transit affect people's long-term perceptions of transit, and how does this affect their willingness to use transit?
6. How do riders and the broader public think about the ways fareless transit initiatives relate to racial justice within the transportation system?

AGGRESSIVE DRIVING

This topic was discussed in the Safe and Healthy Transportation working group, which included physical safety from traffic violence. The group's research priorities included the need for a better understanding of how society views and understands road-based safety issues, and why there has been a recent expansion in street racing and aggressive driving behaviors. This topic also emerged as part of the cross-cutting theme of Determinants of Individual Behavior.

Aggressive driving can refer to many behaviors behind the wheel. Where road rage can be understood as intentional violence or attempted violence on the road, aggressive driving involves tailgating, cutting people off, reckless or unsafe passing, blocking cars that are attempting to pass or change lanes, running red lights, and other dangerous behaviors.[163] Aggressive driving is a factor in more than half of all fatal car crashes.[164]

WHAT EXISTING RESEARCH TELLS US

Demographic Influences of Aggressive Driving: There is a wide body of research on aggressive driving that correlates higher degrees of aggressive driving with different demographics. For example, men, especially young men, are more prone to aggressive driving.[165] [166] [167] Toxically masculine attitudes appear to increase this trend.[168] Some studies have also concluded that wealthy individuals are more likely to engage in aggressive driving, and less likely to perceive their driving as aggressive.[169] [170] [171]

Psychological Influences on Aggressive Driving: Studies of Post-Traumatic Stress Disorder (PTSD) and Attention Deficit Hyperactivity Disorder (ADHD) have found PTSD and ADHD to be correlated with aggressive driving.[172] [173] [174] [175] [176] Psychological stressors like being in a hurry, peer pressure (particularly for young people) and anger have been shown to increase aggressive driving and decrease drivers' awareness of their aggressive driving.[177] [178] [179] [180] Passion for driving is also correlated with aggressive driving behavior.[181] Lastly, anonymity increases aggressive driving behaviors, while public self-consciousness reduces them.[181] [182]

Addressing Aggressive Driving: At the individual level, interventions like cognitive behavioral therapy, group therapy, and mindfulness have been shown to reduce aggressive driving. At a societal scale, highly visible enforcement and messaging campaigns have been shown to be effective in reducing aggressive driving.[183] Tailoring messages for particular audiences, and ensuring that appeals to positive or negative emotions are in line with each audience's values, are critical to the efficacy of such campaigns.[184] [185] While examples of broad messaging campaigns are somewhat limited, there is supporting evidence that they provide a small reduction in aggressive driving as well.[186]

Future Research

While a large body of evidence shows how individual-level psychological and demographic factors affect aggressive driving, we know less about the effectiveness of interventions, especially those that go beyond individual-level messaging. Open questions include:

1. Local, state and national governments often implement awareness campaigns to reduce aggressive driving. Do these campaigns draw on the evidence base from psychology and public health through, for example, targeting messages to young men or other key audiences? Why or why not? If so, to what extent? How effective are these campaigns?
2. Cities have targeted specific behaviors, such as speeding, with road design.[187] How might road design influence aggressive driving overall? Are there road designs that reduce other aggressive driving behaviors (e.g., cutting people off), in the same way that road diets reduce speeding?
3. How effective is automated enforcement of aggressive driving? Would public opinion support this practice? What methods of automated enforcement exist (e.g., speed cameras), and how effective are they?
4. How effective might a campaign addressing the intersection of toxic masculinity and aggressive driving be? What messages might have the greatest impact on aggressive driving in young men? Have any local governments attempted to address this issue?

ELECTRIC VEHICLE INCENTIVES AND POLICY LOCK-IN

This topic emerged from the Phasing Out Fossil Fuels working group, which emphasized moving beyond a dependence on cars and freeways towards alternative, more equitable modes of travel. The group's research priorities included understanding funding priorities and the potential for the focus on electric vehicles to interfere with larger transformation and a shift from investment in freeways to transit systems. A central goal described by a group member is to find, "opportunity for more of a transition to other systems as well, instead of locking ourselves into cars forever." The topic was also part of the cross-cutting theme of Environment and Health.

Enormous investments in both electric and alternative-fuel vehicle infrastructure and public transportation are required to reduce emissions at the scale and pace needed to avoid the worst impacts of climate change.[188] Electric vehicles (EVs) and charging infrastructure are already being widely promoted and subsidized through, for example, rebates on utilities and federal taxes.[189] However, EVs are generally out of reach for low-income drivers, and EV rebates have been given predominantly to high-income electric vehicle buyers.[190] Additionally, achieving greenhouse gas reduction goals will also require a sharp increase in transit use, biking, and walking.[191] The promise of EVs bears the risk of reducing political support for funding public transit and reinforcing land use patterns devoted to private cars, even as climate change demands a rapid shift away from driving.

WHAT EXISTING RESEARCH TELLS US

EV Uptake: Cost and range anxiety are two of the most common factors cited as barriers to EV uptake.[192] Research studying the psychology of EV uptake has found that levels of environmental concern, perceptions of vehicle safety, and willingness to accept new technology are also important.[193] Incentive programs are an effective method of increasing uptake, particularly when providing upfront rebates to lower-income drivers. In the United States, financial rebates and educational programs have succeeded in increasing EV sales.[194] Non-monetary factors and incentives, such as the availability of EV infrastructure, HOV lane access, and workplace charging also play a major role.[194]

EVs and Travel Choices: After purchasing an electric vehicle, people may drive more and use public transit less.[193 195] One explanation is the rebound effect: because EVs are cheaper to drive, people may drive more. However, there is not yet a consensus on this in the literature.[193 196 197 198 199 200 201] There are also potential psychological effects of EV adoption.

Future Research

In contrast to the large volume of research that examines individuals' decisions to buy EVs, we know much less about how electric vehicle incentives affect the politics of mobility and transportation funding choices. For example, key questions include:

1. What is the relationship between government spending on EV incentives and infrastructure and spending on public transportation? How many greenhouse gas reduction pledges, laws and funds dedicated more money to private vehicle electrification instead of transit? Is there a relationship between spending on incentives for EVs and spending on public transportation or infrastructure for bicycles and pedestrians?
2. What is the potential for policy lock-in? Is EV-friendly infrastructure design in conflict with infrastructure that incentivizes biking and using public transit?[202]

MITIGATING EMISSIONS AND HEALTH IMPACTS OF ELECTRIC VEHICLES

This topic emerged from the Phasing Out Fossil Fuels Working Group, which emphasized environmental justice and the impacts of fossil fuel infrastructure, barriers to electrifying freight, and understanding who will benefit and who will be harmed from decarbonization. The group's research priorities included improving our understanding of the potential impacts of electrification. It was also part of the cross-cutting theme of Environment and Health.

Sales of electric vehicles (defined here as vehicles that rely solely on an electric battery for power) and hybrid vehicles have grown rapidly worldwide,[203] and are touted as a solution to climate change and air pollution. Despite recent progress, EVs still pose technical challenges. For example, it is still difficult for heavy electric trucks to compete with their diesel counterparts due to the weight of the batteries needed.[204] [205] Additionally, while EVs are generally less polluting than gasoline-powered vehicles, they are not environmentally benign. Even without tailpipe emissions, EVs still emit fine particulates from brake and tire wear. In recognition of the potential air quality impacts of EVs, the European Union has proposed new limits for brake and tire emissions.[206] The weight of EV batteries also puts other road users, particularly pedestrians and bicyclists, at greater risk in the event of a crash. Finally, the increased production of EVs creates international demand for precious metals like lithium, leading to environmental and health concerns related to mining.[207]

WHAT EXISTING RESEARCH TELLS US

EVs and Air Quality: EVs normally reduce greenhouse gas emissions when compared to combustion-engine vehicles, and reduce many local air pollutants as well.[208] [209] [210] [211] A 2020 study focused on air pollution and premature mortality in the United States estimated that with 75% EV adoption and increased emission-free energy sources, around $70 billion in damages could be avoided.[208] However, because of brake and tire wear and road dust, EVs still emit particulate matter and may even increase certain types of emissions.[212] [213] [214] [215] [216] [217] Potential particulate matter emissions from EVs vary based on vehicle weights, brake pad types, and regenerative braking intensity.[218] [219]

Heavy Duty Vehicles: Medium and heavy duty vehicles make up only 10% of vehicles on the road, but account for nearly 30% of transportation greenhouse gas emissions and 57%of direct particulate matter emissions.[220] These emissions disproportionately burden communities of color, who more frequently live near highways, ports, shipping terminals and warehouses due to the legacy of discriminatory policies like redlining.[13] [220] Even partial electrification of heavy duty vehicle fleets produces significant health, equity, and climate benefits, however current research does not typically include estimates of potential increases in particulate matter from brake, tire and road wear as EVs get heavier.[221] Additionally, long-haul heavy duty trucks are challenging to electrify because of battery and charging needs, and will require a combination of technological advancements and policy interventions to accelerate adoption.[220]

Crash Safety: EVs continue to become heavier and more powerful, partly because of how much their batteries weigh, and partly because automakers and U.S. consumers are favoring SUVs and other larger models.[222] Additionally, pedestrians and cyclists may be at increased risk of being hit by electric and hybrid vehicles due to their low-noise engines.[223] [224] [225] [226]

Health and Social Impacts of Mining: A large proportion of the world's lithium reserves are in concentrated geographic areas, such as the "Lithium Triangle" where Chile, Argentina and Bolivia meet. The international demand for electric batteries creates an extractivist dynamic, leading to social and environmental degradation and challenges over water rights.[227] Case studies of existing lithium mines find that a lack of mining restrictions, or challenges implementing such requirements, frequently leaves room for the exploitation of Indigenous communities.[228] [229] [230]

Future Research

While the benefits of EVs in reducing tailpipe emissions are well understood, we know less about whether or how these health benefits are offset. Particular questions include:

1. How does EV design, including size, weight and noise level, influence the risk of injury or death for pedestrians and cyclists?
2. What are the technological barriers to the electrification of heavy duty trucks, and how do potential unintended consequences from brake, tire and road wear compare to potential benefits?
3. What are the health and equity effects of non-exhaust emissions from EVs? What policy solutions are effective in mitigating those effects?
4. EV production creates environmental and social impacts globally, particularly from mining. What are the socio-economic impacts of metal extraction and use, particularly in lithium-rich areas? How should decision-makers factor in those impacts when making decisions around EV incentives and policy?

AUTO DEPENDENCY AND RESILIENCE

This topic emerged from the Resilient Transportation working group, which emphasized the harms and inequities of private-vehicle travel, as well as how our reliance on cars reduces resilience. The group's research priorities included understanding the ways in which multi-modal transit offers more adaptability than car-centric transportation, and how to create a more resilient multi-modal system. It was also part of the cross-cutting theme of Environment and Health.

Resilient cities have a strong capacity to endure disasters and other system shocks; they tend to be reflective, robust, redundant, flexible, resourceful and inclusive.[231] Dependence on cars, however, leaves cities vulnerable to crises. For example, it leaves few options for evacuation in case of fuel shortages or road blockages, or for people who do not drive. Driving also reinforces isolation and separation, while building strong social infrastructure is a key component of resilience. Finally, it contributes to the climate crisis, further destabilizing weather patterns and creating more frequent and intense shocks to cities' transportation systems. Meanwhile, multi-modal sustainable transit creates more opportunities to interact and build social infrastructure, provides multiple mode choices in case of emergency, reduces the inequities inherent to a car-first culture, and reduces harmful emissions.

WHAT EXISTING RESEARCH TELLS US

Car-Centric Evacuations: Personal vehicles are currently an integral part of evacuations. For those with access to a car, driving provides a fast and independent option to escape a crisis, such as an impending hurricane or wildfire. People who depend on transit — more often low-income people, people of color, seniors, and people with health challenges — are left vulnerable.[232] [233] Even for people able to evacuate by car, traffic congestion during evacuations from natural disasters can become deadly, and impede first responders.[234] Gasoline shortages are another major vulnerability, particularly during hurricanes.[235] In the wake of Superstorm Sandy and extreme fuel shortages, the federal government created the Northeast Gasoline Supply Reserve, storing one million barrels of gasoline in case of supply chain breakdowns.[236] However, the U.S. Government Accountability Office assessed the reserve in 2022 and found it ineffective.[237] The growing adoption of

EVs presents different challenges, including the potential for electric power shortages, outages, and insufficient range for hurricane evacuations.[238] Evacuation planning and policy has not yet caught up to EV adoption. For example, EV charging stations along major evacuation routes are often not subject to the same back-up power requirements as gasoline stations.[239]

Multi-Modal Evacuation Planning: Interconnected, multi-modal evacuation systems that include pedestrian, rail, aircraft, and bus evacuation routes are more resilient in an emergency.[240] Local network models help planners understand the interactions between different pieces of the transportation system, identify weaknesses, and improve infrastructure design (e.g., where to place crosswalks, bus and shuttle stops and priority bus lanes) to speed up evacuations.[241] However, many evacuation models and plans still focus on the traffic flow of cars, and do not sufficiently address different populations' needs.[242] Bus evacuations can be more efficient and equitable compared to personal vehicles, particularly for events with advance notice, such as a major hurricane.[233] Prioritizing buses over personal vehicles in an evacuation through bus lanes or special bus signals is an effective strategy in areas where traffic is a concern.[243] That said, bus-based evacuations require significant resources and advance planning, and many places do not have enough buses to evacuate everyone in need.[233]

Rebuilding From Disasters: In the wake of disasters, restoring transportation infrastructure to the previous standards reinforces existing vulnerabilities and inequities.[244] Communities have the opportunity to re-build in a more sustainable, resilient and equitable manner. However, reaching a consensus of what building back "better" means ahead of time is key to successful recoveries.[245] After a disaster strikes, there is a relatively short period of time to create radical change before construction plans are set.[246] For example, Christchurch, New Zealand attempted a community re-envisioning process in the wake of devastating earthquakes, but there were challenges in process and governance, with multiple levels of government creating plans that did not always align.[247] Additionally, the slow pace of insurance payouts and construction was a major barrier to the rebuild's success.[247]

Future Research

Key questions related to this topic include:

1. How can government agencies meet the emergency transportation requirements of groups with specific needs (e.g., people with visual or hearing impairments, people with limited mobility, those with certain medical conditions, seniors, people without cars, residents of rural areas, monolingual or Limited English Proficiency speakers)?
2. How should cities prepare to rebuild or re-envision major pieces of transportation infrastructure in the wake of a disaster?
3. How can transitioning from car-centric systems to multi-modal transportation systems improve resilience, especially among vulnerable populations or those without access to cars? For example, are cooling centers better utilized in areas accessible by transit?
4. How can transportation design and planning support human and social connectivity, and what impact could that have on the transportation system's resilience?

Photo Credit: iStock

TRANSPORTATION IN A CHANGING CLIMATE

This topic was discussed in the Resilient Transportation working group, which emphasized the need for human-centered design and transportation infrastructure that is adaptive to the effects of climate change, in particular extreme heat and rain. The group's research priorities included understanding how human-powered and pedestrian mobility can be adapted in response to extreme weather. It was also part of the cross-cutting theme of Environment and Health.

The world is already experiencing the effects of climate change, particularly extreme heat and flooding. These changes are becoming more severe, and without a significant reduction in global greenhouse gas emissions, the number of extremely hot days (over 95 F) is expected to dramatically increase.[248] In Los Angeles County, for example, inland areas could see 60–90 more extremely hot days by the end of the century.[248] Extreme rain and flooding events will also become more frequent as the region alternates more sharply between dry and wet weather.[249] Sea level rise will worsen flooding, which can damage essential infrastructure, including highways, bridges, ports and railways.[250] Transportation systems will have to adapt to these more severe conditions.

WHAT EXISTING RESEARCH TELLS US

Weather and Transit Ridership: People choose different modes and routes of travel depending on the weather. Light rail ridership tends to be higher in light and heavy rain, but not moderate rain.[251] It is also higher on hotter days. Bike share ridership is highest on warmer days, between 68 and 86 degrees Fahrenheit, and lower on extremely hot or cold days.[252] On extremely hot days, pedestrians often choose to take longer alternate routes if they have more shade.[253] Understanding these relationships and applying them to predicted weather conditions under climate change will help planners adapt systems and resources accordingly.

Designing Transit for Extreme Weather: Transit design and amenities can go a long way in mitigating extreme weather. Shade is extremely effective for managing extreme heat,[253] and people are willing to walk further to reach a bus stop if it is shaded.[254] Bus stops that enable breeze and incorporate amenities such as evaporative misters can also improve rider comfort and public health on hot days. New transit amenities can increase ridership,[255] but the inverse is also true — discomfort while waiting at transit stops increases perceived wait times, an important indicator of rider satisfaction.[256]

Effectiveness of Resilience Planning: Developing disaster recovery plans can help communities act quickly in the wake of disasters and take action to prepare for potential disasters ahead of time.[257] Long-term resilience planning can also mitigate future disasters. For example, long-term planning around sea level rise can lessen the damage to transportation infrastructure from future flooding and storms. The California Coastal Act requires sea level rise to be factored into planning, and provides a regulatory framework for coastal Caltrans projects.[258] However, there is still a long way to go for sea level rise planning, particularly at the local level. Recently passed California legislation (Senate Bill 272) requires Local Coastal Plans to include sea level rise plans, but compliance is not required until 2034.[259] Building trust and capacity through community-engaged planning efforts before disasters occur can increase resilience.[257] Although the quality of a resilience or recovery plans is crucial, and local land use and disaster mitigation plans are sometimes inconsistent, incomplete and difficult to operationalize.[260] Additionally, while the word "equity" is mentioned throughout many plans, it is not often translated into action.[261]

Photo Credit: Midjourney

Future Research

Existing research focuses on how weather affects mode choice, the best practices for transit amenities and design and the current state of resilience planning, but there is less knowledge available about how cities can support multi-modal transportation in new and extreme weather. Topics to investigate include:

1. To what extent do resilience and adaptation plans promote transit, walking and cycling, both today and in a hotter, wetter and more volatile future climate? This could include assessing the extent to which plans focus on the need to decommission or reroute infrastructure due to flooding and sea level rise, and the implications of the resulting shifts in transportation dynamics.
2. How does climate change affect bike and pedestrian mobility, and how can cities adapt? How can shade, cool pavements, and other design strategies be employed to best reduce climate impacts?
3. How are climate adaptation resources and amenities, such as shade structures, distributed throughout cities, and what are the equity implications? Will climate adaptation reinforce racial and income-based disparities?

IMPLICATIONS FOR POLITICS AND POLICYMAKING

The ***TRACtion*** working groups, research and conversations based on cross-cutting themes at the 2023 UCLA Arrowhead Symposium on Transforming Transportation yielded many insights into knowledge, political, and values gaps. While closing knowledge gaps is the role of the academy, politicians and policymakers are primarily responsible for addressing the political and values gaps that obstruct public agencies from achieving their goals and objectives.

While this report focuses on opportunities for researchers to inform transportation decision-making, we concede that many of the most critical barriers to a just and sustainable transportation future are not knowledge gaps, but values gaps. For example, debates over the impacts of fare-free transit are often proxy battles over the rights of unhoused people to access public space, just as debates over pedestrian safety improvements are often proxies for conflicts over the competing goals of congestion reduction and preserving human life.

More technical analysis is not the solution for values gaps, which impact the priorities for allocating scarce resources.

POLITICAL PROCESSES TO ADDRESS VALUES GAPS

Those involved in trying to change hearts and minds around transportation values should look towards housing policy in California, where legislative changes to limit the power of those who oppose new housing have been built by directly addressing values gaps over housing supply. The explicitly political processes of planning, budgeting, coalition building and storytelling can help bridge values gaps.

Strategic Use of Planning Processes

Planning processes can be used to engage stakeholders on long-term expressions of their values. Planning processes can also be used to spin wheels without moving forward.

Planning is most effective when there is disagreement about how commonly held values translate into policy and actions (i.e., there are political gaps but not values gaps), and the planning process seeks to bridge the political gaps. Planning can be impactful when planning processes explore and characterize values gaps to find possible points of agreement.

Planning is not effective when there are values gaps that the process does not directly or indirectly address, instead producing information on alternatives without confronting the underlying disagreements. When planning produces copious amounts of information, but little insight about how shared or distinct values are best expressed through government action, the situation can be characterized as "analysis paralysis."

Coalition-Building

Building coalitions is critical to making a transportation system that serves the interests — such as access to opportunities, better health outcomes and environmental sustainability — of people with less power.

In some cases, advocates for a just and sustainable transportation future should look to find new messaging and approaches to building coalitions. Shorthand advocacy calls to "reduce vehicle travel" or "stop freeway expansions," without context, will alienate potential allies who see value in the status quo, such as building trades, but who could also see value in building transit or sustainable streets infrastructure.

Expand the Focus of Transportation Decision-Making

Values gaps extend beyond transportation. However, when transportation decision-making doesn't explicitly consider these values gaps, policy debates and implementation can become mired in disagreements that public agencies are not equipped to handle.

To debate and implement policies effectively that concern values gaps, public agency leaders should expand the scope of transportation decision-making to internalize many of the system's negative externalities. Focusing narrowly on transportation creates an emphasis on efficiency, speed and congestion reduction over safety, sustainability and equity. Expanding the focus to include public health, environmental sustainability, and social issues like housing can introduce a new set of transportation solutions that are consistent with broader societal values. For example, traffic and parking issues have been leading concerns for housing project opponents,[262] [263] but now, an increasingly housing-insecure public sees long vehicle trips as a consequence of seeking housing affordability.[264]

Pilots

While novel demonstrations, including pilots, are important tools for bridging gaps in values and politics, their effectiveness is dependent on how they address values and political gaps that hinder full implementation. Pilots can bridge political gaps where people agree on values, but disagree on whether the implementation of a project or program will be consistent with those values. However, pilots can also be approached as cheap or temporary projects without goals of learning and scaling embedded in their designs.

By definition, a "pilot" is an experiment or test prior to a more widespread rollout. To be effective, pilots should be designed to inform future scaling. Pilots need not only focus on demonstrating infrastructure; processes such as public engagement (pre-project) and reaction (post-project) can be designed, evaluated, tweaked and then expanded in intensity or geography.

However, if it is widely known that a certain type of project or process works, storytelling with a focus on the narrative of urgency and scale may build more trust or goodwill than another limited pilot.

CONCLUSION

This report sets out an enormous quantity of research ideas. Many of these questions and issues speak for themselves, and can be worth taking forward for researchers, community-focused research partnerships, or transportation agencies and elected officials. However, several core messages underlie the findings.

First, there is only limited overlap between the priorities that have emerged from ***TRACtion*** and the types of questions that are commonly addressed in the pages of transportation academic journals and other research publications. This is particularly notable in regard to the themes of decision-making processes and institutional effectiveness. ***TRACtion*** shows that in many areas of policy, sufficient credible, technical information already exists for agencies to make informed decisions. The most pertinent questions, then, relate to how and why these decisions are made, particularly when they perpetuate inequities and/or environmental degradation.

As two U.K. transportation academics point out in the context of discussions on road capacity expansion and induced travel, agencies often refer to "limited information" in order to avoid acting on research findings. "It is indeed strictly true that the evidence [on induced travel] is 'limited,' in the sense that it is not unlimited," they point out. "But it is still substantial."[265] In this type of setting, the working group findings imply that further technical research may not be a priority. Instead, interdisciplinary approaches that draw from public administration and political science may yield greater rewards.

Other themes were defined more broadly by ***TRACtion*** working groups than by traditional transportation research. For example, the working groups emphasized that the critical considerations of transportation research related to safety must expand to enforcement approaches, determinants of behavior beyond design elements and non-collision safety-related impacts occurring within transportation environments.

Second, there are still many areas where basic knowledge gaps remain. Some of these relate to engineering questions — cost-effective systems to inventory sidewalk quality, for example — while others — such as aggressive driving or public agency contracting — are the domain of psychology, sociology, economics or public administration.

Third, some themes that are central to many federal and state calls for research proposals, such as traffic congestion and transportation infrastructure, do not emerge as priorities from the ***TRACtion*** process. Another little-emphasized theme is technology. Throughout the working group process, participants highlighted how technology can provide solutions to pressing transportation problems, but also pointed out the ways that it can create problems when pursued for the sake of novelty. Indeed, one fertile area for research relates to the potential unintended consequences of new technologies, such as the safety and emissions impacts related to the greater weight of electric vehicles, including increased risk to pedestrians and particulate emissions from road and tire wear.

Fourth, much of this ***TRACtion*** research agenda is of national or international relevance. Other parts, however, are more salient in the specific context of Southern California. For example, the region's high housing costs mean that income inequality also manifests in unequal access to opportunities. Additionally, many people in the region are unbanked, which in turn affects the equity of fare payment systems such as TAP cards. Moreover, the localized nature of some priorities reflects the physical and economic geography of Southern California. Los Angeles lies on an oil field and there are more than 20,000 active and inactive oil wells in Los Angeles County.[266] The region's polycentric urban structure, together with the existence of 88 independent cities within Los Angeles County alone, may also balkanize decision-making and create difficulty in reaching consensus on geographic priorities for transportation spending.

Finally, ***TRACtion*** is at heart a process to develop a community-driven research agenda for sustainable and equitable transportation. Many working group participants' priorities are related to issues that represent values gaps or political gaps between different groups of people. This leads to another potential research question: How effective is transportation research in influencing policymaker decisions? Additionally, fields traditionally viewed as separate from transportation studies, like political science, social psychology and sociology, have proved important to organizations engaging in the work of addressing values and political gaps in transportation. Transportation researchers may have opportunities to collaborate in more broad and unique ways that focus research more on changing hearts and minds, rather than infrastructure.

ACKNOWLEDGMENTS

We would like to thank the following individuals for their assistance in shaping this report.

TRACTION WORKING GROUP PARTICIPANTS

Jasneet Bains (Prevention Institute)

Tafari Bayne (CicLAvia)

Tierra Bills (UCLA Civil and Environmental Engineering, Public Policy)

Henry Burton (UCLA Civil and Environmental Engineering)

Guang Cheng (UCLA Statistics and Data Science)

Tamar Christensen (UCLA Writing Programs)

Rachel Connoly (UCLA Luskin Center for Innovation)

Dana Cuff (cityLAB UCLA)

Yolanda Davis-Overstreet (Yolanda Davis-Overstreet Consulting, Biking While Black)

Sahar Derakhshan (UCLA Luskin Center for Innovation)

Alfonso Directo, Jr. (Alliance for Community Transit - LA)

Kristopher Eclarino (Climate Resolve)

Ruth Engel (UCLA Luskin Center for Innovation)

Randall Fallows (UCLA Writing Programs)

John Gahbauer (UCLA Institute of Transportation Studies)

Brian Yueshuai He (UCLA Civil and Environmental Engineering)

Scott Hindell (UCLA Extension)

Raul Hinojosa (UCLA Chicana, Chicano and Central American Studies, North American Integration and Development Center)

Damian Kevitt (Streets are for Everyone)

Linda Khamoushian (GRID Alternatives)

Keith Klein (UCLA Medicine)

Rayne Laborde Ruiz (cityLAB UCLA)

Eli Lipmen (Move LA)

Jimmy Lizama (Re:Ciclos)

mark! Lopez (East Yard Communities for Environmental Justice)

Jiaqi Ma (UCLA Civil and Environmental Engineering)

Allison Mannos (Allison Mannos Consulting, Advocate)

Adam Millard-Ball (UCLA Urban Planning)

Megan Mullin (UCLA Public Policy, Luskin Center for Innovation)

Claire Nelischer (UCLA Architecture, cityLAB)

Dilia Ortega (Communities for a Better Environment)

Tala Oszkay Febres-Cordero (Alliance for Community Transit - LA)

Regan Patterson (UCLA Civil and Environmental Engineering)

Suzanne Paulson (UCLA Atmospheric & Oceanic Sciences)

Gregory Pierce (UCLA Luskin Center for Innovation)

Stephanie Pincetl (UCLA Institute of the Environment and Sustainability)

Deepak Rajagopal (UCLA Institute of Environment and Sustainability, Urban Planning)

Andres Ramirez (People for Mobility Justice)

Stephanie Ramirez (South Los Angeles Transit Empowerment Zone)

Donald Shoup (UCLA Urban Planning)

Julia Stein (UCLA Emmett Institute on Climate Change & the Environment)

Jacob Wasserman (UCLA Institute of Transportation Studies)

Walker Wells (Raimi + Associates, UCLA Urban Planning)

Zhiyuan Yao (UCLA Data Science Center)

John Yi (Los Angeles Walks)

Oscar Zarate (Strategic Actions for a Just Economy)

Yifang Zhu (UCLA Environmental Health Sciences)

UCLA TRACtion Team

Moderators

Madeline Brozen
Adonia Lugo
Juan Matute

Facilitators

Jennifer Craer
Sophie Katz

Graduate Student Researchers

tamika l. butler
Chase Engelhardt
Carolyn Pugh
Monisha Reginald

Student Notetakers

Phoebe Chiu
Shaellen Franco
Mehrnush (Nushy) Golriz
Charles Kellenberger
Hannah Schwartz
Galyn Sumida-Ross

Institute of Transportation Studies

Claudia Bustamante
Whitney Willis

Sustainable LA Grand Challenge

Alex Hall
Eric Hoek
Natalie Kaye
Cassie Rauser
Katie Son
Jonathan Van Dyke

Research Agenda Section Reviewers

Tierra Bills
Evelyn Blumenberg
Hannah King
Anastasia Loukaitou-Sideris
Adonia Lugo
Megan Mullin
Stephanie Pincetl
Julia Stein
Brian D. Taylor
Yifang Zhu

Authors

Juan Matute, Chase Engelhardt, Carolyn Pugh, Monisha Reginald, tamika l. butler, Adam Millard-Ball

Contributors

Juan Matute and Jennifer Craer jointly created the ***TRACtion*** process with the substantial input of Adam Millard-Ball.

Juan Matute managed the ***TRACtion*** working groups process and the process to create this ***TRACtion*** Report. Moderators Madeline Brozen, Adonia Lugo and Juan Matute engaged each working group on subject matter and revisited previous notes to strengthen the ***TRACtion*** team's understanding of working group input. Facilitators Jennifer Craer and Sophie Katz encouraged the balanced participation of all who attended the meetings.

Adam Millard-Ball provided intellectual leadership for the ***TRACtion*** Report.

Graduate student researchers tamika l. butler, Chase Engelhardt, Carolyn Pugh and Monisha Reginald provided research-based information to the working groups, participated in the identification and definition of cross-cutting themes, and performed the research for sections on Transportation and Sustainability in Los Angeles, Developing a Research Agenda and the 2023 ***TRACtion*** Research Agenda.

Student notetakers recorded and summarized notes from each of ***TRACtion's*** 17 working group meetings.

Allison Mannos, Tala Oszkay Febres-Cordero and Jennifer Craer reviewed the draft ***TRACtion*** Report.

Any errors or omissions are those of the authors.

Design & Editorial Team

Graphic design
Studio de Castro

Editing
Joe Rihn

Publication coordination
Claudia Bustamante

1. Haagen-Smit, A. J. The Control of Air Pollution. *Sci. Am.* **210**, 24–31 (1964).

2. Shoup, D. C. *The High Cost of Free Parking*. (Planners Press, American Planning Association Washington, DC, USA, 2005).

3. Los Angeles County Metropolitan Transportation Authority. 2020 Long Range Transportation Plan. (2020).

4. Office of Los Angeles Mayor Eric Garcetti. LA's Green New Deal Plan. *L.A.'s Green New Deal | Sustainability plan 2019* ***https://plan.lamayor.org/targets*** (2019).

5. Marsden, G. & Reardon, L. Questions of governance: Rethinking the study of transportation policy. *Transp. Res. Part -Policy Pract.* **101**, 238–251 (2017).

6. Cohen, M. D., March, J. G. & Olsen, J. P. A Garbage Can Model of Organizational Choice. *Adm. Sci. Q.* **17**, 1–25 (1972).

7. Kingdon, J. *Agendas, Alternatives, and Public Policies*. (Little, Brown, 1984).

8. Boswell, C. & Smith, K. Rethinking policy 'impact': four models of research-policy relations. *Palgrave Commun.* **3**, 1–10 (2017).

9. UCLA Clinical and Translational Sciences Institute. Top 10 Causes of Premature Death. ***https://ctsi.ucla.edu/overview/pages/top10*** (2023).

10. U.S. Environmental Protection Agency. 2022 TRI Factsheet for Los Angeles County, CA | TRI Explorer | US EPA. ***https://enviro.epa.gov/triexplorer/tri_factsheet.factsheet?pParent=TRIQ1&pDataset=TRIQ1&pstate=CA&pcounty=Los%20Angeles&pFips=06037&pyear=2022*** (2023).

11. Dhillon, R. LA County GHG Inventory. (2023).

12. Current California GHG Emission Inventory Data | California Air Resources Board. *CA.Gov* ***https://ww2.arb.ca.gov/ghg-inventory-data***.

13. Rowangould, G. A census of the US near-roadway population: Public health and environmental justice considerations. *Transp. Res. Part -Transp. Environ.* **25**, 59–67 (2013).

14. Donaghy, T. Q., Healy, N., Jiang, C. Y. & Battle, C. P. Fossil fuel racism in the United States: How phasing out coal, oil, and gas can protect communities. *Energy Res. Soc. Sci.* **100**, 103104 (2023).

15. Brugge, D., Durant, J. L. & Rioux, C. Near-highway pollutants in motor vehicle exhaust: A review of epidemiologic evidence of cardiac and pulmonary health risks. *Environ. Health* **6**, 23 (2007).

16. Brauer, M. *et al*. A Cohort Study of Traffic-Related Air Pollution Impacts on Birth Outcomes. *Environ. Health Perspect.* **116**, 680–686 (2008).

17. Bhusal, S., Blumenberg, E. & Brozen, M. Access to Opportunities Primer. (2021).

18. Murphy, B. & Owen, A. Access Across America: Transit 2019 Data - Los angeles.

19. Callahan, C., Coffee, D., DeShazo, J. R. & Gonzalez, S. R. Making Justice40 a Reality for Frontline Communities. ***https://innovation.luskin.ucla.edu/wp-content/uploads/2021/10/luskin-justice40-final-web-1.pdf*** (2021).

20. *2045 Climate Action Plan - County of Los Angeles*. ***https://planning.lacounty.gov/long-range-planning/climate-action-plan/documents/*** (2022).

21. LADWP Media Advisory: Passage of Council Motion Mandating 100 percent Clean Energy by 2035. ***https://www.ladwpnews.com/media-advisory-krekorian-ofarrell-mark-passage-of-council-motion-mandating-100-percent-clean-energy-by-2035/*** (2021).
22. City of Los Angeles 2021 Community Greenhouse Gas Inventory. ***https://www.lacitysan.org/cs/groups/public/documents/document/y250/mdg4/~edisp/cnt088358.pdf*** (2023).
23. Criteria Air Pollutants in Los Angeles. *County of Los Angeles Public Health* ***http://publichealth.lacounty.gov/eh/safety/criteria-air-pollutants.htm***.
24. Air Quality Management Plan (AQMP). *South Coast AQMD* ***http://www.aqmd.gov/home/air-quality/clean-air-plans/air-quality-mgt-plan*** (2022).
25. U.S. Environmental Protection Agency. AirData Annual Summary Data. (2023).
26. Ji Luo, Chao Wang, Barry Wallerstein, Matthew Barth, & Kanok Boriboonsomsin. Heavy-duty truck routing strategy for reducing community-wide exposure to associated tailpipe emissions. Transp. Res. Part -Transp. Environ. **107,** 103289–103289 (2022).
27. Xu Bai, Ht, C. & Oliver, B. G. The health effects of traffic-related air pollution: A review focused the health effects of going green. *Chemosphere* 133082 (2021) doi:10.1016/j.chemosphere.2021.133082.
28. Aaron Cohen *et al*. Estimates and 25-year trends of the global burden of disease attributable to ambient air pollution: an analysis of data from the Global Burden of Diseases Study 2015. *The Lancet* **389**, 1907–1918 (2017).
29. Paul, K. C., Haan, M. N., Mayeda, E. R. & Ritz, B. Ambient Air Pollution, Noise, and Late-Life Cognitive Decline and Dementia Risk. *Annu. Rev. Public Health* **40**, 203–220 (2019).
30. Haley M. Lane, Rachel Morello-Frosch, Marshall, J. D. & Apte, J. S. Historical Redlining Is Associated with Present-Day Air Pollution Disparities in U.S. Cities. *Environ. Sci. Technol. Lett.* (2022) doi:10.1021/acs.estlett.1c01012.
31. Tian, N., Xue, J. & Barzyk, T. M. Evaluating socioeconomic and racial differences in traffic-related metrics in the United States using a GIS approach. *J. Expo. Sci. Environ. Epidemiol.* **23**, 215–222 (2013).
32. Clark, L. P., Millet, D. B. & Marshall, J. D. Changes in Transportation-Related Air Pollution Exposures by Race-Ethnicity and Socioeconomic Status: Outdoor Nitrogen Dioxide in the United States in 2000 and 2010. *Environ. Health Perspect.* **125**, 097012–097012 (2017).
33. Apelberg, B. J., Buckley, T. J. & White, R. H. Socioeconomic and Racial Disparities in Cancer Risk from Air Toxics in Maryland. *Environ. Health Perspect.* **113**, 693–699 (2005).
34. Yifan Wang *et al*. Disparities in ambient nitrogen dioxide pollution in the United States. *Proc. Natl. Acad. Sci. U. S. A.* (2023) doi:10.1073/pnas.2208450120.
35. Motor Vehicle & Child Passenger Safety. *L.A. COUNTY PUBLIC HEALTH - Injury & Violence Prevention Program* ***http://publichealth.lacounty.gov/ivpp/injury_topics/MotorVehOccup/MVHOME.htm***.
36. Vision Zero - Los Angeles City. *LADOT Livable Streets* ***https://ladotlivablestreets.org/***.
37. Vision Zero - Los Angeles County. ***https://pw.lacounty.gov/visionzero/#***.
38. Safe Transportation Research & Education Center. Transportation Injury Mapping System. (2023).
39. Garcetti, E. Executive Directive No. 10. ***https://d3n8a8pro7vhmx.cloudfront.net/mayorofla/pages/17070/attachments/original/1440454405/Mayor_Garcetti_File_Executive_Directive_10_Vision_Zero.pdf?1440454405*** (2015).

40. Macek, K. *Pedestrian Traffic Fatalities by State - 2022 Preliminary Data*. ***https://www.ghsa.org/sites/default/files/2023-06/GHSA%20-%20Pedestrian%20Traffic%20Fatalities%20by%20State%2C%202022%20Preliminary%20Data%20%28January-December%29.pdf*** (2023).

41. Office of Health Assessment and Epidemiology. Patterns in Mortality Among Los Angeles County Residents from January 1 – June 30 of 2019, 2020, 2021, and 2022. *County of Los Angeles Public Health* ***http://www.publichealth.lacounty.gov/media/coronavirus/docs/Six_Month_Mortality_Patterns_2019_to_2022.pdf***.

42. Raifman, M. & Ernani F. Choma. Disparities in Activity and Traffic Fatalities by Race/Ethnicity. *Am. J. Prev. Med.* (2022) doi:10.1016/j.amepre.2022.03.012.

43. Brozen, M. & Yahata Ekman, A. The Need to Prioritize Black Lives in LA's Traffic Safety Efforts. ***https://escholarship.org/uc/item/0dm6x8k4*** (2020).

44. Center for Health Impact Evaluation. Mortality Rates and Causes of Death Among People Experiencing Homelessness in Los Angeles County: 2014-2021. *Los Angel. Cty. Dep. Public Health* (2023).

45. FM3 Research. Los Angeles County Quality of Life Survey 2023. ***https://ucla.app.box.com/s/1kymzqkmzkk3tbvh0wmxdzf4mj58aco8*** (2023).

46. Manville, M. *Measure M and the Potential Transformation of Mobility in Los Angeles*. ***https://escholarship.org/uc/item/3t41j8gv*** (2018).

47. Ralph, K. M., Klein, N. J., Calvin Thigpen & Brown, A. Are Transportation Planning Views Shared by Engineering Students and the Public? *J. Plan. Educ. Res.* (2022) doi:10.1177/0739456x221097840.

48. Gase, L. N., Barragan, N. C., Simon, P. A., Jackson, R. J. & Kuo, T. Public awareness of and support for infrastructure changes designed to increase walking and biking in Los Angeles County. *Prev. Med.* **72**, 70–75 (2015).

49. B. Dao *et al*. Public support of street projects to improve traffic safety in unincorporated Los Angeles County: Developing an action plan to eliminate traffic-related fatalities. *J. Transp. Amp Health* (2023) doi:10.1016/j.jth.2023.101622.

50. Fonseca, R. In Culver City's street space battle, cars are set to make a comeback. *Los Angeles Times* (2023).

51. Bureau of Economic Analysis. Table 3033. Selected western metropolitan statistical areas: Average annual expenditures and characteristics, Consumer Expenditure Surveys, 2021-2022.

52. U.S. Department of Transportation Bureau of Transportation Statistics. Transportation Economic Trends: Household Spending on Transportation. ***https://data.bts.gov/stories/s/Transportation-Economic-Trends-Transportation-Spen/ida7-k95k/***.

53. California State Controller's Office. City Street Raw Data 2017-18 to 2021-22. SCO By the Numbers (2023).

54. California State Controller's Office. Counties Raw Data 2017-18 to 2021-22. SCO By the Numbers (2023).

55. California State Controller's Office. Transit Operator Raw Data 2020-21 to 2021-22. SCO By the Numbers (2023).

56. Los Angeles County Metropolitan Transportation Authority. Adopted Budget: July 1, 2021 - June 30, 2022. ***https://www.dropbox.com/s/avhdm0gll5phdxb/FY22%20Adopted%20Budget.pdf***.

57. Wachs, M., Chesney, P. S. & Hwang, Y. H. *A Century of Fighting Traffic Congestion-in Los Angeles: 1920 - 2020*. ***https://luskincenter.history.ucla.edu/wp-content/uploads/sites/66/2020/10/A-Century-of-Fighting-Traffic-Congestion-in-LA.pdf*** (2020).

58. Sorensen, P. *et al. Moving Los Angeles: Short-Term Policy Options for Improving Transportation*. ***https://www.rand.org/pubs/monographs/MG748.html*** (2008).

59. Elkind, E. N. *Railtown: The Fight for the Los Angeles Metro Rail and the Future of the City*. (2014).

60. Lugo, A. Bicycle/Race: Transportation, Culture, & Resistance. *Microcosm Publishing* ***https://microcosmpublishing.com/catalog/books/7833*** (2018).

61. Bottles, S. L. *Los Angeles and the Automobile: The Making of the Modern City*. (University of California Press, 1987).

62. Wasserman, J. L. *et al.* The Future of Transportation and Urban Planning: A California 100 Report on Policies and Future Scenarios. (2022).

63. UCLA Institute of Transportation Studies & UCLA Sustainable LA Grand Challenge. ***TRACtion***: Transformative Transportation: An Introduction. ***https://bit.ly/TRACtionDiscussions*** (2023).

64. UCLA Institute of Transportation Studies & UCLA Sustainable LA Grand Challenge. ***TRACtion***: Transformative Transportation Working Groups Synthesis. (2023) doi:10.17610/T6V890.

65. M. Ryghaug *et al.* A Social Sciences and Humanities research agenda for transport and mobility in Europe: key themes and 100 research questions. *Soc. Sci. Res. Netw.* (2023) doi:10.1080/01441647.2023.2167887.

66. Lucas, K., Hanegraaff, M. & De Bruycker, I. Lobbying the lobbyists: when and why do policymakers seek to influence advocacy groups in global governance? *Interest Groups Advocacy* **8**, 208–232 (2019).

67. McNutt, J. Is Social Work Advocacy Worth the Cost? Issues and Barriers to an Economic Analysis of Social Work Political Practice. *Res. Soc. Work Pract.* **21**, 397–403 (2011).

68. Hoefer, R. Altering State Policy: Interest Group Effectiveness among State-Level Advocacy Groups. *Soc. Work* **50**, 219–227 (2005).

69. Baumgartner, F. R. & Leech, B. L. *Basic Interests: The Importance of Groups in Politics and in Political Science*. (Princeton University Press, 1998).

70. Anzia, S. F. *Local Interests: Politics, Policy, and Interest Groups in US City Governments*. (University of Chicago Press, 2022).

71. Warshaw, C. Local Elections and Representation in the United States. *Annu. Rev. Polit. Sci.* **22**, 461–479 (2019).

72. Sances, M. W. When Voters Matter: The Limits of Local Government Responsiveness. *Urban Aff. Rev.* **57**, 402–427 (2021).

73. Schaffner, B. F., Rhodes, J. H. & La Raja, R. J. *Hometown Inequality: Race, Class, and Representation in American Local Politics*. (Cambridge University Press, 2020). doi:10.1017/9781108662550.

74. Anzia, S. F. Party and Ideology in American Local Government: An Appraisal. *Annu. Rev. Polit. Sci.* **24**, 133–150 (2021).

75. Fischel, W. A. Homevoters, Municipal Corporate Governance, and the Benefit View of the Property Tax. *Natl. Tax J.* **54**, 157–173 (2001).

76. Gilens, M. & Page, B. I. Testing Theories of American Politics: Elites, Interest Groups, and Average Citizens. *Perspect. Polit.* **12**, 564–581 (2014).

77. Lang, C., Weir, M. & Pearson-Merkowitz, S. Status quo bias and public policy: evidence in the context of carbon mitigation. *Environ. Res. Lett.* **16**, 054076 (2021).

78. Hopkins, D. J. *The Increasingly United States: How and Why American Political Behavior Nationalized*. (University of Chicago Press, 2018).

79. Hill, S. J. & Tausanovitch, C. A Disconnect in Representation? Comparison of Trends in Congressional and Public Polarization. *J. Polit.* **77**, 1058–1075 (2015).

80. Lapowsky, I. This Is What Congress Does With Your Phone Calls and Emails. *Wired* (2018).

81. Open Government Foundation. From Voicemails to Votes. *From Voicemails to Votes* ***https://v2v.opengovfoundation.org/*** (2017).

82. Broockman, D. E. & Skovron, C. Bias in Perceptions of Public Opinion among Political Elites. *Am. Polit. Sci. Rev.* **112**, 542–563 (2018).

83. Gallup. How does the World Feel About Science and Health? ***https://wellcome.org/sites/default/files/wellcome-global-monitor-2018.pdf*** (2018).

84. Merkley, E. Anti-Intellectualism, Populism, and Motivated Resistance to Expert Consensus. *Public Opin. Q.* **84**, 24–48 (2020).

85. Gudmundsson, H. & Sørensen, C. H. Some use—Little influence? On the roles of indicators in European sustainable transport policy. *Ecol. Indic.* **35**, 43–51 (2013).

86. Shanley, P. & López, C. Out of the Loop: Why Research Rarely Reaches Policy Makers and the Public and What Can be Done. *Biotropica* **41**, 535–544 (2009).

87. Levine, A. S. Single Conversations Expand Practitioners' Use of Research: Evidence from a Field Experiment. *PS Polit. Sci. Polit.* **54**, 432–437 (2021).

88. Guess, A. & Coppock, A. Does Counter-Attitudinal Information Cause Backlash? Results from Three Large Survey Experiments. *Br. J. Polit. Sci.* **50**, 1497–1515 (2020).

89. Bolsen, T. & Palm, R. Motivated Reasoning and Political Decision Making. in *Oxford Research Encyclopedia of Politics* (2019). doi:10.1093/acrefore/9780190228637.013.923.

90. Haynes, A. S. *et al.* Galvanizers, Guides, Champions, and Shields: The Many Ways That Policymakers Use Public Health Researchers. *Milbank Q.* **89**, 564–598 (2011).

91. Brulle, R. J. The climate lobby: a sectoral analysis of lobbying spending on climate change in the USA, 2000 to 2016. *Clim. Change* **149**, 289–303 (2018).

92. Fyall, R. The Power of Nonprofits: Mechanisms for Nonprofit Policy Influence. *Public Adm. Rev.* **76**, 938–948 (2016).

93. Junk, W. M. When Diversity Works: The Effects of Coalition Composition on the Success of Lobbying Coalitions. *Am. J. Polit. Sci.* **63**, 660–674 (2019).

94. Ford, A. *Modeling the Environment, Second Edition*. (Island Press, 2009).

95. Beimborn, E., Kennedy, R. & Schaefer, W. Inside the Blackbox: Making Transportation Models Work for Livable Communities. (2006).

96. Miller, H. J. Theories and Models in Transportation Planning. in *The Geography of Urban Transportation Planning* 113–186 (Guilford Press, 2017).

97. Ortúzar, J. de D., Willumsen, L. G. & Consultancy, L. W. Modelling Transport (4th ed.). *Wiley* (2011).

98. Southworth, F. & Garrow, L. A. Travel Demand Modeling. in *Wiley Encyclopedia of Operations Research and Management Science* (2011). doi:10.1002/9780470400531.eorms0922.

99. Algers, S., Eliasson, J. & Mattsson, L.-G. Is it time to use activity-based urban transport models? A discussion of planning needs and modelling possibilities. *Ann. Reg. Sci.* **39**, 767–789 (2005).

100. Bhat, C. R. & Koppelman, F. S. Activity-Based Modeling of Travel Demand. in *Handbook of Transportation Science* (ed. Hall, R. W.) 39–65 (Springer US, 2003). doi:10.1007/0-306-48058-1_3.

101. Ben-Akiva, M. E. & Bowman, J. L. Activity Based Travel Demand Model Systems. in *Equilibrium and Advanced Transportation Modelling* (eds. Marcotte, P. & Nguyen, S.) 27–46 (Springer US, 1998). doi:10.1007/978-1-4615-5757-9_2.

102. Wachs, M. Learning from Los Angeles: transport, urban form, and air quality. *Transportation* **20**, 329–354 (1993).

103. Bills, T. S., Sall, E. A. & Walker, J. L. Activity-Based Travel Models and Transportation Equity Analysis: Research Directions and Exploration of Model Performance. *Transp. Res. Rec.* **2320**, 18–27 (2012).

104. Cahill, C. Repositioning Ethical Commitments: Participatory Action Research as a Relational Praxis of Social Change. *ACME Int. J. Crit. Geogr.* **6**, 360–373 (2007).

105. Pain, R., Kesby, M. & Askins, K. The politics of social justice in neoliberal times: a reply to Slater. Area **44**, 120–123 (2012).

106. Battaglio Jr., R. P., Belardinelli, P., Bellé, N. & Cantarelli, P. Behavioral Public Administration ad fontes: A Synthesis of Research on Bounded Rationality, Cognitive Biases, and Nudging in Public Organizations. *Public Adm. Rev.* **79**, 304–320 (2019).

107. Lane, J.-E. The Principal–Agent Approach and Public Administration. in *Oxford Research Encyclopedia of Politics* (2020). doi:10.1093/acrefore/9780190228637.013.1462.

108. Whynes, D. K. Can Performance Monitoring Solve the Public Services' Principal-Agent Problem? *Scott. J. Polit. Econ.* **40**, 434–446 (1993).

109. Hong, S. A Behavioral Model of Public Organizations: Bounded Rationality, Performance Feedback, and Negativity Bias. *J. Public Adm. Res. Theory* **29**, 1–17 (2019).

110. Hong, S. Performance Management Meets Red Tape: Bounded Rationality, Negativity Bias, and Resource Dependence. *Public Adm. Rev.* **80**, 932–945 (2020).

111. Wiesel, F., Modell, S. & Moll, J. Customer Orientation and Management Control in the Public Sector: A Garbage Can Analysis. *Eur. Account. Rev.* **20**, 551–581 (2011).

112. Olsen, J. P. Garbage Cans, New Institutionalism, and the Study of Politics. *Am. Polit. Sci. Rev.* **95**, 191–198 (2001).

113. Jensen, P. H. & Stonecash, R. E. The Efficiency of Public Sector Outsourcing Contracts: A Literature Review. SSRN Scholarly Paper at ***https://doi.org/10.2139/ssrn.625461*** (2004).

114. Bloomfield, P. & Ahern, F. D. Long-Term Infrastructure Partnerships: Contracting Risks and Risk-Reduction Strategies. *State Local Gov. Rev.* **43**, 49–59 (2011).

115. Ernita Joaquin, M. & Greitens, T. J. Contract Management Capacity Breakdown? An Analysis of U.S. Local Governments. *Public Adm. Rev.* **72**, 807–816 (2012).

116. LA Metro. Results of our 2022 Customer Experience Survey. *The Source* ***https://thesource.metro.net/2022/10/27/results-of-our-2022-customer-experience-survey/*** (2022).

117. Song, L. & Mizrahi, E. From Infrastructural Repair to Reparative Planning. *J. Am. Plann. Assoc.* **0**, 1–14 (2023).

118. Cialdini, R. B., Reno, R. R. & Kallgren, C. A. A focus theory of normative conduct: Recycling the concept of norms to reduce littering in public places. *J. Pers. Soc. Psychol.* **58**, 1015–1026 (1990).

119. Davies, E. J., Jackson, J. M. & Streeter, S. Bringing abolition in: Addressing carceral logics in social science research. *Soc. Sci. Q.* **102**, 3095–3102 (2021).

120. Moore, S. Understanding and managing anti-social behaviour on public transport through value change: The considerate travel campaign. *Transp. Policy* **18**, 53–59 (2011).

121. Parker, B. *Masculinities and Markets*. (2017).

122. Eichler, M. Change of Plans: Towards a Non-Sexist Sustainable City. (University of Toronto Press, 1995).

123. Rosenberger, R. *Callous Objects: Designs against the Homeless*. (U of Minnesota Press, 2017).

124. Rivadeneyra, A. T., Dodero, A. L., Mehndiratta, S. R., Alves, B. B. & Deakin, E. Reducing Gender-Based Violence in Public Transportation: Strategy Design for Mexico City, Mexico. *Transp. Res. Rec.* **2531**, 187–194 (2015).

125. Cialdini, R. B., Kallgren, C. A. & Reno, R. R. A Focus Theory of Normative Conduct: A Theoretical Refinement and Reevaluation of the Role of Norms in Human Behavior. in *Advances in Experimental Social Psychology* (ed. Zanna, M. P.) vol. 24 201–234 (Academic Press, 1991).

126. Millie, A. Anti-Social Behaviour, Behavioural Expectations and an Urban Aesthetic. *Br. J. Criminol.* **48**, 379–394 (2008).

127. McGuirk, J. *Radical Cities: Across Latin America in Search of a New Architecture*. (Verso, 2014).

128. Skogan, W. G. Evaluation of CeaseFire-Chicago. (2009).

129. Webster, D. & Whitehill, J. M. Evaluation of Baltimore's Safe Street Program: Effects on Attitudes, Participants' Experiences, and Gun Violence | Office of Justice Programs. ***https://www.ojp.gov/ncjrs/virtual-library/abstracts/evaluation-baltimores-safe-street-program-effects-attitudes*** (2012).

130. Policing Project at NYU Law. Convening of Minneapolis Community Leaders: Reimagining Public Safety. ***https://mn.gov/mdhr/assets/Convening%20of%20Minneapolis%20Community%20Leaders%20Cover_merged_tcm1061-516316.pdf*** (2021).

131. Ammar, A., Dillon, M. & Man Oram, M.-Y. Queering Public Space. ***https://www.arup.com/en/perspectives/publications/research/section/queering-public-space*** (2021).

132. Suppakittpaisarn, P., Jiang, X. & Sullivan, W. C. Green Infrastructure, Green Stormwater Infrastructure, and Human Health: A Review. *Curr. Landsc. Ecol. Rep.* **2**, 96–110 (2017).

133. Moqadam, S. & Nubani, L. The Impact of Spatial Changes of Shiraz's Historic District on Perceived Anti-Social Behavior. *Sustainability* **14**, 8446 (2022).

134. Su, N., Li, W. & Qiu, W. Measuring the associations between eye-level urban design quality and on-street crime density around New York subway entrances. *Habitat Int.* **131**, 102728 (2023).

135. Gamble, J. L. & Hess, J. J. Temperature and Violent Crime in Dallas, Texas: Relationships and Implications of Climate Change. *West. J. Emerg. Med.* **13**, 239–246 (2012).

136. Heilmann, K., Kahn, M. E. & Tang, C. K. The urban crime and heat gradient in high and low poverty areas. *J. Public Econ.* **197**, 104408 (2021).

137. Sohn, D.-W., Yoon, D. K. & Lee, J. The impact of neighborhood permeability on residential burglary risk: A case study in Seattle, USA. *Cities* **82**, 27–34 (2018).

138. Cozens, P. Planning Policy and Designing Out Crime in Western Australia - The Issue of Permeability. *Plan. Perspect. West. Aust. Read. Pract. Theory* 307–323 (2010).

139. Grannis, R. The Importance of Trivial Streets: Residential Streets and Residential Segregation. *Am. J. Sociol.* **103**, 1530–1564 (1998).

140. Smith, N. & Walters, P. Desire lines and defensive architecture in modern urban environments. *Urban Stud.* **55**, 2980–2995 (2018).

141. Atkinson, R. Domestication by Cappuccino or a Revenge on Urban Space? Control and Empowerment in the Management of Public Spaces. *Urban Stud.* **40**, 1829–1843 (2003).

142. Kern, L. *Feminist City: Claiming Space in a Man-made World*. (Routledge, 2020).

143. Bates, C. Conviviality, disability and design in the city. *Sociol. Rev.* **66**, 984–999 (2018).

144. *BodySpace: Destabilising Geographies of Gender and Sexuality*. (Routledge, 1996). doi:10.4324/9780203974070.

145. Anderson, E. "The White Space". *Sociol. Race Ethn.* **1**, 10–21 (2015).

146. *How Can We Do Better? Limits on Black Mobility in Transportation*. (2020).

147. Martens, K., Golub, A. & Robinson, G. A justice-theoretic approach to the distribution of transportation benefits: Implications for transportation planning practice in the United States. *Transp. Res. Part Policy Pract.* **46**, 684–695 (2012).

148. Seo, S. The New Public. *Yale J* **125**, 1616 (2016).

149. Woods, J. B. Traffic Without the Police. SSRN Scholarly Paper at ***https://papers.ssrn.com/abstract=3702680*** (2021).

150. Ralph, K., Barajas, J. M., Johnson-Rodriguez, A., Delbosc, A. & Muir, C. Can a racial justice frame help overcome opposition to automated traffic enforcement? *Transp. Res. Interdiscip. Perspect.* **14**, 100594 (2022).

151. Roe, D. Black Cyclists Are Stopped More Often Than Whites, Police Data Shows. *Bicycling* (2020).

152. Brown, C. T., Rose, J. & Kling, S. *Arrested Mobility Report*. ***https://arrestedmobility.com/report/*** (2023).

153. Carter, T. & Johnson, L. "Blacks Can't Jump": The Racialization of Transit Police Responses to Fare Evasion. *Race Justice* **13**, 215336872110075 (2021).

154. Dembo, M. Off the Rails: Alternatives to Policing on Transit. (2020) doi:10.17610/T6XK56.

155. Alliance for Community Transit — Los Angeles, American Civil Liberties Union of Southern California, CoDesign @ Harvard Graduate School of Design, Public Counsel - Statewide Education Rights Project, & Tamika L. Butler Consulting. *Metro as a Sanctuary: Reimagining Safety on Public Transit*. 63 ***http://allianceforcommunitytransit.org/wp-content/uploads/2021/03/Metro-as-a-Sanctuary-ACT-LA.pdf*** (2021).

156. 2022 LA METRO CUSTOMER SURVEY. *ETC Institute* ***https://etcinstitute.com/communityplanning/transportation/la-metro-bus-customer-survey/*** (2022).

157. Chelsea, K. *THE ROAD TO TRANSIT EQUITY: The Case for Universal Fareless Transit in Los Angeles*. 69 ***https://www.saje.net/wp-content/uploads/2023/05/SAJE-The-Road-to-Transit-Equity.pdf*** (2023).

158. Eyken, C. V. *Bus Operators in Crisis: The Steady Deterioration of One of Transit's Most Essential Jobs, and How Agencies Can Turn Things Around*. 36 ***https://transitcenter.org/wp-content/uploads/2022/07/Bus-Operators-in-Crisis_RGB_Interactive-1.pdf*** (2022).

159. Nakanishi, Y. J. & Fleming, W. C. *Practices to Protect Bus Operators from Passenger Assault*. (National Academies Press, 2011). doi:10.17226/14609.

160. Volinski, J. *Implementation and Outcomes of Fare-Free Transit Systems*. (Transportation Research Board, 2012). doi:10.17226/22753.

161. King, H. & Taylor, B. D. Considering Fare-Free Transit in The Context of Research on Transit Service and Pricing: A Research Synthesis. (2023) doi:10.17610/T6161T.

162. Los Angeles County Metropolitan Transportation Authority. Fiscal Year 2024 Proposed Budget Book Summary. ***https://budget.metro.net/wp-content/uploads/Adopted/Fiscal%20Year%202024%20Proposed%20Budget%20Book%20Summary.pdf***.

163. AAA Exchange. Aggressive Driving. ***https://exchange.aaa.com/safety/driving-advice/aggressive-driving/*** (2019).

164. González-Iglesias, B., Gómez-Fraguela, J. A. & Luengo-Martín, M. Á. Driving anger and traffic violations: Gender differences. *Transp. Res. Part F Traffic Psychol. Behav.* **15**, 404–412 (2012).

165. Deniz, P., Lajunen, T., Özkan, T. & Gaygısız, E. Masculinity, femininity, and angry drivers: Masculinity and femininity as moderators between driver anger and anger expression style among young drivers. *Accid. Anal. Prev.* **161**, 106347 (2021).

166. Fountas, G., Pantangi, S. S., Hulme, K. F. & Anastasopoulos, P. Ch. The effects of driver fatigue, gender, and distracted driving on perceived and observed aggressive driving behavior: A correlated grouped random parameters bivariate probit approach. *Anal. Methods Accid. Res.* **22**, 100091 (2019).

167. Karras, M., Delhomme, P. & Csillik, A. Female and Male Driving Offenders Participating in a French Rehabilitation Program: Their Self-Reported Behaviors, Personal Resources and Vulnerabilities. SSRN Scholarly Paper at ***https://doi.org/10.2139/ssrn.4372635*** (2023).

168. Krahé, B. & Fenske, I. Predicting aggressive driving behavior: The role of macho personality, age, and power of car. *Aggress. Behav.* **28**, 21–29 (2002).

169. Piff, P. K., Stancato, D. M., Côté, S., Mendoza-Denton, R. & Keltner, D. Higher social class predicts increased unethical behavior. *Proc. Natl. Acad. Sci.* **109**, 4086–4091 (2012).

170. Sarwar, M. T., Anastasopoulos, P. Ch., Golshani, N. & Hulme, K. F. Grouped random parameters bivariate probit analysis of perceived and observed aggressive driving behavior: A driving simulation study. *Anal. Methods Accid. Res.* **13**, 52–64 (2017).

171. Gino, F. & Pierce, L. The abundance effect: Unethical behavior in the presence of wealth. *Organ. Behav. Hum. Decis. Process.* **109**, 142–155 (2009).

172. Miles, D. E. & Johnson, G. L. Aggressive driving behaviors: are there psychological and attitudinal predictors? *Transp. Res. Part F Traffic Psychol. Behav.* **6**, 147–161 (2003).

173. Aduen, P. A., Kofler, M. J., Cox, D. J., Sarver, D. E. & Lunsford, E. Motor vehicle driving in high incidence psychiatric disability: Comparison of drivers with ADHD, depression, and no known psychopathology. *J. Psychiatr. Res.* **64**, 59–66 (2015).

174. Hassan, A., Lee, C., Cramer, K. & Lafreniere, K. Analysis of driver characteristics, self-reported psychology measures and driving performance measures associated with aggressive driving. *Accid. Anal. Prev.* **188**, 107097 (2023).

175. Kuhn, E., Drescher, K., Ruzek, J. & Rosen, C. Aggressive and unsafe driving in male veterans receiving residential treatment for PTSD. *J. Trauma. Stress* **23**, 399–402 (2010).

176. Zinzow, H. M. & Jeffirs, S. M. Driving Aggression and Anxiety: Intersections, Assessment, and Interventions. *J. Clin. Psychol.* **74**, 43–82 (2018).

177. Abdu, R., Shinar, D. & Meiran, N. Situational (state) anger and driving. *Transp. Res. Part F Traffic Psychol. Behav.* **15**, 575–580 (2012).

178. Hoseinzadeh Nooshabadi, M., Vasquez, H. M. & Donmez, B. Targeting young driver emotions can reduce their cellphone dis***TRACtion***s. Accid. Anal. Prev. 192, 107202 (2023).

179. Dahlen, E. R. & White, R. P. The Big Five factors, sensation seeking, and driving anger in the prediction of unsafe driving. *Personal. Individ. Differ.* **41**, 903–915 (2006).

180. Millar, M. The influence of public self-consciousness and anger on aggressive driving. *Personal. Individ. Differ.* **43**, 2116–2126 (2007).

181. Philippe, F. L., Vallerand, R. J., Richer, I., Vallières, Év. & Bergeron, J. Passion for Driving and Aggressive Driving Behavior: A Look at Their Relationship. *J. Appl. Soc. Psychol.* **39**, 3020–3043 (2009).

182. Ellison, P. A., Govern, J. M., Petri, H. L. & Figler, M. H. Anonymity and Aggressive Driving Behavior: A Field Study. *J. Soc. Behav. Personal.* **10**, 265–272 (1995).

183. Pantangi, S. S. *et al.* Do High Visibility Enforcement programs affect aggressive driving behavior? An empirical analysis using Naturalistic Driving Study data. *Accid. Anal. Prev.* **138**, 105361 (2020).

184. Lewis, I. M., Watson, B. & White, K. M. Response efficacy: The key to minimizing rejection and maximizing acceptance of emotion-based anti-speeding messages. *Accid. Anal. Prev.* **42**, 459–467 (2010).

185. Cerniglia, L. *et al.* Motor vehicle accidents and adolescents: An empirical study on their emotional and behavioral profiles, defense strategies and parental support. *Transp. Res. Part F Traffic Psychol. Behav.* **35**, 28–36 (2015).

186. Lee, C., Saxena, M., Lin, P.-S., Gonzalez-Velez, E. & Rouse, J. W. Aggressive Driving and Safety Campaigns: Lessons Learned from Better Driver Campaign in Florida. *Transp. Res. Rec.* **2182**, 79–87 (2010).

187. Kockelman, K. & Ma, J. Aggressive Driving and Speeding. in *Safe Mobility: Challenges, Methodology and Solutions* (eds. Lord, D. & Washington, S.) vol. 11 37–55 (Emerald Publishing Limited, 2018).

188. Fulton, L. & Reich, D. T. The Compact City Scenario – Electrified. *Institute for Transportation and Development Policy* ***https://www.itdp.org/publication/the-compact-city-scenario-electrified/*** (2021).

189. Internal Revenue Service. Credits for new clean vehicles purchased in 2023 or after. Internal Revenue Service ***https://www.irs.gov/credits-deductions/credits-for-new-clean-vehicles-purchased-in-2023-or-after*** (2023).

190. Guo, Shuocheng & Kontou, Eleftheria. Disparities and equity issues in electric vehicles rebate allocation. *Energy Policy* **154**, (2021).

191. McGraw, J. & Haas, P. *An Update on Public Transportation's Impacts on Greenhouse Gas Emissions".* (National Academy of Sciences, 2021). doi:10.17226/26103.

192. Li, S., Tong, L., Xing, J. & Zhou, Y. Mining Public Opinion on Transportation Systems Based on Social Media Data. *J. Assoc. Environ. Resour. Econ.* (2016) doi:10.2139/ssrn.2515037.

193. Hasan, S. & Simsekoglu, Ö. The role of psychological factors on vehicle kilometer travelled (VKT) for battery electric vehicle (BEV) users. *Res. Transp. Econ.* **82**, 100880 (2020).

194. Jenn, A., Springel, K. & Gopal, A. R. Effectiveness of electric vehicle incentives in the United States. *Energy Policy* **119**, 349–356 (2018).

195. van Dijk, J., Farsi, M. & Weber, S. Travel Mode Choices in a Greening Market: The Impact of Electric Vehicles and Prior Investments: *Transp. Res. Rec.* 036119812110252 (2021) doi:10.1177/03611981211025279.

196. Klöckner, C. A., Nayum, A. & Mehmetoglu, M. Positive and negative spillover effects from electric car purchase to car use. *Transp. Res. Part -Transp. Environ.* **21**, 32–38 (2013).

197. Aviv Steren, Ofir D. Rubin, & Stav Rosenzweig. Energy-efficiency policies targeting consumers may not save energy in the long run: A rebound effect that cannot be ignored. *Energy Res. Soc. Sci.* **90**, 102600–102600 (2022).

198. Gillingham, K., Jenn, A., Chelikowsky, J. R. & Azevedo, I. Heterogeneity in the response to gasoline prices: Evidence from Pennsylvania and implications for the rebound effect. *Energy Econ.* **52**, 41–52 (2015).

199. Chakraborty, D., Hardman, S. & Tal, G. Integrating Plug-in Electric Vehicles (PEVs) into Household Fleets - Factors Influencing Miles Traveled by PEV Owners in California. *Travel Behav. Soc.* **26**, 67–83 (2022).

200. Wenjian Jia & Chen, T. D. Beyond Adoption: Examining Electric Vehicle Miles Traveled in Households with Zero-Emission Vehicles. *Transp. Res. Rec.* 036119812210825–036119812210825 (2022) doi:10.1177/03611981221082536.

201. Gillingham, K., Kotchen, M. J., Rapson, D. & Wagner, G. Energy policy: The rebound effect is overplayed. Nature **493,** 475–476 (2013).

202. Millard-Ball, A. & Timmons, N. Electric Vehicle Charging and Car Dependency. *Findings* (2023) doi:10.32866/001c.88247.

203. International Energy Agency. Electric car sales, 2016-2023 – Charts – Data & Statistics. IEA ***https://www.iea.org/data-and-statistics/charts/electric-car-sales-2016-2023*** (2023).

204. Leonard, A. T., Farhad Salek, Azizi, A., & Shahaboddin Resalati. Electrification of a Class 8 Heavy-Duty Truck Considering Battery Pack Sizing and Cargo Capacity. *Appl. Sci.* 12, 9683–9683 (2022).

205. Björn Nykvist, Nykvist, B., Olsson, O., & Olle Olsson. The feasibility of heavy battery electric trucks. *Joule* **5**, 901–913 (2021).

206. European Commission. Commission proposes new Euro 7 standards. *European Commission — European Commission* ***https://ec.europa.eu/commission/presscorner/detail/en/ip_22_6495*** (2022).

207. Agusdinata, D. B., Liu, W., Eakin, H., Aravena, H. R. & Romero, H. Socio-environmental impacts of lithium mineral extraction : towards a research agenda. Environ. Res. Lett. 13, 123001 (2018).

208. Peters, D. R. *et al*. Public Health and Climate Benefits and Trade-Offs of U.S. Vehicle Electrification. *GeoHealth* **4**, (2020).

209. Schnell, J. L. *et al*. Air quality impacts from the electrification of light-duty passenger vehicles in the United States. *Atmos. Environ.* **208**, 95–102 (2019).

210. Tessum, C. W., Hill, J. & Marshall, J. D. Life cycle air quality impacts of conventional and alternative light-duty transportation in the United States. *Proc. Natl. Acad. Sci. U. S. A.* **111**, 18490–18495 (2014).

211. Pan, S. *et al*. Potential impacts of electric vehicles on air quality and health endpoints in the Greater Houston Area in 2040. *Atmos. Environ.* **207**, 38–51 (2019).

212. Ji, S., Cherry, C. R., Bechle, M. J., Wu, Y. & Marshall, J. D. Electric vehicles in China: emissions and health impacts. *Environ. Sci. Technol.* **46**, 2018–2024 (2012).

213. Shen, J. et al. Aerosol Oxidative Potential in the Greater Los Angeles Area: Source Apportionment and Associations with Socioeconomic Position. *Environ. Sci. Technol.* (2022) doi:10.1021/acs.est.2c02788.

214. Hooftman, N. S., Messagie, M., Joint, F., Segard, J.-B. & Coosemans, T. In-Life Range Modularity for Electric Vehicles: The Environmental Impact of a Range-Extender Trailer System. *Appl. Sci.* **8**, 1016 (2018).

215. Agrawala, S., Walid, O. & Farrow, K. Non-exhaust Particulate Emissions from Road Transport. Organ. *Econ. Coop.* Dev. (2020).

216. Liu, Y. *et al*. Exhaust and non-exhaust emissions from conventional and electric vehicles: A comparison of monetary impact values. *J. Clean. Prod.* 129965–129965 (2021) doi:10.1016/j.jclepro.2021.129965.

217. Soret, A., Guevara, M., Baldasano, J. M. & Baldasano, J. M. The Potential impacts of electric vehicles on air quality in the urban areas of Barcelona and Madrid (Spain). *Atmos. Environ.* **99**, 51–63 (2014).

218. Sang-Hee Woo, Hyungjoon Jang, Seung-Bok Lee, & Seokhwan Lee. Comparison of total PM emissions emitted from electric and internal combustion engine vehicles: An experimental analysis. *Sci. Total Environ.* 156961–156961 (2022) doi:10.1016/j.scitotenv.2022.156961.

219. Amato, F. *et al*. Urban air quality: The challenge of traffic non-exhaust emissions. *J. Hazard. Mater.* **275**, 31–36 (2014).

220. Fleming, K. L. *et al*. Electrification of Medium- and Heavy-Duty Ground Transportation: Status Report. *Curr. Sustain. Energy Rep.* **8**, 1–9 (2021).

221. Camilleri, S. F. et al. Air quality, health and equity implications of electrifying heavy-duty vehicles. *Nat. Sustain.* (2023) doi:10.1038/s41893-023-01219-0.

222. Cleave, K. V. As electric vehicles become more common, experts worry they could pose a safety risk for other drivers - CBS News. *CBS News* (2023).

223. Chenhui Liu, Li Zhao & Lu, C. Exploration of the characteristics and trends of electric vehicle crashes: a case study in Norway. *Eur. Transp. Res. Rev.* **14**, (2022).

224. Brand, S., Petri, M., Haas, P., Krettek, C. & Haasper, C. Hybrid and electric low-noise cars cause an increase in traffic accidents involving vulnerable road users in urban areas. *Int. J. Inj. Contr. Saf. Promot.* **20**, 339–341 (2013).

225. Stelling-Konczak, A., Hagenzieker, M. & van Wee, B. Traffic Sounds and Cycling Safety: The Use of Electronic Devices by Cyclists and the Quietness of Hybrid and Electric Cars. *Transp. Rev.* **35**, 422–444 (2015).

226. del Carmen Pardo-Ferreira, M., Torrecilla-García, J. A., de las Heras-Rosas, C., Carlos de las Heras-Rosas & Rubio-Romero, J. C. New Risk Situations Related to Low Noise from Electric Vehicles: Perception of Workers as Pedestrians and Other Vehicle Drivers. *Int. J. Environ. Res. Public. Health* **17**, 6701 (2020).

227. Jerez, B., Garcés, I. & Torres, R. Lithium extractivism and water injustices in the Salar de Atacama, Chile: The colonial shadow of green electromobility. *Polit. Geogr.* **87**, 102382 (2021).

228. Robbins, J. As the US Rushes After the Minerals for the Energy Transition, a 150-Year-Old Law Allows Mining Companies Free Rein on Public Lands. *Inside Climate News* ***https://insideclimatenews.org/news/13032022/as-the-us-rushes-after-the-minerals-for-the-energy-transition-a-150-year-old-law-allows-mining-companies-free-reign-on-public-lands/*** (2022).

229. Dunlap, A. & Riquito, M. Social warfare for lithium extraction? Open-pit lithium mining, counterinsurgency tactics and enforcing green extractivism in northern Portugal. *Energy Res. Amp Soc. Sci.* (2023) doi:10.1016/j.erss.2022.102912.

230. Marchegiani, P., Morgera, E. & Parks, L. Indigenous peoples' rights to natural resources in Argentina: the challenges of impact assessment, consent and fair and equitable benefit-sharing in cases of lithium mining. *Int. J. Hum. Rights* **24**, 224–240 (2020).

231. da Silva, J. *City Resilience Framework*. ***https://www.rockefellerfoundation.org/report/city-resilience-framework/*** (2014).

232. Car Access | National Equity Atlas. *National Equity Atlas* ***https://nationalequityatlas.org/indicators/Car_access*** (2020).

233. Bish, D. R. Planning for a bus-based evacuation. *Spectr.* **33**, 629–654 (2011).

234. Ahmad, S., Ali, A., Ahmed, H. U., Huang, Y. & Lu, P. Evaluating Traffic Operation Conditions during Wildfire Evacuation Using Connected Vehicles Data. *Fire* **6**, 184 (2023).

235. Gao, Y., Chiu, Y.-C., Wang, S. & Küçükyavuz, S. Optimal Refueling Station Location and Supply Planning for Hurricane Evacuation. *Transp. Res. Rec.* **2196**, 56–64 (2010).

236. Office of Cybersecurity, Energy Security, and Emergency Response. Northeast Gasoline Supply Reserve. *Energy.gov* ***https://www.energy.gov/ceser/northeast-gasoline-supply-reserve***.

237. Office, U. S. G. A. *Energy Resilience: DOE's Northeast Petroleum Product Reserves | U.S. GAO*. ***https://www.gao.gov/products/gao-22-105404*** (2022).

238. Feng, K., Lin, N., Xian, S. & Chester, M. V. Can we evacuate from hurricanes with electric vehicles? *Transp. Res. Part Transp. Environ.* **86**, 102458 (2020).

239. Adderly, S. A., Manukian, D., Sullivan, T. D. & Son, M. Electric vehicles and natural disaster policy implications. *Energy Policy* **112**, 437–448 (2018).

240. Xu, Z. & Chopra, S. S. Interconnectedness enhances network resilience of multimodal public transportation systems for Safe-to-Fail urban mobility. *Nat. Commun.* **14**, 4291 (2023).

241. Blum, J. J. & Eskandarian, A. The impact of multi-modal transportation on the evacuation efficiency of building complexes. in *Proceedings. The 7th International IEEE Conference on Intelligent Transportation Systems (IEEE Cat. No.04TH8749)* 702–707 (2004). doi:10.1109/ITSC.2004.1398987.

242. Hess, D. B. & Gotham, J. C. Multi-Modal Mass Evacuation in Upstate New York: A Review of Disaster Plans. *J. Homel. Secur. Emerg. Manag.* **4**, (2007).

243. Lu, W., Wang, F., Liu, L., Hu, G. & Mao, J. Pedestrian–bus route and pickup location planning for emergency evacuation. *Transport* **36**, 176–184 (2020).

244. Boakye, J., Guidotti, R., Gardoni, P. & Murphy, C. The role of transportation infrastructure on the impact of natural hazards on communities. *Reliab. Eng. Syst. Saf.* **219**, 108184 (2022).

245. Su, Y. & Le Dé, L. Whose views matter in post-disaster recovery? A case study of "build back better" in Tacloban City after Typhoon Haiyan. *Int. J. Disaster Risk Reduct.* **51**, 101786 (2020).

246. Platt, S. Factors Affecting the Speed and Quality of Post-Disaster Recovery and Resilience. in *Earthquake Engineering and Structural Dynamics in Memory of Ragnar Sigbjörnsson: Selected Topics* (eds. Rupakhety, R. & Ólafsson, S.) 369–403 (Springer International Publishing, 2017). doi:10.1007/978-3-319-62099-2_19.

247. Gjerde, M. Building Back Better: Learning from the Christchurch Rebuild. *Procedia Eng.* **198**, 530–540 (2017).

248. Sun, F., Walton, D. & Hall, A. A Hybrid Dynamical-Statistical Downscaling Technique. Part II: End-of-Century Warming Projections Predict a New Climate State in the Los Angeles Region. *J. Clim.* **28**, 4618–4636 (2015).

249. Hall, A., Berg, N. & Reich, K. Los Angeles Region Report. 97 ***https://www.energy.ca.gov/sites/default/files/2019-11/Reg%20Report-%20SUM-CCCA4-2018-007%20LosAngeles_ADA.pdf*** (2018).

250. US EPA. Climate Impacts on Transportation. *United States Environmental Protection Agency* ***https://19january2017snapshot.epa.gov/climate-impacts/climate-impacts-transportation***.

251. Wang, X. *et al.* The Effects of Weather on Passenger Flow of Urban Rail Transit. **6**, 11–20 (2020).

252. Mahmoud, M., Mohamed Mahmoud, Mohamed S. Mahmoud, El-Assi, W. & Habib, K. N. Effects of Built Environment and Weather on Bike Sharing Demand: Station Level Analysis of Commercial Bike Sharing in Toronto. (2015) doi:10.1007/s11116-015-9669-z.

253. Middel, A., Selover, N., Hagen, B. & Chhetri, N. Impact of shade on outdoor thermal comfort-a seasonal field study in Tempe, Arizona. *Int. J. Biometeorol.* **60**, 1849–1861 (2016).

254. Pueboobpaphan, R., Pueboobpaphan, S. & Sukhotra, S. Acceptable walking distance to transit stations in Bangkok, Thailand: Application of a stated preference technique. *J. Transp. Geogr.* **99,** 103296–103296 (2022).

255. Shi, X. *et al.* Does improving stop amenities help increase Bus Rapid Transit ridership? Findings based on a quasi-experiment. **10**, 100323 (2021).

256. Fan, Y., Guthrie, A. & Levinson, D. Waiting time perceptions at transit stops and stations: Effects of basic amenities, gender, and security. *Transp. Res. Part -Policy Pract.* **88**, 251–264 (2016).

257. Kim, K. & Olshansky, R. B. The Theory and Practice of Building Back Better. *J. Am. Plann. Assoc.* **80**, 289–292 (2014).

258. California, S. of. Sea Level Rise and the Transportation System in the Coastal Zone | Caltrans. *CA.Gov* ***https://dot.ca.gov/programs/environmental-analysis/coastal-program/coastal-act-policy-resource-information/coastal-hazards/sea-level-rise*** (2023).

259. California SB272 | 2023-2024 | Regular Session — Sea level rise: planning and adaptation. *LegiScan* ***https://legiscan.com/CA/text/SB272/id/2824573*** (2023).

260. Berke, P. R. *et al.* Evaluation of Networks of Plans and Vulnerability to Hazards and Climate Change: A Resilience Scorecard. *J. Am. Plann. Assoc.* **81**, 287–302 (2015).

261. Lambrou, N. & Loukaitou-Sideris, A. Resilience plans in the US: an evaluation. *J. Environ. Plan. Manag.* 1–24 (2021) doi:10.1080/09640568.2021.1904849.

262. Ding, H. & Taylor, B. D. Traffic Trumps All: Examining the Effect of Traffic Impact Analyses on Urban Housing. *J. Plan. Lit.* **37** , 3–16 (2022).

263. Monkkonen, P. & Manville, M. Opposition to development or opposition to developers? Experimental evidence on attitudes toward new housing. *J. Urban Aff.* **41**, 1123–1141 (2019).

264. Blumenberg, E. & Wander, M. Housing affordability and commute distance. *Urban Geogr.* **44** , 1454–1473 (2023).

265. Hopkinson, L. & Goodwin, P. Induced traffic: yet again a worryingly overlooked dimension in crucial road planning and appraisal policy. *TAPAS Network* ***https://tapas.network/35/hopkinsongoodwin.php*** (2023).

266. City of Los Angeles. Oil Wells Inside LA County.

Photo Credit: Midjourney

UCLA Sustainable LA Grand Challenge
595 Charles E. Young Dr. East
Suite 4608
Los Angeles, CA 90095
SustainableLA@ucla.edu
sustainablela.ucla.edu

UCLA Institute of Transportation Studies
3320 Public Affairs Building
Los Angeles, CA 90095-1656
uclaits@ucla.edu
its.ucla.edu
© 2024