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Employing a Modified Delphi Approach to Explore Scenarios for California's Transportation and Land Use Future

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16. Abstract

There are many methods for engaging experts in interactive groups to explore, clarify, and/or decide on various issues. In an investigation of possible future transportation and land use scenarios for California, we used techniques common to several methods and developed our own variation, a "hybrid policy Delphi," for use with a panel of 18 experts. We applied it to explore the policies that would lead to these scenarios and the consequences that would result from them. Through our process, panel members discussed and reported on the future scenarios they considered most desirable and also the scenarios they considered most likely to materialize by 2050. Panelists reported that the scenario they considered the most desirable was also least likely to occur, and that the likely trajectory of California transportation and land use policies and practices will lead to the scenario panelists considered less desirable.

This report reflects on the processes behind reaching these panel conclusions, a five-stage sequence of two meetings and three online questionnaires. Our mix of discussion and questionnaires traded the benefit of anonymity (common in Delphi methods) for the benefit of exploratory discussion (used in workshops, focus groups, and the nominal group technique). In addition, our use of surveys before and after meetings allowed tracking changes in panel opinion on a central question (scenario likelihood) and discussing survey results at meetings, at the cost of greater administrative effort. We discuss the results of this effort, reflect on how well our combination of methods worked, and conclude with a discussion of limitations and future directions.

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The California Resilient and Innovative Mobility Initiative (RIMI) serves as a living laboratory—bringing together university experts from across the four UC ITS campuses, policymakers, public agencies, industry stakeholders, and community leaders—to inform the state transportation system's immediate COVID-19 response and recovery needs, while establishing a long-term vision and pathway for directing innovative mobility to develop sustainable and resilient transportation in California. RIMI is organized around three core research pillars: Carbon Neutral Transportation, Emerging Transportation Technology, and Public Transit and Shared Mobility. Equity and high-road jobs serve as cross-cutting themes that are integrated across the three pillars.

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The UCLA Institute of Transportation Studies acknowledges 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.

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Employing a Modified Delphi Approach to Explore Scenarios for California's Transportation and Land Use Future

July 2022

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Introduction

Report Purpose

This report explores the methods and processes used in a panel study that the UCLA Institute of Transportation Studies (ITS) conducted for the California 100 Initiative. The research investigated the future of transportation, land use, and planning in the Golden State by exploring the likelihood, desirability, and implications of four transportation/land use scenarios for 2050 with a panel of 18 experts.

This report summarizes some key findings of this research, which are also presented in the other research products from this project (Wasserman et al., 2022 and Gahbauer et al., 2022), but focuses in particular on the research process that led to these findings to both explain how they came about and how this research method might be applied to future research that gathers expert insights. Specifically, we consider the mix of group research methods that UCLA ITS researchers adopted that borrow from the Delphi method and resemble parts of the "policy Delphi," the "hybrid Delphi," the nominal group technique, and workshops and focus groups.

Expert Opinion Research Overview

Researchers employ numerous strategies to involve panels in their research, each with a particular emphasis and purpose. Some are multi-stage and iterative; others involve one-off engagements. Some rely on surveys of large groups of people who remain anonymous to each other; others involve smaller groups in face-to-face discussion.

We developed a research strategy tailored to the needs of this particular research project that was relatively short in duration and had a mix of quantitatively measured survey responses and qualitative discussion. We initially modeled our approach on the well-established Delphi method, used by our colleagues to explore recently pandemic-related uncertainties in transportation planning (Shaheen and Wong, 2020), to assess urban development impacts of high-speed rail (Loukaitou-Sideris et al., 2012), and to evaluate strategies in transit-oriented development (Loukaitou-Sideris, 2000). However, we ultimately developed a strategy with multiple design elements that align with other methodologies, such as the nominal group technique, the policy Delphi, the hybrid Delphi, and the focus group. Our method most closely resembles the hybrid Delphi but differs in process; hence, we have named it the “hybrid policy Delphi.”

Table 1 outlines the similarities and differences among these strategies and highlights the elements our method has in common with others. Note that this table characterizes each strategy with attributes that are typical, as described in academic literature, but many deviations exist in practice (especially in the Delphi method (Goodman, 1987 and Sackman, 1974). The methods are discussed in greater detail below.

Group Research Processes

Workshop

The workshop is a commonly used tool—with so many variations and applications that it is perhaps best defined in contrast with other methods. It is a single convening of panelists (experts and/or non-experts), usually in person, to discuss topics without anonymity. It can be useful for exploring issues and its relatively undirected format means researchers can collect many perspectives.

Focus Group

Focus groups aim to obtain qualitative data from a specifically-selected group of people. A meta-study of focus groups describes them as relatively small: typically between three and 21 participants, with a median of ten participants. While many variations exist, especially pertaining to how focus groups are moderated, the focus group typically involves a one-time convening of participants to respond to prompts given by the researchers. Focus groups identify themes and clarify issues presented (Nyumba et al., 2018).

Nominal Group Technique

The nominal group technique (NGT) is similar to a focus group but smaller (seven to ten participants) and more structured (Van De Ven and Delbecq, 1974 and Horton, 1980). It blends group discussion with panelists’ written ideation and feedback, which moderators use to gauge interest in or agreement with a given topic, direct discussion, and order results by rank accordingly. Compared to workshops, focus groups, and other interacting

Table 1. Comparison of Group Research Methods

	Workshop	Focus Group	Nominal Group Technique	Delphi	Policy Delphi	Hybrid Delphi	Hybrid Policy Delphi (Our Method)
Typical Method	meeting	meeting	meeting	survey	survey	**survey and meetings**	**survey and meetings**
Multi-stage/Iterative	no	sometimes	no	**yes**	**yes**	**yes**	**yes**
Panelists Develop Topics	yes	**no**	**no**	**no**	yes	**no**	**no**
Number of Rounds/Stages	1	1-4	1	2-3	**4-5**	4	**5**
Statistical Group Feedback Shared with Participants	no	no	**yes**	**yes**	**yes**	**yes**	**yes**
Written Questionnaires	no	no	**yes**	**yes**	**yes**	**yes**	**yes**
Typical Size	variable	**3-21**	7-10	**10-30**	**10-50**	5-10	**18**
Typical Panelists	experts or non-experts	experts or non-experts	experts or non-experts	**experts**	experts or non-experts	**experts**	**experts**
Process	**exploratory**	explanatory, clarifying	prioritizing	narrowing responses	**exploratory**	exploratory, prioritizing	**exploratory, narrowing scope**
Result	collection of perspectives	themes, understanding, clarification	decisions, ranked ideas	range of quantitative answers with rationales	range of possible outcomes, considerations	list of ordered proposals, arguments	**themes, perspectives, quantitative answers**

	Workshop	Focus Group	Nominal Group Technique	Delphi	Policy Delphi	Hybrid Delphi	Hybrid Policy Delphi (Our Method)
Role	decision-making or -facilitating	**decision-facilitating**	decision-making	decision-making	**decision-facilitating**	**decision-facilitating**	**decision-facilitating**
Role Orientation of Group (Van De Ven and Delbecq, 1974)	socio-emotional group maintenance	socio-emotional group maintenance	**socio-emotional and task-focused**	task-focused	task-focused	**socio-emotional and task-focused**	**socio-emotional and task-focused**
Ideation/Response Formulation	group discussion	group discussion	independent, round-robin	isolated	isolated	**isolated and group discussion**	**isolated and group discussion**
Anonymity	**no**	**no**	**no**	yes	yes	**no**	**no**
Controlled Feedback	no	no	**yes**	**yes**	**yes**	**yes**	**yes**
Convergence-focused[1]	no	no	no	**yes**	no	**yes**	**yes**
Precursor to Group Processes	**no**	**no**	**no**	**no**	yes	**no**	**no**
Administrative Costs	low	low	**medium**	high	high	**medium**	**medium**

1. As explained later, “convergence” is properly understood to mean a stability of responses rather than agreement.

	Workshop	Focus Group	Nominal Group Technique	Delphi	Policy Delphi	Hybrid Delphi	Hybrid Policy Delphi (Our Method)
Panelist Time Requirements	low	low	low	**high**	**high**	**high**	**high**
Process Time	very short	short	short	very long	very long	**medium**	**medium**

Note: The darkened boxes in this table indicate the attributes our hybrid policy Delphi has in common with other panel group research methods.

Sources: Nyumba et al., 2018; Lilja, Laakso, and Palomäki, 2011; Horton, 1980; Van De Ven and Delbecq, 1974; de Loe, 1995; Turoff, 1970; Linstone and Turoff, 1975; Barrios et al., 2021; Rayens and Hahn, 2000; and Landeta, Barrutia, and Lertxundi, 2011

groups, the NGT avoids the problems of dominant speakers (unless the moderator is dominant) and reticent participants through its use of independent writing (Van De Ven and Delbecq, 1974).

Delphi Method Processes

"Traditional" Delphi

While there are innumerable variations, the Delphi method, first formulated by the RAND Corporation, involves "a series of intensive questionnaires interspersed with controlled opinion feedback" (Dalkey and Helmer, 1963, p. 458). Its four distinct features include the anonymity of panelists to each other, iteration of process with controlled feedback (i.e., questionnaire results are shared with panelists, sometimes along with limited written responses), statistical group response (i.e., results can be quantified), and expert input (Goodman, 1987). The method is designed to narrow the range of panelists' responses over time. Over a series of surveys, panelists receive the same question(s), along with the panel's aggregated responses to previous iterations. Importantly, the method avoids "direct confrontation of the experts with one another" (Dalkey and Helmer, 1963, p. 458). RAND first employed the Delphi method to forecast how technology would change war, but it has since been used in health care, education, management, and environmental science contexts (Dalkey and Helmer, 1963 and RAND Corporation, 2022).

According to its formulators, the method of surveying panelists, revealing results, and repeating is "more conducive to independent thought" than a direct discussion, which can harden initial opinions or lead other panelists to be swayed too rashly (Dalkey and Helmer, 1963, p. 459). In addition to the separation of panelists, the Delphi method is distinct in its use of iterative questionnaires. For example, a first questionnaire would ask panelists for initial responses to a central question. Later, a second questionnaire would present the findings from the first questionnaire to the panelists and ask panelists for feedback, comment, and additional factors. Later still, a third questionnaire would ask for a reconsideration of the original panelists' responses—as can subsequent questionnaires after that, with the results of the previous questionnaire presented first. Through this iteration, the panelists may converge on a narrower range of answers while considering the question independently, without the confrontation of a group and without necessarily even knowing the identity of other panelists (Dalkey and Helmer, 1963, p. 458). In its original application, this process resulted in a significantly narrower range of responses to the question of how many bombs were required in a hypothetical Cold War military action (See **Figure 1**) (Dalkey and Helmer, 1963).

For researchers seeking expert opinion on forecasting the future, the Delphi method confers several advantages. First, the format captures both an initial set of responses and a "corrected" range of answers. Second, the results reflect panelists' individual reflection on the question at each stage of the process. Third, the final results offer a useful range of responses that reflects both individual input and a collective response. Together, these facets of the Delphi method allow researchers to examine the direction, speed, and completeness of any convergence (or divergence).

Some scholars have criticized the Delphi method for providing a narrower but no more accurate range of responses. The final judgements of the panel may represent a "compromise position" rather than best judgements and may therefore lack the "significance" of "extreme or conflicting positions" (Linstone and Turoff, 1975, p. 22). There is some evidence that the majority alone, rather than the quality of arguments shared among panelists, has the strongest influence on shifts in opinion. Further cementing the lead of the initial majority, panelists who change views more tend to end up following that majority. In a recent study of this bandwagon effect, a 75-

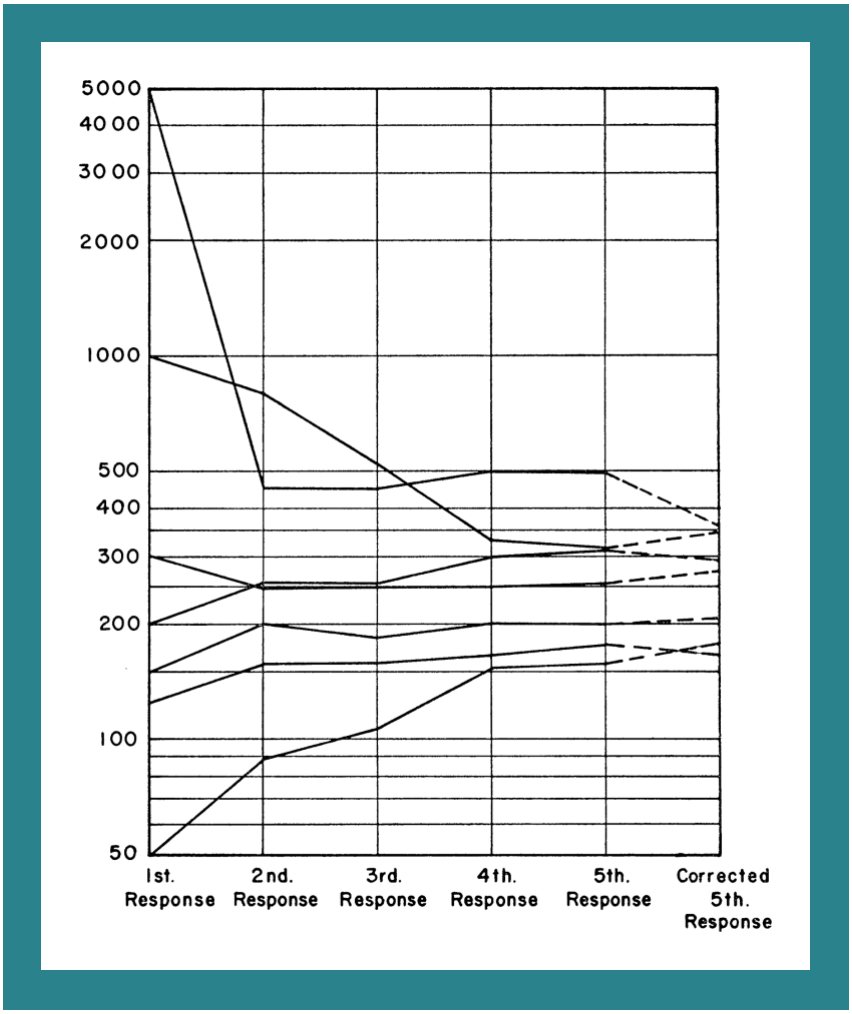

Figure 1. "Successive Estimates of Bomb Requirements" (from Dalkey and Helmer, 1963, p. 466)

percent threshold proved determinative: when at least three quarters of panelists agreed in the previous round, panelists are more likely to shift to the majority opinion. Below this threshold, though, participants were more likely to instead move away from the majority response. The farther above or below the threshold, the stronger this tendency appears to be. Evidence (from a study in which panelists predicted political and economic outcomes) also suggests that the best forecasters at the outset tend to be the least prepared to change their answer over subsequent rounds, indicating that the Delphi works well when confidence is well-placed and poorly when it is not (Bolger et al., 2011; Rowe, Wright, and McColl, 2005; Rowe and Wright, 1996; Makkonen, Hujala, and Uusivuori, 2016; and Barrios et al., 2021).

However, poor results from Delphi panels may be due to faults or idiosyncrasies in particular applications rather than the method itself. The type of feedback that panelists receive, in particular, affects shifts in opinion. Argumentative written feedback shared among panelists, for example, prompts less change than statistical feedback. Nevertheless, some researchers argue that the Delphi method is better than other techniques at avoiding the pressure of conformity, though they concede the presence of the bandwagon effect. One study that gave false feedback (i.e., inaccurate aggregate response scores) to panelists yet still resulted in convergence

raises questions about whether conformity pressure is actually absent in Delphi panels, despite panelists' anonymity and isolation (Landeta, 2006; Barrios et al., 2021; and Goodman, 1987).

Although convergence on consensus has come to typify the Delphi, it is sometimes misunderstood: the prominent authors of an early authoritative book on the Delphi method and its techniques clarify that the goal is not to achieve consensus but rather a *stability of responses*—i.e., a point at which respondents' answers do not change in successive rounds. A split distribution of responses can be a result and is in fact revealing, though many applications of the Delphi method do not pay attention to such divergences (Linstone and Turoff, 2011).

In its early years, the Delphi method also suffered from a reliance on correspondence. Each iteration took considerable time awaiting responses and time for processing and returning a summary of responses for the next questionnaire. Even RAND's original five-questionnaire Delphi took a shortcut due to time constraints (Dalkey and Helmer, 1963).

"Policy" Delphi

One early variation of the Delphi method, the policy Delphi, uses the Delphi method's iteration, interaction, and anonymity but emphasizes strong opposing views and is designed to present all options and supporting evidence to policymakers. Rather than narrowing a range of responses over two or three iterations as does the traditional Delphi, the policy Delphi uses four or five rounds to explore and expand on responses. The first round explores ideas on the topic; the second and third rounds narrow areas of interest and establish group views; the fourth and fifth rounds involve discussions and decisions based on opinions established in the third round. This method provides technical expertise and analysis that can inform but not decide on policy matters. The policy Delphi shares many of the advantages and disadvantages of other Delphi approaches: it is economical, provides respondents the time and opportunity to re-think responses, and is flexible, although it is lengthy. Strengths and weaknesses particular to the policy Delphi include a tendency to produce many ideas and evaluations of ideas, though these gathered ideas can be difficult to synthesize and make sense of and are only as diverse as panelists and their views. Moreover, resulting arguments can sometimes be broad but not deep. For this reason, some researchers think the policy Delphi is suitable as a precedent to or foundation for workshops or other group discussions (Turoff, 1970 and de Loe, 1995).

"Hybrid" Delphi

Economists in Spain developed another variation, the hybrid Delphi, in order to draw on the strengths of the Delphi method while mitigating its shortcomings by preceding the Delphi process with in-person convening processes. In a hybrid Delphi, researchers lead a panel of five to ten experts through first a focus group and then a nominal group technique exercise, before conducting a traditional Delphi exercise by correspondence among the same group. By doing so, researchers garnered new ideas and identified new aspects of a particular issue (a strength of the NGT), which informed the questionnaire that panelists answered in a first Delphi round—which in turn informed the second Delphi round. The authors diagrammed the technique's stages (See **Figure 2**). As its developers note, the hybrid Delphi differs from other variations of the Delphi in that the Delphi process itself is not modified per se but supplemented (Landeta, Barrutia, and Lertxundi, 2011).

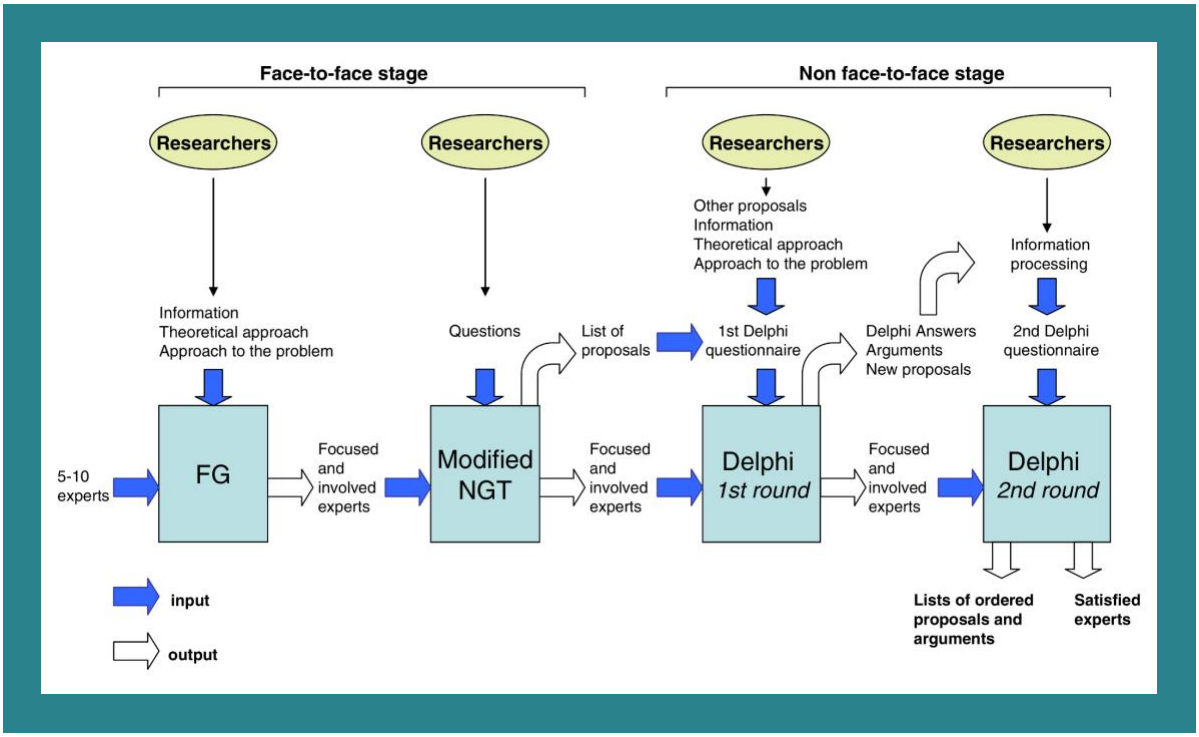

Figure 2. Hybrid Delphi Process Diagram (from Landeta, Barrutia, and Lertxundi, 2011)

A New Hybrid Method

Hybrid Policy Delphi

California 100, a future-focused, commission-led initiative, asked research teams to imagine and forecast the future of policy realms in the Golden State—transportation and urban planning, in our case. Given this broad and important remit and the tight (three month) timeline of the research, we quickly concluded that time did not allow for the type of iterative correspondence used in the "full" Delphi process. Even so, we thought that the concept of iteration would serve our project well.

Given our charge and timeline, we developed our own modification of the Delphi method that has many elements in common with the policy and hybrid Delphi methods but also some in common with the NGT and focus groups as well.

Our method lost some of the Delphi benefits of individual panelist assessment, conducted in total isolation without confrontation, as described earlier. However, our modified approach allowed for hearing and learning from thought processes and conversation still informed by iterative questionnaires that were completed privately. Our approach took steps to mitigate the concern over "hasty formulation of preconceived notions" raised by Delphi's creators (Dalkey and Helmer, 1963) and to capture both some Delphi-style convergence (or stability of opinion) and the added nuance of respectful and diverse group discussion. In addition, we used our method not just to forecast and explore the future but also to "backcast" how a preferred scenario might be attained.

Our modified Delphi method involved three "rounds" that combined surveys (with some questions repeated to track changes in response over time) and convenings (conducted virtually during the Coronavirus Disease 2019 (COVID-19) pandemic), as outlined in **Table 2**. (See also **Table A-1** in Appendix A for further details of the activities and their durations). Throughout the exercise, panelists considered and helped further develop four scenarios on transportation and land use, outlined below.

For the specific goals of our project, which required panelists to give opinions on both the desirability and likelihood of each of four possible future scenarios, we needed a somewhat holistic approach. Unlike the original Delphi application, we did not seek from our panelists a specific number but rather an assessment of which scenario was most desirable and which was most likely in the initial rounds. For the former in particular, our method allowed us to hear "thoughts out loud" and nuanced conversation among the panelists.

We wanted panelists to consider each of the project's scenarios in a number of ways. The four, pre-developed scenarios remained the same throughout, but how we asked panelists to think about them changed over the course of the exercise. First, panelists assessed current conditions and future scenarios—specifically, what aspects and statements were "most applicable" and "least applicable" to any one of the four scenarios—and to forecast what scenario was most likely to materialize.

In the second round, we asked panelists to "backcast"—i.e., to forecast in reverse, this time focusing on only the "Easy to Get Around without a Car" scenario, as the consensus among panelists was that it was the preferred (but least likely) scenario. We told panelists to assume the "Easy to Get Around without a Car" scenario existing in the year 2050 and asked what policies and conditions had to have been in place to have arrived at this scenario. By removing the uncertainty about the future outcome—because it was given—backcasting appeared to give

Table 2. Summary of Hybrid Policy Delphi Activities Conducted, Their Purpose, and Results

Round	Activity	Approximate Time	Purpose	Result
First	Survey 1	45 min.	Record panel's initial thoughts on the importance of California trends and the desirability and likelihood of each of four future scenarios	Initial opinions and quantitative record on scenario likelihood established
	Meeting 1	90 min.	Present Survey 1 results, discuss results, and hear panel's specific rationales for Survey 1 answers	Rationales for survey choices captured qualitatively
Second	Survey 2	15 min.	Ask panel about the importance of specific policies for achieving a multimodal, higher-density scenario and to probe further for reasons for Survey 1 responses (based on Meeting 1 discussion)	Relative importance of policies identified; revised quantitative record of scenario likelihood captured
	Meeting 2	120 min.	Present Survey 2 results; focus panel on most desirable scenario and discuss what would need to change for it to happen ("backcasting" exercise)	Key themes and challenges identified
Third	Survey 3	15 min.	Quantify panelists' agreement or disagreement with the themes identified in Meeting 2 and with statements that synthesized comments made in Meeting 2	Quantitative record of agreement/disagreement with Meeting 2 summary statements; revised quantitative record of scenario likelihood captured

panelists more comfort connecting policy choices to outcomes (albeit in a different direction of causality). Finally, in the third round, we used a survey to confirm agreement/disagreement with summary statements from the discussion in Meeting 2 and to collect quantitative data on those agreements (using a seven-point Likert scale).

Panel of Experts

To help us explore the dimensions of uncertainty and possibility across our scenarios, we assembled a panel of 18 experts with professional experience covering a wide range of disciplines and sectors, touching on transportation and land use in diverse ways (See **Table 3** and Appendix C). To identify potential panelists, we sought recommendations and nominations from members of the UCLA Institute of Transportation Studies Advisory Board, UCLA faculty and staff, and nominees themselves. From an initial list of 155 candidates, we chose 60 to poll for interest and availability. From this group, we enrolled 18 participants based on their interest and availability, 14 of whom participated in all activities throughout our study. As an incentive for continued participation throughout all surveys and meetings, we offered an honorarium of $500 to each participant who attended both meetings and completed all surveys and proportionately smaller honoraria for panelists who missed a meeting or survey.

Table 3. Panelist Affiliations

Category	Number of Panelists
Local government	2
State agency	1
Private sector consultant	7
Private sector operator	1
Nonprofit	4
Activist	3

For further details on panelists, see Appendix C.

Panelists participated in the three surveys and two panel discussions, described in **Table 2**. Each of the panel discussions (Meetings 1 and 2) were held in two sessions to allow for scheduling flexibility. Between seven and nine participants attended each session; the sessions consisted of different mixes of participants each time.

Scenarios

Prior to the panelists' first activity, we introduced the four scenarios that we would discuss over the period of the panel study (See **Figure 3** and Appendix B). In a method consistent with other California 100 research (Phillips et al., 2022; Wooley et al., 2022; Randolph and Brennan, 2022; Ponce et al., 2022; Le and Pastor, 2022; Kubrin and Bartos, 2022; Maple, 2022; Brynjolfsson et al., 2022; Heys et al., 2022; Cain et al., 2022; Murphy et al., 2022; and Brady, Fukuyama, and Bennon, 2022), we created and arranged the scenarios in a 2 × 2 matrix that showed how two possible directions each for two policy dimensions—here land use policies and transportation policies—intersect to result in four distinct outcomes (Wasserman et al., 2022).

Two important, related transportation concepts shaped the scenarios: accessibility and mobility. Accessibility is the ability to avail one's self, household, firm, or institution of goods, services, activities, and opportunities. Access often entails travel but the internet enables access as well, without travel. Mobility, by contrast, refers to the ability to move about. Walking for ten minutes or driving for ten minutes can yield the same access (for example, to a store), but entail vastly different levels of mobility. Mobility often conveys access, but more mobility does not necessarily mean more access, and sometimes means less when, for example, long distances mean time spent traveling to destinations is time away from activities at destinations (Mondschein and Taylor, 2017). Greater accessibility, in contrast, means that people need not travel far or make long trips to reach their desired destinations. Land uses can support greater accessibility via higher densities, allowing for destinations to be closer to each other. In this context, accessibility may be enhanced, even as mobility is hindered by the traffic delays that high densities can engender. This is because the higher density of buildings does not typically provide sufficient road and parking capacity that fast point-to-point mobility via driving requires. Transportation policy,

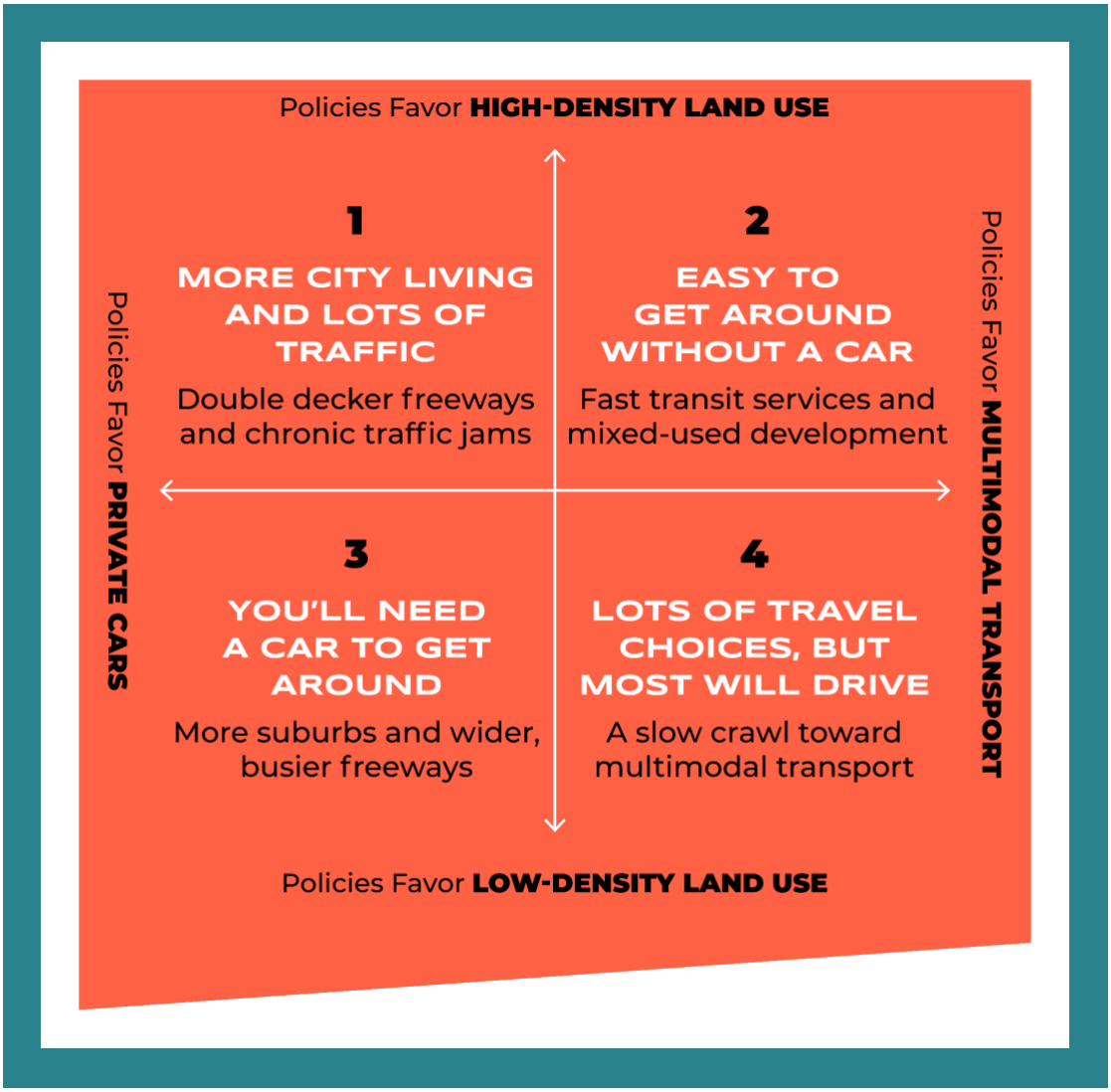

Figure 3. Scenario Matrix (from Wasserman et al., 2022, p. 37)

planning, and engineering are in the midst of a significant, albeit gradual, shift from a mobility focus to an accessibility focus (Siddiq and Taylor, 2021), and that shift figures into the scenarios we presented to the panelists.

Scenario: "You'll Need a Car to Get Around"
Car-centered/Low-density *(More Mobility, Less Accessibility)*

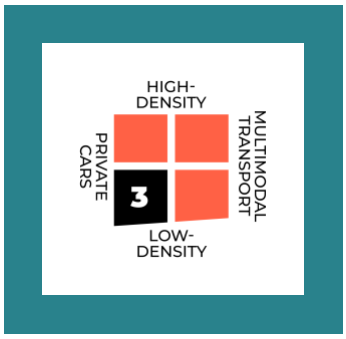

Figure 4. "You'll Need a Car to Get Around" Scenario Quadrant (from Wasserman et al., 2022, p. 38)

This is the postwar norm in California that still describes most suburban areas (Scenario 3 in **Figures 3** and **4**). Building densities are low, land uses are separated, streets are wide, parking is abundant, and almost every trip is made by motor vehicle for those with cars. Single-family neighborhoods, for those who can afford them, are pleasant, but travel distances are often long and many arterials and most freeways are chronically congested. Most new transportation investments support increasingly electric and autonomous vehicles, ever-widened roads frequently re-congest, and new housing continues to be built primarily on the fringes of metropolitan areas.

Scenario: "Lots of Travel Choices, but Most Will Drive"
Multimodal/Low-density *(Less Mobility, Variable Accessibility)*

Figure 5. "Lots of Travel Choices, but Most Will Drive" Scenario Quadrant (from Wasserman et al., 2022, p. 39)

This is the new normal in much of metropolitan California, where transportation investments go increasingly toward walking, biking, scootering, and public transit infrastructure, though most trips are still made by car (Scenario 4 in **Figures 3** and **5**). Looking ahead, multimodal options continue to expand and policies to rein in unfettered driving—such as improved and expanded public transit service and pricing driving to reduce congestion and emissions and encourage much more multimodal travel—are gradually phased in. However, outside of already built-up central cities, most development remains dispersed and poorly served by modes other than driving, while housing, particularly in-town affordable housing, is chronically undersupplied.

Scenario: "More City Living and Lots of Traffic"
Car-centered/Higher-density *(Variable Mobility, Less Accessibility)*

Figure 6. "More City Living and Lots of Traffic" Scenario Quadrant (from Wasserman et al., 2022, p. 40)

Under this scenario, policymakers prioritize urban infill development and limit suburban expansion into fire-prone and agricultural areas (Scenario 1 in **Figures 3** and **6**). Development densities increase in central cities and inner-ring suburbs, raising the supply of in-town housing and affordable housing. But rather than investing in multimodal travel, public officials accede to popular calls to widen boulevards and freeways (even double-decking the most heavily-trafficked ones) and build parking decks to store the mass of cars in central areas. Walking increases, but chronic traffic slows cars and buses to a crawl, increases emissions, and prompts ever more calls for expanded road and parking capacity.

Scenario: "Easy to Get Around without a Car"
Multimodal/Higher-density *(Less Mobility, More Accessibility)*

Figure 7. "Easy to Get Around without a Car" Scenario Quadrant (from Wasserman et al., 2022, p. 41)

This scenario entails the biggest break from current patterns, wherein the multimodal-focused transportation policies in the "Lots of Travel Choices, but Most Will Drive" scenario are combined with the land use policies of the "More City Living and Lots of Traffic" scenario (Scenario 2 in **Figures 3** and **7**). Road and parking access is managed to substantially reduce congestion (making driving both better and rarer) and emissions. Fast, frequent transit service reduces waits and makes riding more attractive. Denser, mixed-use development puts more destinations in walking distance and more affordable housing where it is most demanded.

Process and Results

Below is a summary of findings from our panel exercise. The full results from the surveys and meetings are available in the UCLA ITS report "Steering California's Transportation Future: A Report on Possible Scenarios and Recommendations" (Gahbauer et al., 2022).

Round 1

We used Survey 1 as a baseline to understand what opinions the panel had at the outset and to identify areas of agreement and disagreement. We presented survey findings in Meeting 1 and explored rationales for survey responses.

Survey 1

Our first survey asked panelists to rate the importance and likely persistence of current trends in or factors affecting California transportation and land use. The survey also asked respondents to report agreement or disagreement on statements concerning California's transportation system and the equity and efficacy of its development and use. Finally, respondents were presented with 40 statements describing aspects of a potential transportation future and asked to choose the scenario for which each statement was *most* applicable and *least* applicable. One question, for example, asked panel members to answer (on a Likert scale) to what extent they agreed with the statement "California's transportation system generally has a diversity of mobility options"; a second part of the question listed all four scenarios and prompted panelists to select one as "least applicable" and "most applicable."

The survey results showed some areas of strong consensus. Nearly all panelists disagreed (50%) or strongly disagreed (43%) with a statement that community participation in transportation and land-use decision-making is generally equitable. Likewise, most panelists disagreed with statements that said California's transportation system generally serves the needs of communities of color (71% disagreed; 21% strongly disagreed), disabled individuals (57% disagreed; 36% strongly disagreed), children (64% disagreed; 29% strongly disagreed), rural communities (21% disagreed; 36% strongly disagreed), immigrant communities (36% disagreed; 43% strongly disagreed), and especially older adults (21% disagreed; 57% strongly disagreed). All panelists strongly disagreed (71%) or disagreed (29%) with the claim that California's transportation system has addressed past injustices on disadvantaged communities, and most also disagreed (71%) with the statement that California's transportation system "generally has a diversity of mobility options."

The panel split or was unsure, though, on questions concerning the role of technology in transportation. While most agreed (64%) or strongly agreed (7%) with the statements that technology "makes it easier for many Californians to travel without a privately-owned automobile" and that it reduces their need for work-related travel, they diverged over whether it reduces Californians' need for non-work travel (43% agreed; 43% disagreed or strongly disagreed). Meanwhile, the statement that technology has helped to reduce the transportation sector's greenhouse gas emissions received a neither-agree-nor-disagree response from half of the panelists. And panelists divided evenly on the key question of whether technology has helped to improve mobility options for most Californians: 43% strongly agreed or agreed and 43% strongly disagreed or disagreed.

Finally, in response to the list of different aspects of possible transportation futures, panelists deemed the most favorable aspects "most applicable" to the "Easy to Get Around without a Car" scenario (multimodal/ higher-density) and the most unfavorable aspects "most applicable" to the "You'll Need a Car to Get Around" scenario (car-centered/low-density).

We used the results of Survey 1 to identify themes for exploration in Meeting 1 and to compare with subsequent panel remarks and survey results.

Meeting 1

At Meeting 1, we presented the survey results to panelists as prompts for further discussion, which added further context and texture to each scenario. Panelists discussed each scenario in depth and considered the relative desirability of each scenario.

Out of specific scenario discussion arose panelists' immediate reactions and concerns. For example, panelists raised safety and equity concerns about the urban developments described in some scenarios. On one hand, less car-centered travel patterns risk making people more vulnerable to police interaction as they ride transit or otherwise travel in non-private spaces; on the other, more automobile-centered futures put pedestrians and bicyclists at greater risk. Other themes that arose out of the discussion of scenarios included: social isolation, displacement, equity in housing access, equity in job access, "not in my backyard" objections to changes in the urban environment, and unintended consequences/disparate impacts of such changes. To a varying degree, these themes were discussed for each scenario.

Round 2

Survey 2

Our second survey was more specific than the first. We asked panelists to opine on what changes they thought would be likely by 2050 and what catalysts for change they thought were most important. Because the panel showed some convergence around one scenario being most desirable but another being most likely, we also added questions to Survey 2 to probe *why* panelists thought the most desirable scenario was relatively unlikely to materialize.

Specifically, we asked panelists to identify:

- What scenario is the most likely (not necessarily the most desirable) for California by 2050
- What set of policies are most determinative in enabling any given scenario
- What scenario would best achieve California's social, economic, and environmental goals
- Which areas and built environment contexts would fare better and worse in California's future if the "Easy to Get Around without a Car" scenario were realized
- What ten strategies are important for California governments to enable the "Easy to Get Around without a Car" scenario (and then, in rank order, which are most important)
- The top five agents of change (groups, interests, etc.) that will be most influential in shaping the land use and transportation options that Californians will have in 2050

Although nearly all (94%) panelists identified that a multimodal, higher-density scenario aligned best with California's social, economic, and environmental goals, panelists thought other less-aligned scenarios are more

likely. They identified the multimodal, low-density scenario ("Lots of Travel Choices, but Most Will Drive") as being the most likely: 56% of panelists ranked it as first most likely; 25% as second most likely. Next came the car-centered, low-density future ("You'll Need a Car to Get Around"), with 13% ranking it as first-most likely and 50% ranking it as second-most. In comparison, 50% ranked the "Easy to Get Around without a Car" scenario as fourth-most likely, and only 6% thought it was most likely.

When considering the "Easy to Get Around without a Car" scenario, panelists clearly perceived cities as benefiting the most: 73% said urban centers and 40% said urban areas would fare "much better." Compact suburban areas would also fare "better" (73%), while dispersed suburban areas would fare "worse" (40%). Panelists were split on rural areas' prognosis under this scenario, with 40% foreseeing "neutral" effects, 33% saying "better," 13% saying "worse", and 13% saying "much worse."

Per the panelists, the policies most determinative in shaping any future scenario are demand for more diverse housing options and the cost of single-occupancy vehicle travel. The top three strategies that panelists collectively identified as being most important for enabling the multimodal, higher-density future included: "meet[ing] California's demand for subsidized (affordable) housing," "charg[ing] a demand-based toll for vehicles on most would-be congested roadways and highways (congestion pricing)," and "charg[ing] a distance-based fee on private vehicles in California (VMT fee)."

On the question of what change agents will most shape California's transportation and land use future (for better or worse), panelists cited state and local government. Most ranked California state legislators as the most important change agent, with local mayors and councilmembers coming in second. Real estate developers, metropolitan planning organizations, and organized pro-housing, pro-density (i.e., "YIMBY") groups followed.

Meeting 2

With a single scenario now in focus ("Easy to Get Around without a Car": multimodal/higher-density), panel discussions centered on how it could be realized, what change agents would be most influential in its occurrence, and what necessary preconditions needed to be assumed for the scenario to happen.

Echoing earlier responses, panelists expressed some ambivalence about the role of technology in a future multimodal/higher-density scenario. Panelists discussed the role that technology could play in improving mobility options (for example, by enabling Mobility-as-a-Service (MaaS) platforms, better service integration with transit, better transit service planning, and facilitating shared rides and scooter-share). However, they also thought that social connections are key to creating community and pursuing repairing past harms of racial and social injustice, and while those connections may be made with technology (e.g., with more universal high-speed internet connectivity), they are perhaps best made without it (i.e., offline). Some skepticism arose around whether technology will improve land use and transportation outcomes, based on its failure to do so in the past, how powerful tech companies can be reined in to operate more in the public interest, and how a lack of diversity among the people who fund and build technology affects the equity of its uses. One panelist commented on technology "solving small problems, but not changing the large land use patterns." Another said that investor interests lead tech companies to offer "frivolous," disconnected solutions.

Without action taken to defend the goals behind the multimodal/higher-density, many panelists appeared to share the view that California could aim for the multimodal/higher-density scenario ("Easy to Get Around without a Car") and "sleepwalk" into the car-centered/higher-density scenario ("More City Living and Lots of Traffic"), as one panelist put it. The consensus among panelists was that this risk was greatest if land-use policies and concerns continued to focus only on the needs of and demand from wealthier people and white Californians.

Round 3

Survey 3

In our final survey, we sought to focus on topics raised in Meeting 2, so we asked panelists to identify the degree to which they agreed or disagreed with summary statements about:

- California's present (e.g., "Californians trust the government to implement changes to transportation and land use")
- California's future (e.g., "System shocks (such as COVID, natural disasters, and climate change impacts) are an important opportunity for re-aligning land use and transportation issues.")
- Prerequisite conditions and policy changes for achieving the "Easy to Get Around without a Car" scenario
- Necessary policy changes for avoiding poor, undesirable, and/or inequitable outcomes of the "Easy to Get Around without a Car" scenario
- The support of change agents in enabling the "Easy to Get Around without a Car" scenario

In the results, panelists again identified the "Easy to Get Around without a Car" scenario as the most desirable but least likely scenario. Notably, the panel's opinions shifted from the prior survey on the most important change agents for enabling the "Easy to Get Around without a Car" scenario, now naming elected local leaders, rather than California state legislators in Survey 2.

Survey 3 results clarified quantitatively where the panel stood as a group in their agreement or disagreement with ideas that arose in Meeting 2. **Table 4** shows an excerpt from the results with the percentage of panelists agreeing or disagreeing with summary statements. From the Survey 3 results, we were able to positively identify what "essential ingredients" the panel thought were important for improving prospects of better land use and transportation options for future Californians. Specifically, most panelists identified improving trust in government as essential to implementing scenarios that require a change from the status quo. This finding, which raised sweeping questions about the role and conduct of the public sector vis-à-vis the myriad constituencies it ostensibly serves that reach well beyond planning and transportation, was beyond our initial scope and expectations, but is among the most significant to emerge from this research.

Table 4. Excerpt from Survey 3 Results

Statement	Strongly Disagree	Disagree	Somewhat Disagree	Not Sure	Somewhat Agree	Agree	Strongly Agree	Likert Scale Weighted Average (-3 to +3)
Governments and people in California have a shared vision for the state's transportation and land use future	12%	**59%**	18%	6%	0%	6%	0%	-1.59
Californians trust the government to implement changes to transportation and land use	0%	35%	**47%**	0%	18%	0%	0%	-1.00
Californians have a strong sense of place in their neighborhoods or local communities	0%	0%	12%	0%	35%	**41%**	12%	+1.41
California is resilient to future climate change impacts	35%	**47%**	12%	0%	6%	0%	0%	-2.06
Decision-makers in California are responsive to the needs of wealthy constituents	0%	6%	0%	0%	**35%**	24%	**35%**	+1.76
Decision-makers in California are responsive to the needs of low-income constituents	0%	35%	**47%**	0%	18%	0%	0%	-1.00
Government in California does not always realize or recognize its own power	0%	0%	24%	18%	24%	**29%**	6%	+0.76
Many transportation agencies and public transit operators have relatively little power over factors that influence ridership (such as land use)	0%	0%	18%	0%	12%	**41%**	29%	+1.65

Discussion

Delphi in Action: Convergence and Divergence

In each of our three surveys, we asked panelists which scenario they thought was the most likely to materialize by 2050. The scenario definitions did not change, but the responses did, likely explained by panelists having time and reflection on their own and others' thoughts between their surveys.

Panelists' responses were mostly consistent between Survey 1 (which preceded Meeting 1) and Survey 2 (which followed Meeting 1). However, responses shifted notably between Surveys 2 and 3, suggesting that the content of the medial Meeting 2 changed several participants' minds. The focus of Meeting 2 on the singular scenario ("Easy to Get Around without a Car": multimodal/higher-density) that the panel had previously established was most desirable and on what policies were necessary for that scenario appears to have motivated panelists to find it somewhat more likely. In other words, talking about the specifics of the scenario and how it might materialize may have made it seem more plausible to some panelists. It also seems possible—and even probable—that the "backcasting" method we used in Meeting 2 was particularly effective in enabling panelists to envision feasible paths forward and therefore view the scenario as more likely. Because backcasting allows a scenario to be "given," it removes uncertainty about the future outcome and frees (or forces) participants to think about how that scenario came to be.

Table 5 illustrates how responses to the same question about the likelihood of each scenario changed with each survey. The most dramatic shifts occurred between Surveys 2 and 3, as mentioned above, but there was also a sizable shift between Survey 1 and 2 for the "More City Living and Lots of Traffic" (car-centered/higher-density) scenario. It is possible that the definition of this scenario definition was more ambiguous than others at the outset and that clarification in Meeting 1 changed responses.

The results of Survey 3 show less convergence than the prior two. In Survey 2, half of the panelists ranked the "More City Living and Lots of Traffic" scenario (car-centered/higher-density) as the third-most likely, but in Survey 3, more than half of respondents thought it the most likely. Responses for this scenario also became more scattered, with a sizable minority ranking it second-most likely as well. It could be that a greater common understanding of all scenarios led to this shift, but it also seems possible that a panelist's single, salient comment in Meeting 2—that California could aim for the "Easy to Get Around without a Car" scenario but "sleepwalk" into the "More City Living and Lots of Traffic" scenario—might have influenced participants' thinking. This result reflects a strength of iteration in our Delphi-like method: participants have the opportunity to reflect on others' input and change their response thoughtfully without being put on the spot (since the question in Survey 3 followed Meeting 2).

Modifying the Delphi: Lessons Learned

The traditional Delphi method poses specific questions of its panelists to get a range of responses that narrows with iteration. The needs of this project, however, required that we develop four scenarios in advance and examine their implications and likelihoods. Defining the scenarios *de novo* with a panel would have been time-consuming, and although we did not try it, the traditional Delphi method does not appear to be well suited for "from-scratch" scenario development (which might instead be better served by other, more interactive methods

Table 5. Panelists' Views on Scenario Likelihood over the Course of Three Surveys

Scenario	Survey	Most Likely	Second-most Likely	Third-most Likely	Least Likely
"You'll Need a Car to Get Around" (Car-centered/Low-density)	Survey 1	7%	**43%**	29%	21%
	Survey 2	11%	**56%**	17%	17%
	Survey 3	12%	29%	24%	**35%**
"Lots of Travel Choices, but Most Will Drive" (Multimodal/Low-density)	Survey 1	**53%**	27%	13%	7%
	Survey 2	**61%**	22%	6%	11%
	Survey 3	**29%**	24%	29%	18%
"More City Living and Lots of Traffic" (Car-centered/Higher-density)	Survey 1	**29%**	21%	**29%**	21%
	Survey 2	22%	6%	**50%**	22%
	Survey 3	**53%**	18%	24%	6%
"Easy to Get Around without a Car" (Multimodal/Higher-density)	Survey 1	14%	7%	29%	**50%**
	Survey 2	6%	17%	28%	**50%**
	Survey 3	6%	29%	24%	**41%**

such as brainstorming, round-table discussion, whiteboarding, etc.). Iteration, not ideation, is the Delphi method's best use. Thus, we instead posed questions to our panelists based on scenarios that we developed beforehand.

Our hybrid policy Delphi method for identifying convergence on panelists' opinions differs from the classic Delphi and other Delphi-like methods in another way: whereas the traditional Delphi and hybrid Delphi methods use iterative questioning to narrow the *range* of responses to a specific problem, and the policy Delphi does not narrow responses at all, our hybrid policy Delphi used iterations primarily to narrow the *scope* of considerations. For example, we first discussed all four scenarios but then decided to focus on the panel's most desirable (but least likely) scenario for further discussion in Meeting 2.

What Worked Well

Our hybrid policy Delphi combined online surveys completed individually with (virtual) meetings. This retained the benefit of surveys—their being the product of individual thought and anonymous responses without undue influence from a group—while also allowing panelists to digest survey results from the group with the group. While we did not see any evidence that seeing survey results changed opinions within the meetings, their presentation possibly contributed to the subsequent shifts in responses between Surveys 2 and 3.

The meetings did sacrifice panelists' anonymity, which is not trivial. As described above, individuals' reputation, rank, or force of opinion risks "halo" and "bandwagon" effects (Steinert, 2009) and could yield a premature convergence of opinion that is not derived from individual panelists' thought and reflection. Similarly, panel meetings also carry the risk of "direct confrontation" (Dalkey and Helmer, 1963) discussed earlier—i.e., panelists offer hasty opinions because they are put "on the spot" and then have a tendency to stick with opinions once uttered.

As mentioned earlier, we organized two sessions for each meeting to accommodate panelists' schedules, so the 18 panels were divided into smaller groups and the two sessions had different mixes of panelists each time. The different panel composition in each session might have had the effect of reducing any "longitudinal" bandwagon effects—i.e., the influence of one or a few dominant viewpoints might be mitigated by their being shuffled into different panels over the course of the study.

Despite these risks and potential shortcomings, the panel meetings did offer at least one significant advantage to our research: they allowed us to hear specific themes that developed in conversation. As noted above, in Meeting 2, a discussion about inequitable outcomes in some scenarios became an exchange about the more fundamental problem that trust in governmental action is lacking but is necessary for achieving any deviation from the status quo. This topic (and political science problem) is not one we anticipated in our urban planning study, yet the fact that most of our panelists believed this to be a significant factor affecting possible scenario outcomes emerged as a major finding in our study—one we likely would not have heard about without panel discussion. For the purposes of this exploratory study, our hybrid policy Delphi approach probably yielded richer results than a traditional Delphi process would have.

The final survey aimed to at least partially mitigate any "halo" or "bandwagon" effect. If panelists had succumbed to bandwagon pressures when they were in fact unsure in Meeting 2, the survey at least provided the opportunity for them to correct their response independently.

Limitations

This expansive, fast-moving project had multiple objectives, and our hybrid policy Delphi method was well-suited for some but not others. For instance, we wanted to learn more about why panelists answered the way they did in Survey 1, and discussion in Meeting 1 facilitated that better understanding. However, that element of the study did not take advantage of the Delphi method nor did it advance it: there was no follow-up to our conversation on rationales or iterative questioning that could lead to convergence. That discussion was therefore somewhat outside the Delphi method and process. In retrospect, rationales—though interesting—may not have been important to capture in as much detail as we did, and other data points might have (and did) fit the Delphi format better. Moreover, while we did hear panelists' reasoning for their answers in Survey 1, we do not know (and they likely would not realize) the extent to which their spoken answers were influenced by others. In other words, the panel discussion probably did not capture with fidelity the rationale behind respondents' answers on a survey taken earlier. For projects in which it is important for rationales to be understood and to "match" the survey response, such questions could be better asked on the survey itself though careful wording or in individual follow-up interviews.

Moreover, panel discussions are inherently difficult to direct, especially when enthusiastic experts are engaged on topics as wide-ranging and expansive as ours. In Meeting 2, for example, our intention was to narrow the focus to the challenge of implementing the "Easy to Get Around without a Car" using the framework and terms used in Meeting 1 and Survey 1. While the panel discussed this, panelists also identified *new* challenges that broadened discussion in ways that might have complicated convergence or introduced new divergences. At the same time, it was in this discussion that the major finding about trust in government emerged. Considering these linked limitations and benefits, discussion of the sort we undertook may be more suitable for projects in which it is not critical to achieve convergence or a narrower range of responses. Indeed, our study did not aim to test a pre-established hypothesis, which could have been more difficult using our method.

Future Directions

The Delphi method is a valuable tool for arriving at a stable, often narrower range of responses among experts on a defined question that requires (or benefits from) a range of initial responses. The hybrid Delphi method similarly enables a narrower range of proposals (from a broader range of inputs sourced from initial focus group and NGT activities). The policy Delphi is a useful tool for exploring (and even expanding on) a range of options. Our hybrid policy Delphi used Delphi-type iteration and NGT-style activities to both explore emergent themes and track respondents' change of opinion over the course of panel activities.

Based on our experience with our own variation of the Delphi method, we would recommend it on future projects that:

- Have sufficient time to allow for multiple iterations of interrogation
- Concern a topic whose conditions are unlikely to change over the duration of the project
- Have a high degree of uncertainty involved and/or a need for forecasting
- Have predefined scenarios to evaluate
- Do not require brainstorming or ideation
- Would benefit from expert opinions

On similar future projects, however, we would apply some lessons learned from this experience. Specifically, we would make more use of backcasting, which proved to be effective at focusing panelists' attention on catalysts and causes of future conditions rather than on the uncertainty of a future condition. Our project used two steps—forecasting and backcasting. On a similar future project, we might incorporate four steps to explore future scenarios:

1. *Positive forecasting*: Panelists assess current conditions and predefined future scenarios
2. *Backcasting*: Panelists imagine each scenario existing in the year 2050 and are asked what policies and/or conditions needed to be in place to have arrived at this scenario
3. *"What if" today forecasting*: Panelists imagine what the future would look like if a given (alternative) policy or condition were in put in place today
4. *Backcast from the "what if" tomorrow*: Panelists imagine a scenario in 2050 with "what if" changes having been in place and are asked what changes in baseline policies and/or conditions would be needed to support that "what if"

Based on our experience with the first two steps, we expect that these four steps would result in greater definition of potential scenarios and a better overall understanding of the connection between policy choices and specific scenario outcomes (i.e., what policies in what conditions are most important for attaining the most desirable scenario). The tradeoff is, of course, that expanding the method to four steps also extends the amount of time the study will require.

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Appendices

Appendix A: Panel Activities and Schedule

Table A-1. Panel Activity Overview

Round	Activity	Time Estimate	Schedule
First	Survey 1	45 min.	August 11-17, 2021
	Meeting 1	90 min.	August 18 and 19, 2021
Second	Survey 2	15 min.	August 24-27, 2021
	Meeting 2	120 min.	August 31 and September 2, 2021
Third	Survey 3	15 min.	September 7-10, 2021

Appendix B: Detailed Scenario Descriptions

Scenario: "You'll Need a Car to Get Around" Car-centered/Low-density *(More Mobility, Less Accessibility)*

This scenario describes the "sprawling" developmental patterns that have prevailed in California and elsewhere in the U.S. since World War II. Building densities are low, with most residential land zoned and used for single family homes, with some low-density, multi-family units. Land uses are separated, with housing deliberately segregated from jobs, retail, recreation, and entertainment. Most new housing is built on the fringes of metropolitan areas, where zoning permits. Housing in central areas is undersupplied. High housing prices relative to incomes are the primary contributor to homelessness, and many individuals and families are unsheltered or do not have access to regular housing.

Most trips are made by motor vehicles (for those who have them). Streets tend to be wide, highways capacious, and parking is abundant. These accommodations for the car mean that driving is convenient and quick for some trips at some times, but at other times, congestion makes trips long and unpredictable. Most vehicles are zero-emission, reducing their environmental and public health impacts. If vehicles are automated, this would reduce the opportunity cost of travel time for would-be drivers.

We heard panelists indicate they believe that this scenario works well only for people it was designed for: those with full physical abilities, with higher incomes, and who are of employment age (not children or retirees). Panelists noted that car-centered scenarios could lead to fewer interactions with police but lower levels of pedestrian and bicyclist safety from vehicles.

One panelist described this as their nightmare scenario. Another panelist said they believed this scenario would lead to higher levels of social isolation. Another noted that most emergency management plans today are designed around this scenario.

Scenario: "Lots of Travel Choices, but Most Will Drive" Multimodal/Low-density *(Less Mobility, Variable Accessibility)*

This scenario describes areas of metropolitan California where transportation investments increasingly go to walking, biking, and transit. Most new housing in California is built as single-family homes and low-density townhomes on the fringes of metropolitan areas or in outer suburbs. Due to density restrictions in city centers and close-in suburbs, housing is undersupplied in these core areas.

With a reduced emphasis on driving, less surface area is devoted to parking, and streets are redesigned to accommodate the safe use of alternative modes, ecosystem services (trees and shrubs, cleaning of water runoff, etc.) and leisure (outdoor dining, parklets, etc.). Electric bikes, scooters, and a range of new multimodal mobility options (and supporting infrastructure) help fulfill the needs of dispersed travel without a car. Shared, automated vehicles provide "microtransit"-like shuttle services around these communities. However, few trips are made by walking.

A congestion-based toll may be used to reduce congestion on adjacent highways, motivating the use of long-distance shared mobility, such as commuter shuttles, buses, trains, and future transportation technologies. A greater proportion of the vehicles on the streets would be for goods movement, as opposed to personal mobility. Even with a focus on multimodal travel and transit, these modes may not adequately serve manufacturing, warehouse, and service workers commuting to swing and graveyard shifts in dispersed, single-story industrial parks.

Displacement and spatial mismatch of jobs and housing, particularly among people of color, is a serious concern. Low-income Californians who are dependent on vehicles for work fare worse in this scenario, with high housing costs preventing them from living in central cities and congestion-based tolls and long travel distances resulting in high transportation expenditures. Governments must either 1) provide subsidized housing in areas where housing is expensive to provide or 2) subsidize public mobility in low-density areas where mobility is expensive to provide, lest it fail to meet the mobility needs of low-income households.

Panelists noted that this scenario describes areas of California where ballot measures fund transit construction and a shift to multimodal travel but where those with political power prevent densification of central cities and inner-ring suburbs. Panelists viewed this scenario somewhat more positively than the prior one, but some also questioned how this scenario would be possible in a climate-impacted California, as water supply could constrain the low-density development pattern.

Scenario: "More City Living and Lots of Traffic" Car-centered/Higher-density *(Variable Mobility, Less Accessibility)*

This scenario includes high-density nodes that lack rapid transit access and supposed transit-oriented developments with large parking structures, where many still access the development and transit in a private vehicle. In general, infrastructure neglects modes other than public transit. Nearly all new development includes, perhaps as a result of governmental requirements, substantial amounts of structured and subterranean parking that hide the terminal cost of driving (parking) within the costs of new housing, commercial centers, and other developments.

Under this scenario, development densities increase in central cities and inner suburbs. This supplies more housing, including affordable housing, in areas where it is most demanded, reducing homelessness as well. As with the final scenario, an increase in densification via development of built-out areas would create gentrification and displacement pressures.

The density of cars yields traffic congestion that makes mobility highly variable, especially in core areas. Some chronically congested boulevards and freeways may have a second deck added or be channeled underneath cross-streets. Roads are widened for private vehicle access, and the public right-of-way is rarely dedicated to transit, bikes, pedestrians, outdoor dining, or green space. Because density means more destinations are nearby, walking increases, as might the use of self-powered devices like e-scooters on sidewalks if users do not feel safe in streets.

Panelists questioned whether the transportation system would be seen as successful. Panelists stated that those with minimal mobility needs could fare well in this scenario, including those who wish to age in place without much travel or certain higher-income workers who can afford to live near work or work remotely and have most goods and services delivered (possibly utilizing expensive urban aerial mobility options like drones).

Panelists were least able to think of contemporary examples comparable to this scenario. They noted the risk of ending up implementing this scenario while aiming for the next one. This could happen, for example, if the state government pre-empted some local authority on land use, but local governments retained most authority over road design and transportation investments.

Scenario: "Easy to Get Around without a Car" Multimodal/Higher-density *(Less Mobility, More Accessibility)*

In this scenario, most new development takes the form of redevelopment, concentrated in central cities and inner-ring suburbs. This too brings more housing to places it is most demanded.

A reduced emphasis on parking means less surface area devoted to vehicles and asphalt. Streets emphasize access over mobility and serve multiple modes and functions. Denser, mixed-use development puts more destinations in walking distance. More trips are made by walking but also by biking, scootering, transit, and other modes of transportation. Public and private shared mobility options are robust and plentiful and can serve most but not all trips. Indeed, far fewer trips are made by private vehicle, because of both an increase of alternatives and because driving in a vehicle is not as convenient or cheap as in car-centric scenarios. A congestion pricing fee would make driving fast but expensive. In the absence of such a fee, vehicle networks would be slow and congested.

As with the "Lots of Travel Choices, but Most Will Drive" scenario, a multimodal travel emphasis still may not adequately serve workers beyond the nine-to-five and beyond central business districts. Those who would certainly lose out are those wishing to access central cities but whose only option is a private vehicle. Meanwhile, more vehicles would be used for goods movement and deliveries.

This scenario represents the biggest break from California's predominant development and transportation patterns in the post-World War II era. Because of California's relative inexperience with the strategies of this scenario on a large scale, panelists saw a risk that it would introduce many unknowns and fear of disparate impacts that leave some people or places behind. Panelists noted a key question of whether California could build enough housing or affordable housing to meet demand in central areas; some had difficulty positing a realistic version of this scenario where housing and opportunity were available to people of all incomes and backgrounds. And similarly to the "Lots of Travel Choices, but Most Will Drive" scenario, ensuring a greater diversity of transportation system users feel safe and secure without the cocoon of a personal vehicle would require changes to the way community safety is fostered and enforced.

Appendix C: Expert Panelists

Table C-1. Panelists

Name	Affiliation (as of the Panel Exercise)
Ratna Amin	Strategic transportation advisor
Avital Barnea	California State Transportation Agency
Allison Brooks	Bay Area Regional Collaborative
Tamika Butler	Tamika L. Butler Consulting, LLC
Stuart Cohen	Stuart Cohen Strategies
Karl Fielding	WSP Inc.
Sarah Jones	San Francisco Municipal Transportation Agency
Sam Morrissey	Urban Movement Labs
Chris Pangilinan	Uber
Timothy Papandreou	Emerging Transport Advisors
Dr. Regan Patterson	Congressional Black Caucus Foundation
Julie Quinn	QuinnWilliams
Seleta Reynolds	Los Angeles Department of Transportation
Sahar Shirazi	Nelson\Nygaard
Lilly Shoup	Shoup Strategies
Thomas Small	Culver City Forward
Dr. Destiny Thomas	Thrivance Project
Marla Westervelt	Commission on the Future of Mobility