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Planning for transportation equity in small regions: Towards meaningful performance assessment

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ABSTRACT

Regional transportation planning agencies seek to achieve multiple objectives simultaneously including consensus on key issues, compliance with relevant laws and regulations, and improvements in the congestion, air quality, and safety performance of the transportation system. Some performance areas lend themselves well to operationalization while others do not. One area that has received comparatively little study is the assessment of a plan's impacts on environmental justice and social equity. Although research on regional planning usually emphasizes larger metropolitan areas and agencies, these issues are especially relevant in smaller regions where planners lack the capacity for innovation and careful analysis. Further, the transit services on which disadvantaged populations depend are often lacking or non-existent in less-populated regions. Understanding how planners in these locations undertake social equity-related analyses and providing suggestions for improvement is thus an important endeavor. While prior work has assessed whether, and to what extent, equity objectives are included in plans, there are few detailed investigations of the key analytical choices that shape equity outcomes. This paper fills this important research gap, providing such an analysis of existing practice in a largely rural region in California, the San Joaquin Valley, as well as recommendations for future analyses aimed at improving the consistency between equity analyses and the real-world impacts of transportation plans.

1. Introduction

Achieving transportation equity—encompassing a fair distribution of the benefits and burdens of transportation investments across demographic groups and space—is an ongoing challenge. Yet the analysis of transportation-related benefits and burdens is routinely undertaken by metropolitan planning organizations (MPOs) to comply with environmental justice and civil rights regulations and guidance. Environmental justice activism and regulatory activity has historically sought to mitigate the disproportionately high and adverse environmental impacts borne by communities of color and low-income communities resulting from locally undesirable land uses (Cole and Foster, 2001; McGurty, 2007; Pellow and Brulle, 2005). The US Department of Transportation (DOT) has adopted directives and guidance aimed at achieving environmental justice in planning and programming activities (see, e.g., US Department of Transportation Office of the Secretary, 2012). This guidance requires MPOs to address traditional environmental justice concerns related to burdens, but also prohibits the denial, reduction, or delay in receipt of the *benefits* of transportation projects and plans. Because of the similarities between the goals of transportation equity and environmental justice, the legal and regulatory frameworks that have emerged to achieve the latter are often used to advance the goals of the former.

In the wake of 1991's Intermodal Surface Transportation Equity Act (ISTEA), the subsequent broadening of factors that transportation planners must consider (Dilger, 1992; Schweppe, 2001), and the empowerment of MPOs, regional planning agencies in the US have become the preferred unit of governance at which to advocate for transportation equity (Marcantonio and Karner, 2014). This scale is also consistent with the literature on regional equity that points to important inequities that manifest at the scale of the metropolitan region (Benner and Pastor, 2012; Pastor et al., 2009; Pastor et al., 2000). In practice, regional planning agencies have been called upon to address differential funding across transit agencies and modes, overall funding shares across all modes, gentrification and displacement, and affordable housing policy, among other areas.

MPOs and other transportation planning agencies are required to follow guidance when assessing transportation equity (see, e.g., Federal Highway Administration, 1998; Federal Highway Administration/Federal Transit Administration, 1999, 2012a, 2012b). Although some prior work has assessed MPO practice generally (Karner and Niemeier, 2013; Martens et al., 2012) or their

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definitions of equity (Manaugh et al., 2015), at least two important gaps remain. First, most analyses of practice focus on large regions, but approximately half of the 408 MPOs designated in the US as of 2015 represent urbanized areas with fewer than 200,000 residents.[1] Resources and analytical capacity are likely to differ substantially across MPOs of differing size so recommendations on improving practice are likely to differ as well. Second, the work has scarcely addressed the fundamental components of an equity analysis, including the definition of comparison communities and the formulation and calculation of performance measures. If these steps are conducted poorly, the ultimate assessment of equity is likely to tell us little about current conditions in a region or the likely effects of a plan in the future. This paper fills these gaps by assessing the environmental justice and equity analyses of eight smaller MPOs located in California's San Joaquin Valley (SJV) to determine the extent to which their results are likely to reflect extant or projected patterns of equity and inequity resulting from the implementation of their regional transportation plans (RTPs). The analysis is aimed at providing concrete recommendations for practice capable of improving the consistency between actual transportation benefits and burdens and the analyses conducted to illuminate them.

The remainder of this paper is structured as follows. After a literature review on transportation performance assessment and equity analysis, the regional transportation planning documents that were reviewed for the study are described. The results section summarizes the major findings of the study and implications for policy and practice are discussed in the concluding section.

2. Literature review

Whether implicit or explicit, performance management—setting goals, establishing metrics, and tracking progress—has been present in transportation planning in multiple forms since the field's inception. The topic of performance assessment and management has been extensively studied (Black et al., 2002; Cambridge Systematics, 2000; Transportation Research Board, 2001). Its allure is clear: with explicit performance measures, transportation planning and decision-making would no longer be affected by political whims. Sensible goals would be set and progress towards them measured and made. Although more data and better analysis are unlikely to result in a planning revolution (Wachs, 1995), better articulating and measuring progress towards or away from our multiple, often conflicting, goals for the transportation system certainly would represent an improvement over current practice by allowing decision makers and the public to better understand the inherent tradeoffs between popular objectives.

In the wake of the Intermodal Surface Transportation Act of 1991 (ISTEA), transportation performance concepts were broadened beyond highway level of service to include many additional "planning factors" including safety, environmental performance, and reliability, among others (Dilger, 1992; Dittmar, 1995; Schweppe, 2001). One area of transportation system performance in which interest has been steadily gaining is transportation equity (Brenman and Sanchez, 2012; Bullard and Johnson, 1997; Bullard et al., 2004). The history of transportation planning in the United States is rife with examples of the negative effects of transportation infrastructure on people of color and low-income populations. Throughout the 1950s, these involved rather explicit efforts to use the combined interstate and urban renewal programs to displace people of color populations from central cities (Rose and Mohl, 2012, pp. 95–7). Disparities in the distribution of benefits and burdens tend to persist and are deeply ingrained due to biases, incentives, and behaviors that tend to lock in patterns of racial discrimination (see, e.g., Golub et al., 2013; Pulido, 2000). Academic research on this topic has proceeded briskly, with researchers routinely making recommendations for and carrying out the analysis of transportation system costs and benefits, stratified either by demographic group or across space (see, e.g., Grengs, 2010; Hu, 2015; Karner and London, 2014; Morency et al., 2011; Rowangould, 2013; Sanchez, 1998; Schweitzer and Valenzuela, 2004; Shen, 1998; Welch and Mishra, 2013). These studies are useful for bringing advances in geographic information science, spatial analysis, and data availability to bear on problems of transportation equity.

Despite the proliferation of academic studies, sophisticated data and methods are slow to diffuse to practice. MPOs routinely assess equity performance as part of their efforts to comply with various laws that govern planning activities including Title VI of the 1964 Civil Rights Act and Executive Order 12898 (Karner and Niemeier, 2013; Sanchez et al., 2003). General practice-oriented reviews have found agency efforts to be particularly lacking (Manaugh et al., 2015; Martens and Golub, 2014; Martens et al., 2012). These reviews have variously addressed whether equity is stated as a goal, the outcome measures used to assess it, or the definition of equity either implicitly or explicitly adopted.

In terms of equity definitions, Bullard (1994) provides a helpful taxonomy that maps onto the equity assessment practice among MPOs. Specifically, he defines three types of equity: procedural, geographic, and social. Procedural equity refers to process-related factors including the timing and location of public meetings and the languages in which information is distributed. This type of equity has its roots in the early environmental justice movement that connected a lack of inclusion with unjust outcomes (Cole and Foster, 2001). Geographic equity refers to the distribution of costs and benefits across space and social equity refers to the distribution of costs and benefits across demographic groups. From a civil rights and justice perspective, geographic equity obtains its relevance because of ongoing patterns of spatial separation and segregation in US cities on the basis of demographics (e.g. race and income). All analyses of transportation equity in practice are undergirded by the notion of social equity.

Understanding geographic and social equity requires some type of qualitative or quantitative performance assessment. Popular performance measures include accessibility, commute time, dollar amounts of investments, and air quality, although others are possible. An analysis of geographic equity compares performance for different spatial units (e.g., cities, counties, or groups of census tracts) while an analysis of social equity compares the performance for different demographic groups (e.g. low-income people and non-low-income people). In practice, and because of the structure of traditional travel demand models, these two approaches are often merged, with two groups of transportation analysis zones identified based on their demographics (e.g., disadvantaged and non-disadvantaged zones or environmental justice and non-environmental justice communities) and compared to each other.

While procedural equity is undeniably important, a just process does not guarantee just outcomes. Virtually all of the MPOs studied included some mention of their public meetings and distribution of information in multiple languages and at convenient times. The focus of the present analysis is instead their treatment of geographic and social equity performance. Methodological and conceptual challenges plague these assessments, and more guidance and critical analyses of practice are needed (Karner and

[1] Based on MPO boundary data from FHWA combined with population data from the US Decennial Census Summary File 1. This threshold is significant; urbanized areas exceeding 200,000 in population are designated as transportation management agencies (TMAs) and must undertake a congestion management process alongside other planning responsibilities.

Niemeier, 2013; Rowangould et al., 2016). Notably, questions persist regarding appropriate community definitions and performance measures, the fundamental building blocks of a meaningful analysis.

In contrast to the rich literature on the definitions of transportation equity and justice (Litman, 2002; Martens, 2012; Martens and Golub, 2014; Martens et al., 2012), there is comparatively less work that assesses whether particular analytical approaches, either quantitative or qualitative, are likely to reflect the real-world distribution of plan outcomes. Specifically, federal law and guidance require an assessment of the benefits and burdens of a plan across demographic groups, but we know very little about whether and to what extent existing performance measures reflect the travel behavior and transportation conditions faced by particular communities. For example, different approaches to comparison community and performance measure definition can potentially lead to different findings regarding equity impacts. Two studies conducted using different travel demand model datasets found that one performance measure, public transit accessibility, varies widely with different definitions of comparison communities (Karner and London, 2014; Rowangould et al., 2016). Thus, even if a progressive equity definition is adopted that seeks to close the performance gap between disadvantaged communities and the rest of the region over time (e.g., Martens et al., 2012), early analytical choices may lead to inconsistencies between calculated outcomes and the real-world consequences that would result for disadvantaged populations if the plan were to be implemented.

The ability of an MPO to respond to these challenges will be affected by its size. Although their existence is mandated by federal law in urbanized areas exceeding 50,000 in population, MPOs vary widely in their analytical capacity. While the most advanced are adopting and implementing integrated travel demand-land use models with an activity-based travel component, others are content with four (or sometimes even three) step models of travel demand and static land use projections. Because of the concentration of population in large MPOs, much academic research has focused on them (see, e.g., Gerber and Gibson, 2009; Golub and Martens, 2014; Handy, 2008; Sanchez, 2006). Rather than continue this trend, this paper examines in detail the equity analysis practices of a group of MPOs that are likely to represent the capacity of small regions in the US. Prior work has not examined small MPOs and has generally not assessed how key analytical steps like community and performance measure definitions can affect the consistency of calculated outcomes with potential real-world impacts. Small MPOs are a relevant group precisely because they do not possess the staff or financial resources to implement more advanced models, methods, or data. Identifying analytical changes that can be implemented at low cost (including the elimination of some practices that are not informative) is thus especially important for affecting equity outcomes in smaller regions.

3. Data and methods

The data used in this analysis were gleaned from the 2011 RTPs and two supplemental reports prepared by eight California MPOs located in the largely rural SJV. Despite substantial agricultural abundance, the SJV is marked by income and racial inequities (Taylor et al., 1997). Additionally, environmental hazards in the SJV tend to affect those with the fewest resources to address them (Huang and London, 2012; Kramer, 2012). A combination of unfortunate physical geography, agricultural industry, and a heavy reliance on automobiles, make air quality in the Valley some of the worst in the nation with all eight counties in extreme nonattainment for the 2008 ozone national ambient air quality standards (US Environmental Protection Agency, 2015). Comprehensive responses to these problems is challenging because governance is fragmented. For example, each of the eight counties constitutes their own MPO; there is no truly “regional” planning organization in which consensus could be sought on issues of importance.

Importantly, like other MPOs in California, these agencies are required to reduce their per capita greenhouse gas emissions over time by integrating transportation, land use, and housing planning efforts under the state's Senate Bill (SB) 375 (Barbour and Deakin, 2012; Karner et al., 2014). Transportation advocacy efforts are underdeveloped in the SJV because advocates and community-based organizations have historically faced more immediate health threats from air pollution and pesticides. Additionally, the perception and reality of the SJV as mostly rural makes many of the transportation policies proposed for SB 375 compliance seem unsuitable for implementation there (Karner and London, 2014). On the other hand, the SJV's population is projected to increase from about 4 million in 2010 to 7.4 million by 2060 (Department of Finance, 2014). All eight SJV counties will be in the top 15 fastest-growing over the period 2010–2060 (Department of Finance, 2014). Meeting sustainable transportation goals equitably is likely to be key to success (Marcantonio and Karner, 2014).

Without exception, the 2011 RTPs for this group of MPOs contained either chapters, appendices, standalone documents, brief passages or some combination of these devoted to discussions on the impacts of the plans on disadvantaged populations. Often these contained language regarding the connection of the analysis to the requirements of Title VI or Executive Order 12898. For example, the Council of Fresno County Governments (2009) Environmental Justice Plan states that “In the wake of federal guidelines for environmental justice based on Title VI of the Civil Rights act, growing attention has been placed on the need to incorporate environmental justice principles into the processes and products of transportation planning” (p. 4). Similarly, the San Joaquin County Council of Governments mentions both the Executive Order and Title VI in their environmental justice chapter (San Joaquin Council of Governments, 2011, p. 8-1). I reviewed the documents in the locations where environmental justice played a prominent role, or was mentioned at all, paying particular attention to the descriptions given by the MPOs regarding the analyses they completed and the data they employed. These documents compose the data on which the present analysis is based. Rather than critiquing or attempting to uncover the equity definitions employed by the agencies, I consider the extent to which community definitions and performance measures combine to provide information relevant to the distribution of transportation-related benefits and burdens across space and across demographic groups.

4. Results

Summary information on each MPO and their equity analysis methods is shown in Table 1; the table is sorted by the population served by the planning organizations and also includes each agency's definition of environmental justice communities along with details regarding any quantitative and qualitative performance analyses employed. There is a definite decrease in detail and sophistication as the population covered by the MPO decreases. The two largest MPOs (Fresno and Kern) explicitly defined environmental justice communities and derived performance measures from their travel demand model for their analyses. Smaller MPOs also demonstrated sophisticated analytical methods, however, often using off-model approaches to quantify

Table 1
Overview of SJV environmental justice/equity performance analyses.

MPO	Population (2010)[a]	Environmental justice community definition	Quantitative performance assessment	Qualitative performance assessment	RTPs and other relevant documents
Fresno	930,450	60% higher than county average on one of four categories[b]	Existing and future year comparisons of travel time metrics. Travel demand model employed.	None	Council of Fresno County Governments (2009) Council of Fresno County Governments (2010)
Kern	839,631	Areas with higher than average concentrations of target populations[c]	Existing and future year comparisons of travel time metrics. Travel demand model employed.	None	Kern Council of Governments (2003) Kern Council of Governments (2010)
San Joaquin	685,306	60% people of color or 20% low income	Investment equity based on observed mode shares from Census Transportation Planning Package. Proximity analysis.	Noise, congestion, air quality, and economic competitiveness assessed. Capacity expansion thought to mitigate.	San Joaquin Council of Governments (2011)
Stanislaus	514,453	None	None	Visual assessment of project locations overlaid on census demographics.	Stanislaus Council of Governments (2010)
Tulare	442,179	None	None	An "Equity/Environmental Justice - Economic Well-Being" performance measure included but not operationalized.	Tulare County Association of Governments (2010)
Merced	255,793	None	Ambiguous quantification of "minority and low income populations potentially impacted by transportation investments."	None	Merced County Association of Governments (2010)
Kings	152,982	None	None	Discussion of the environmental justice implications of three highway projects.	Kings County Association of Governments (2010)
Madera	150,865	Arbitrary definition of two environmental justice "target areas"	Investment equity analysis for highway, transit, and non-motorized projects.	Air quality assessed. Capacity expansion and investment in non-motorized modes thought to mitigate.	Madera County Transportation Commission (2010)

[a] US 2010 Decennial Census, Summary File 1.
[b] Low income, non-white, senior, and disabled populations.
[c] Low income, minority, elderly, and disabled populations.

impacts (e.g., San Joaquin and Madera counties). Below, I synthesize MPO practices across all agencies and summarize their approaches in each of the categories outlined in Table 1.

4.1. Defining environmental justice communities

Three of the eight MPOs explicitly defined environmental justice communities for analysis. Typically, this process involves a demographic threshold applied to geographic units like transportation analysis zones (TAZs) or census tracts. The unstated goal of this approach is to define a group of places—often referred to as "environmental justice communities" (EJ communities)—whose relative performance on some indicators can be assessed. As noted above, this definition merges Bullard's (1994) geographic and social equity by simultaneously considering demographics and space. But the threshold approach leads to a number of potentially problematic outcomes. Specifically, members of disadvantaged groups that live outside of such communities are not included as part of the demographic group under investigation. Additionally, residents of EJ communities that are not members of the demographic groups used to define the thresholds are included. It is an imprecise approach for understanding the effects of transportation planning on spatial and social equity.

The San Joaquin Council of Governments (SJCOG) recognized these issues in their discussion of the target population. They established thresholds for EJ communities at 60% people of color or 20% low income. These were selected to be "slightly above the county average of approximately 53% minority and nearly 18% below poverty level" (San Joaquin Council of Governments, 2011, p. 8-3). The RTP notes that 46% of the total 2000 population and 48% of all block groups are included within the environmental justice population using their threshold definition and that 71% of those identified residents were not low income and 27% were white. Further, 25% and 27% of people of color and low income, respectively, lived outside of identified areas. For this reason, SJCOG also included a region-wide analysis of investment equity that casts a broader net, discussed below, to include populations of concern regardless of their location relative to identified communities.

Fresno and Kern counties noted that their populations of concern were identified in consultation with stakeholder groups, but they do not demonstrate the same understanding of the limitations of this approach as SJCOG. In Fresno's 2011 RTP, target populations were defined using four disadvantaged groups: low income, non-white, senior, and disabled persons. TAZs with populations 60% higher than the county average on any individual demographic were identified as environmental justice zones (EJ zones). Staff also experimented with 50% and 70% thresholds but found them too permissive and restrictive, respectively. The total number of TAZs identified in this manner was not described, and the maps included at the end of the plan are of extremely low resolution, making interpretation difficult.

Additional evidence of experimentation appears in Kern's 2003 EJ Report, where EJ communities were defined as TAZs where greater than 200 individuals were present in at least one out of four of the following demographics: low income, non-white, seniors, and "transit disabled."[2] Initially selecting a person count threshold of 50 on any of the four target populations, the report states that "such a small number included every inhabited portion of Kern County" but that "using the high-end concentration of 500 excluded too many neighborhoods that staff knew from Census data included environmental justice populations" (Kern Council of Governments, 2003, p. 9). Eventually, the report settled on a threshold of 200 individuals, noting that threshold allowed a "clearer picture" of EJ communities to emerge (Kern Council of Governments, 2003, p. 10).

4.2. Quantitative performance assessments

4.2.1. Travel model-based performance assessment

Travel demand model-based performance metrics only appeared in two analyses. Fresno COG calculated performance measures in seven broad areas for EJ communities and all zones (representing the county average) in 1998, 2030 build, and 2030 no build conditions for several spatial aggregations.[3] Measures included mean travel times from EJ communities/all TAZs to "job centers" (referred to as accessibility) mean travel times from EJ zones/all TAZs (referred to as mobility), person-miles of travel in each zone divided by the total investment in that zone, among others. Although results differed according to the spatial aggregations used, and from year to year, no large differences were observed between EJ communities and all TAZs within any particular category. The report concludes that "programmed transportation investments in Fresno County result in fair distribution of impacts and benefits… when comparing environmental justice TAZs and non-environmental justice TAZs in Fresno County" (Council of Fresno County Governments, 2009, p. 26).

At Kern COG, the environmental justice analysis is nested within the performance measures analysis conducted for the 2011 RTP (Kern Council of Governments, 2010, pp. 2-10–2-26). Performance measures used for environmental justice assessment were very similar to those used by Fresno COG. In most cases, these performance measures were calculated for 2006, 2035 build, 2035 no build for traffic analysis zones identified as representing EJ communities compared to the countywide average performance. With one exception, the analysis concluded that EJ communities fared as well or better than countywide average performance in the forecast year, or in terms of changes from the base year to the forecast year. The single measure that appears to perform worse is the equity measure for transit (pp. 2–19). Specifically, staff calculated the investment in transit per passenger-mile traveled in EJ communities and for the county as a whole. Although not described in detail, it seems that the dollar value of transit projects was allocated to individual zones and then divided by total passenger-miles within the zones. The calculated metric is lower for EJ communities than non-EJ communities, but this could mean either that there is lower investment or more travel in those zones.

4.2.2. Investment equity

In lieu of or in addition to travel demand model-based analyses, several MPOs opted to conduct analyses of investment equity that were not based on travel model outputs. There was no standard approach taken across the MPOs that conducted this type of analysis, but both aspatial and spatial procedures were used. The apparent goal is to apportion RTP investments to different demographic or spatial groupings on the basis of some measure of use.

One example of the aspatial approach is provided by the San Joaquin Council of Governments. They employed mode shares

[2] "Transit disabled" is not fully defined in either of the reports cited here, but seems to inconsistently reference zero vehicle households, persons with disabilities, and those without access to high quality transit. Fresno COG also refers to "transit disabled" populations, but later maps present concentrations of persons with disabilities (Council of Fresno County Governments, 2009, Maps 6–8) and discussion cites disabled persons (Council of Fresno County Governments, 2009, p. 10). Presumably transit disabled refers only to disabled populations, at least in the Fresno COG case.

[3] The results were disaggregated into EJ TAZs/all TAZs for the Fresno-Clovis sphere of influence (the county's major metropolitan areas), the remainder of the county, and overall county results.

Table 2
Investment equity analysis from San Joaquin COG's 2011 RTP supplemented with additional data.

Category	Total RTP Investments (Million $)	Share of workers using mode for journey to work[a] (%)		Share of investments (Million $)		Per household expenditures[c] ($)	
		Low-income households[b]	All other households	Low-income households[b]	All other households	Low-income households[b]	All other households
Bus transit	2074	21.8	78.2	452	1622	10,600	11,680
Roadway maintenance	3004	8.7	91.3	266	2738	6220	19,700
Roadway expansion	4660	8.7	91.3	412	4248	9650	30,600
Rail	667	0	100	0	667	0	4800
Non-motorized	193	23	77	44.6	149	1044	1070

[a] CTPP 2000 Part 1, Table 1-034.
[b] Earning < $20,000/year.
[c] According to the 2000 CTPP, out of a total 181,612 households living in San Joaquin County, 42,727 earned < $20,000.

from the Census Transportation Planning Package (CTPP) for the journey to work to allocate RTP investments in five categories to low-income and non-low-income households. Although not stated in the RTP, the data were from the year 2000 CTPP and low-income households were selected as those earning less than $20,000 per year. Within each expenditure category, investments were allocated to the two groups based on the share of workers normally using that mode during their commute. The analysis from the RTP, supplemented with CTPP 2000 data, is shown in Table 2. Based on the definition of low-income households adopted, any modal pattern that diverges from the relative overall share of low-income compared to non-low income households (approximately 24% vs. 76%) will appear inequitable. Indeed, shares for bus transit and non-motorized modes appear to be relatively equitable, but because higher income households tend to commute by automobile at a much higher rate than would be suggested by their population proportion, they appear to receive a disproportionate benefit from highway investments, a fact noted within the RTP.

To counter this apparent finding of inequity, the RTP conducts additional spatial examinations of highway and bus expenditures using a "proximity analysis" that "assumes … accessibility is enhanced by proximity to the proposed project" (San Joaquin Council of Governments, 2011, pp. 8–12). This analysis considered highway projects to be accessible if they went through or were adjacent to identified environmental justice census block groups, as defined above. Specifically, highway expenditures were allocated to specific block groups in proportion to the length of the facility passing through or around them. A related analysis was conducted for bus transit. The proportion of funding for each of the nine transit operators in San Joaquin County was compared to the percentage of the environmental justice population served by them. In contrast to the household-level analysis, the RTP argues that the proximity-based analyses show that transportation investments are equitable between EJ communities and non-EJ communities.

Madera County also assessed investment equity, but arbitrarily defined five mutually exclusive and collectively exhaustive geographic areas (Madera County Transportation Commission, 2010). Demographic profiles of each area are presented, showing that they range from 15.3% to 72.7% people of color and from 4% to 52% of the county population. Two areas (numbered 1 and 3) are defined as the EJ communities since they contain greater than 50% people of color. Additionally, area 3 is identified as having a substantial proportion of low-income residents. The RTP assigns "project benefits" to one or more areas, operationalized using dollars of investment, by reasoning through the extent and potential users of the projects. Separate analyses are conducted for three modal categories: roads, bus transit, and non-motorized projects. For example, it states that "any capacity increasing or rehabilitation project located on Highway 41 near Avenue 12 will not only benefit residents in target area IV, but will benefit residents in target area V as well, since Highway 41 is the main thoroughfare to the mountain communities" (Madera County Transportation Commission, 2010, p. 7–14). Because benefits are not restricted to a single area, any one area can receive up to 100% of RTP investments within a modal category. This percentage is compared to the total share of automobile commuters residing in each area as assessed using the CTPP 2000. Since benefits can be assigned to more than one area, all areas show greater percentage benefits accruing from roadway projects than their share of use. The use of transit in two areas appears to exceed their share of benefits, but the RTP states that those two areas receive the greatest proportional share, so there is no inequity (Madera County Transportation Commission, 2010, p. 7-6).

4.3. Qualitative assessments

Many of the MPOs supplemented quantitative analyses with qualitative assessments, while others relied on qualitative assessments alone. These qualitative assessments commonly made claims regarding the effect of highway capacity expansion on congestion, air quality, and health outcomes. For example, in San Joaquin County, four qualitative analyses were conducted, all of which relied on the notion that capacity-expanding projects aimed at congestion relief would improve air quality, reduce noise, and improve the economic competitiveness of the region (San Joaquin Council of Governments, 2011, pp. 8-19–8-22). Similarly, the 2011 RTP for Kern County noted that the document conforms to federal air quality standards, and that there would be no degradation in air quality as a result of plan implementation (Kern Council of Governments, 2010, pp. 2–20). Madera County's RTP contained similar arguments (Madera County Transportation Commission, 2010, pp. 7–19).

The smaller counties relied almost exclusively on qualitative analyses for their equity and environmental justice assessments. The Stanislaus Council of Governments used census 2000 data to create maps identifying geographic concentrations of female-headed households, seniors (greater than 65 years old), disabled residents, those living in poverty, and people of color (Stanislaus Council of Governments, 2010, pp. 86-7). Proposed road projects were overlaid on these base maps and visually assessed for disparities. The analysis concludes that, "A visual evaluation of the maps does not reveal noticeable trends or patterns of disproportionate impact. The geographic distribution of transportation improvements throughout the County appears relatively balanced" (Stanislaus Council of Governments, 2010, pp. 87).

Rather than mapping all projects, Kings County assessed the environmental justice implications of three highway project in isolation (Kings County Association of Governments, 2010, pp.

4-57–4-62). The assessments present maps of the proposed alignments and discuss the demographics surrounding two of the three projects. The third project (12th Avenue Interchange) includes no discussion of demographics. Based on the qualitative analysis, no environmental justice problems or concerns are noted. It is unclear why these specific projects were chosen.

5. Discussion and conclusions

The effort invested in and resultant quality of equity-related performance assessments varies widely across the sample of small MPOs studied here. As MPOs often point out, there is no prescribed standard by which to conduct an environmental justice analysis.[4] As a result of this lack of specific guidance, very little emphasis has been paid to crafting meaningful methods likely to reflect the actual impacts of RTPs. But improving the consistency between performance measures and impacts is necessary to understand how conditions will change, individually and collectively, for protected populations under alternative planning scenarios. Fortunately, and despite the resource constraints faced by smaller MPOs, there are a number of analytical refinements that can be implemented or measures and approaches that can be eliminated because they offer little meaningful information. These changes would not require the adoption of advanced modeling frameworks, substantial additional staff expertise, or novel data sources. The recommendations provided below are aimed at improving the consistency between measures and impacts and can be used as a guide for agencies conducting such analyses and members of the public providing input in the United States and elsewhere. Specifically, I discuss EJ community definitions, quantitative performance assessments, and qualitative assessments.

Defining EJ communities using thresholds is very common among the studied MPOs, but is likely to obscure the true impacts of transportation plans on disadvantaged populations by mixing EJ and non-EJ groups within the same geographic units. Several approaches are available to mitigate this problem. Rather than defining thresholds arbitrarily, they could be defined to elicit suspected or observed differences in travel behavior between EJ and non-EJ groups in a base year. Those thresholds would then be held constant to assess future year performance. This approach would involve testing many different definitions (e.g., increasingly strict thresholds for people of color or low-income) for EJ communities and incorporating variation in performance into the analysis. In principle, this would be similar to conducting a sensitivity analysis on the threshold definitions. Additionally, population-weighted means or distributions could be used to define performance measures for a population over an entire region rather than for groups of zones. In general these two approaches do not result in similar findings regarding equity (Rowangould et al., 2016).

Proper attention to EJ community definition is especially important because of the differential ability of individuals to benefit from transportation investments depending on their mode choices. Households with access to vehicles derive the majority of benefits from highway investments while transit-dependent households capture a much smaller share. Population weighting is appropriate for calculating measures that are sensitive to these distinctions because they reflect an average value of performance for protected populations regardless of their geographic location (e.g. change in number of jobs accessible by automobile for vehicle-owning households). In effect, these measures attribute benefits to individual travelers or households rather than geographic units, sidestepping the problem of mixing highlighted above. In that sense they are true social equity measures. Because EJ groups in general have much lower rates of automobile ownership and use, developing approaches capable of illuminating disparities between automobile and transit performance and the effectiveness of mitigations is also desirable (e.g., Golub and Martens, 2014). From a civil rights perspective, population-weighted measures can capture racial differences in performance and would more closely approximate the average experience of individual demographic groups than would geographic threshold approaches.

Quantitative travel model-based performance measures that calculate average travel times from all zones to a subset of destinations or between all origins and destinations are only marginally informative. Current transportation and land use patterns are still deeply affected by historical decisions that were often racially motivated (Golub et al., 2013). Travel patterns are thus shaped by the specific places where people live in relation to the locations of desired activities. The characteristics of actual/modeled trips and/or important activity locations should instead be used to gauge performance. Analyses of investment equity hold promise, but were relatively limited in application. Rather than restricting the analyses to a single low-income category and only work trip mode shares from the CTPP, agencies could consider equity across multiple dimensions and trip types. Doing so would require moving beyond the CTPP, but in California a data source like the California Household Travel Survey provides a wealth of information (California Department of Transportation, 2013). Additionally, MPOs often have their own regional surveys of travel behavior that can be employed to assess facility use by trip purpose.

A number of the MPOs reviewed above used proximity-based metrics to gauge benefit. For example, Fresno COG's measure of cost-effectiveness calculated person-miles of travel in a TAZ per dollar of investment. Such measures are misleading. In reality, persons traveling within a zone do not necessarily reflect the demographics of a zone. A new facility that passes through a low-income neighborhood but connects a high-income neighborhood to high-wage jobs represents potentially little benefit to nearby low-income residents. Yet these types of measures assume that such a benefit exists. Such measures should instead be based on characteristics of individual travelers rather than the geographic zone within which environmental justice populations are concentrated. Origin-destination tables disaggregated by income and automobile ownership might be used for this purpose, but may not be generated by smaller MPOs. Relatedly, the measures employed by San Joaquin COG that equated access and proximity should be eliminated. There are countless examples from the history of transportation planning where populations of color and low-income were displaced by transportation infrastructure that largely benefitted higher income, whiter populations (Mohl, 2004; Rose and Mohl, 2012). Ongoing regulatory shifts have also highlighted the importance of the near-road zone for air pollution exposure, indicating that proximity can also be a burden (Karner et al., 2010).

One of the most troubling results uncovered in the review of small MPO practice, was the use of qualitative, map-based assessments in lieu of model-based analysis. While not all impacts can be captured by a travel model, and there is much room for innovation in off-model equity analysis, any qualitative analyses must be reproducible. The extent to which different population groups are affected by multiple projects is not clear using maps alone (Cambridge Systematics, 2002). Maps that are referred to should be available for public inspection and legible. A low-resolution map on which an equity determination is made is worse than useless, yet several of the MPOs studied included

[4] For example, the 2009 environmental justice report prepared by Fresno COG states that MPOs are granted "considerable latitude… regarding implementation of environmental justice principles into the planning process" (Council of Fresno County Governments, 2009, p. 4).

indecipherable maps in their RTPs. Further, the apparent obliviousness of regional transportation planners to the phenomenon of induced demand is surprising. Academics have long been attuned to this issue (see, e.g., Duranton and Turner, 2011; Noland and Lem, 2002). The purported congestion mitigation and air quality benefits of capacity increasing projects must be subjected to a rigorous analysis that considers the potential for land use to change in response to transportation investments rather than a terse qualitative assessment.

Equity analysis practices at small MPOs apparently vary widely. Although observers and members of the public participating in these processes must be mindful of the differential resources available to MPOs based on their size, there is clearly much room for improvement. As demands to conduct more performance-based planning increase, and as comparative assessments like this one seek to understand the consistency between actual impacts and calculated performance measures, federal agencies engaged in promulgating guidance would be wise to become more prescriptive on this score. In no instance described above was the environmental justice or equity analysis used to decide between alternative scenarios; rather, it was used largely to assess investment decisions that had already been made. In order to make meaningful progress towards equitable outcomes, performance assessments must be linked back to decision-making processes so that they might lead to equitable, real-world outcomes.

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