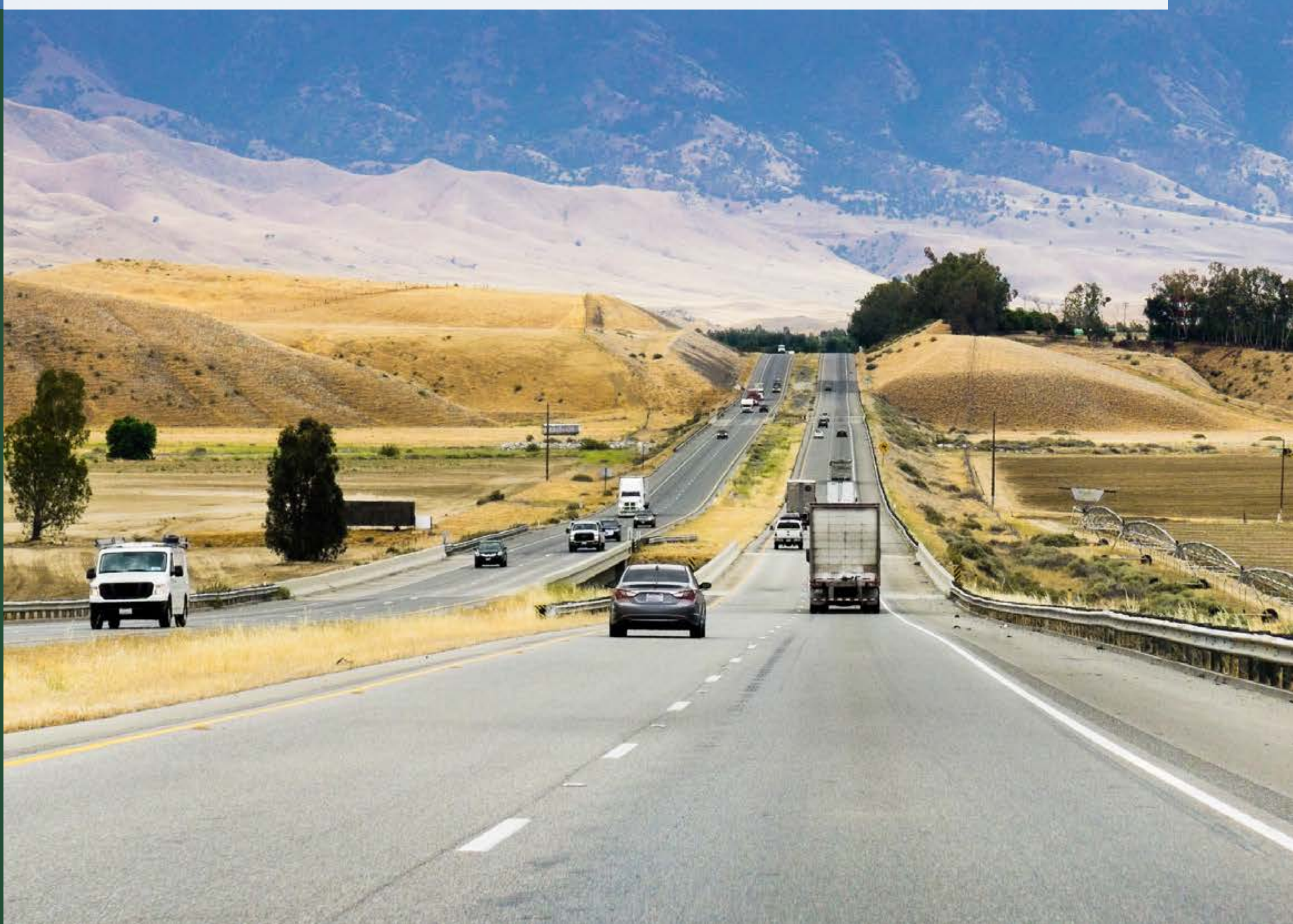
CALIFORNIA RURAL
COUNTIES TASK FORCE

RURAL INDUCED DEMAND STUDY

FEBRUARY 2025



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APS	Alternative Planning Strategy
AADT	Annual Average Daily Traffic
CARB	California Air Resources Board
CEQA	California Environmental Quality Act
CALSTA	California State Transportation Agency
CTC	California Transportation Commission
CSIS	Caltrans System Investment Strategy
CBD	Central Business District
CMS	Changeable Message Sign
CAPTI	Climate Action Plan for Transportation Infrastructure
CCTV	Closed-Circuit Television
CMCP	Comprehensive Multimodal Corridor Plan
CMF	Crash Modification Factor
EIR	Environmental Impact Report
EO	Executive Order
FHWA	Federal Highway Administration
GHG	Greenhouse Gas
HOT	High Occupancy Toll
HOV	High Occupancy Vehicle
HPMS	Highway Performance Monitoring System
HH	Household
IIJA	Infrastructure Investment and Jobs Act
INFRA	Infrastructure for Rebuilding America
LLPC	Local Partnership Competitive Funds
MSA	Metropolitan Statistical Area
MPO	Metropolitan Transportation Planning Organization
MPDG	Multimodal Project Discretionary Grant
NCST	National Center for Sustainable Transportation
NPTS	Nationwide Personal Transportation Survey
NAS	Naval Air Station
OPR	Office of Planning and Research
HPMS	Performance Monitoring System
PROTECT	Promoting Resilient Operations for Transformative, Efficient, and Cost-saving Transportation Program
RAISE	Rebuilding American Infrastructure with Sustainability and Equity
RTP	Regional Transportation Plan
RTPA	Regional Transportation Planning Agency
RCTF	Rural Counties Task Force
SB	Senate Bill
SCCP	Solutions for Congested Corridors
SHS	State Highway System
SR	State Route
SCS	Sustainable Community Strategy
TCEP	Trade Corridor Enhancement Program
TAF	Transportation Analysis Framework
TAC	Transportation Analysis under CEQA
TDM	Travel Demand Model
TIGER	Transportation Investment Generating Economic Recovery
TMS	Transportation Management System
TNC	Transportation Network Company
VMT	Vehicle Miles Traveled

EXECUTIVE SUMMARY

EXECUTIVE SUMMARY

In response to California Senate Bill (SB) 743 (Steinberg, 2013)[1] and the guidance issued by the Office of Planning and Research (OPR), California Department of Transportation (Caltrans) has determined that Vehicle Miles Traveled (VMT) is the most appropriate metric for determining transportation impacts for capacity-increasing transportation projects on the State Highway System (SHS). When evaluating transportation impacts on the SHS, the Caltrans' Transportation Analysis Framework (TAF) guidelines require evaluating the "Induced Travel," or the overall change in VMT attributable to the individual transportation project. Guidelines, such as the Caltrans' TAF and the Climate Action Plan for Transportation Infrastructure (CAPTI) by the California State Transportation Agency (CALSTA), emphasize reducing VMT by supporting projects that do not significantly induce additional demand. However, the guidelines and the tools recommended to estimate the induced VMT may not appropriately address rural contexts and could potentially limit the competitiveness of rural projects for state funding programs.

The Rural Induced Demand Study was commissioned by the California Rural Counties Task Force (RCTF) in response to concerns regarding the State guidance on the implementation of SB 743, in particular, the emphasis on induced demand as a likely outcome of road improvement projects. The RCTF was formed in 1988 in partnership with California Transportation Commission (CTC) to serve as an advisory body to the CTC and to ensure rural agencies remain engaged and have a unified voice when addressing state and federal transportation funding and policy decisions. There are 26 rural county Regional Transportation Planning Agencies (RTPAs) represented on the RCTF.

The Rural Induced Demand Study aims to determine the extent to which induced demand occurs in rural areas. The study also makes recommendations for whether and how this phenomenon should be reflected in environmental analyses of road projects in rural areas or factor into funding decisions at the State or regional level.

IS THE CURRENT VMT GUIDANCE SUITABLE FOR RURAL AREAS?

The SHS includes roads in a wide variety of contexts (i.e., rural, suburban, and urban area types). Existing state guidance and some tools recommended by Caltrans for use in estimating induced VMT have their basis in research performed in congested urbanized areas. As a result, they may not appropriately address rural contexts and could consequently limit the competitiveness of rural projects for state funding programs by overstating their potential California Environmental Quality Act (CEQA) impacts and/or climate implications. The lack of research on induced travel demand specific to rural areas creates a challenge for policymaking, as the underlying studies on induced demand often fail to consider the location and context of rural highway corridors relative to the causal factors for inducing VMT.

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1 California Senate Bill (SB) 743 (Steinberg, 2013), which was codified in California Public Resources Code section 21099, required changes to the California Environmental Quality Act (CEQA) Guidelines (Cal. Code Regs., Title 14, Div. 6, Ch. 3, § 15000 et seq.) regarding the analysis of transportation impacts.

When examining transportation projects in rural areas, it is important to consider the following characteristics that can elicit different travel demand responses relative to more urbanized areas.

- Many rural highway corridors lack significant levels of congestion; i.e., the latent demand from which induced travel arises does not exist for these corridors.
- The focus of rural transportation improvements (i.e., purpose and need) is often on safety, reliability, goods movement, or evacuation — not congestion relief.
- Rural congestion is often related to seasonal or holiday traffic.
- Improvements at individual sites usually do not significantly reduce travel times for rural trips, which tend to be relatively uncongested and greater in distance.
- Rural motorists face limited choices in destinations and routes, so destination and route choices are less likely to change whether improvements are made or not.
- The demand for land development is typically much lower in rural areas than in urban areas.
- Rural areas are typically not well served by public transit.
- Mode shift away from transit to new road facilities is not anticipated as transit ridership in rural areas is heavily influenced by factors like car ownership and personal preference, and not congestion.

THE RURAL INDUCED DEMAND STUDY

The purpose of this study is:

1. To review the extent to which induced VMT or induced travel demand, as a consequence of added roadway capacity, is observed in rural areas; and,
2. To formulate recommendations for whether and how induced VMT should be considered for transportation projects in rural areas in environmental impact analyses and/or factored into transportation funding decisions at the State or regional levels.

This report reviews academic research on induced demand; reviews state guidance that includes considerations of induced demand; identifies and evaluates case studies of past projects' actual effects; and, provides technical recommendations on estimating induced VMT for highway improvement projects in rural areas.

Although the focus of this study is on rural areas, its applicability spans rural, suburban, and urban settings. As such, many of the study findings and recommendations are indifferent to area type. However, the factors that drive induced demand are typically more common in urbanized areas.

LITERATURE REVIEW REVEALS BETTER METHODS TO ESTIMATE INDUCED DEMAND

An extensive literature review was performed as part of this study. The findings of the literature review suggest that over-reliance on systematic review studies appear to have marginalized crucial contextual information from the precedent studies. This leads to distortions in the conclusions – in this case, causal factors associated with induced travel demand. Examples of how distortions can inadvertently occur include:

- Referencing a demand elasticity without including caveats, qualifications, and context that appear in the original work.
- Not fully recognizing or citing relevant additional causal factors and findings from the original research beyond the road capacity elasticity for induced travel demand referenced in the review studies.

- Marginalizing findings specifically relevant to rural areas from the original research.

This literature review highlights numerous relevant findings that haven't been incorporated into current guidance, which are essential for policymaking.

- **Lane miles are an imperfect proxy for travel time savings** – The primary factor that drives induced travel demand is a reduction in travel time. In the absence of congestion, additional capacity does not significantly reduce travel time. Lane miles and capacity have been used in induced travel demand studies as a proxy for travel time savings as it is much easier to obtain than historical data on congested and free-flow travel times.
- **Estimates of induced travel demand declined over time** – There appears to be a declining trend in the estimated elasticities for induced travel demand over time. Two reasons for this appear to be:
    - In the literature: As other factors besides added capacity were increasingly controlled for, the residual effect of road capacity attributable to induced demand diminished.
    - In the field: Induced travel demand as a consequence of road capacity appears to be declining as decades of increasing regulation on land development have limited the land development market's ability to respond to changes to the road system.
- **Only significant reductions in travel times change travel behavior** – Traveler interview surveys found that travel times would have to be reduced by at least 15 minutes to have any appreciable effect on destination and route choice. Based on computational experiences, travel time saving in this order of magnitude typically occurs for large capital improvement projects associated with highly congested corridors in primarily urban settings.

Interviews with drivers and developers challenge the assumed mechanisms behind induced demand. Contrary to the belief that drivers change behavior in response to traffic conditions, research suggests they are not highly responsive to small changes. Similarly, developers prioritize factors like cheap land and access to the roadway system, showing limited concern for congestion levels.

> "WHILE THE EXPANSION OF I-580 IS SEEN AS A BONUS TO DEVELOPERS IN THE AREA, **ALL INDICATE THAT THEIR PROJECTS WOULD STILL HAVE BEEN CONSTRUCTED IN THE ABSENCE OF THE FREEWAY IMPROVEMENT."**
>
> *(HANSEN, GILLEN, AND DOBBINS, 1993)*

The literature review also suggests that change in the workforce could be a significant factor influencing travel behavior. The reviewed studies seldom control for labor force participation, leading to incorrect attributions of increased VMT to induced demand as a result of added road capacity.

- Most of the studies controlled for population and income, but very few controlled for the number of workers.
- There is a big difference in the VMT effect between household income increases associated with wage growth versus household income increases associated with an increase in the number of wage earners per household.

- Observed periods of rapid increase in VMT per capita correlate closely with the increase in dual-income households. This factor appears unaccounted for to a significant degree in the studies that have informed State policy, regulation, and guidance.

The literature review includes numerous examples of studies suggesting that it is improper to develop a tool based on the aggregate elasticity-based approach, such as the Induced Travel Calculator developed by the National Center for Sustainable Transportation (NCST), for project-level analysis. Examples of this include:

> "SIMPLE MODELS OF THE KIND PRESENTED HERE CANNOT SUPPLANT THE DETAILED ANALYSES NEEDED TO EVALUATE SPECIFIC PROJECTS. **IT SHOULD NOT BE ASSUMED THAT THE AGGREGATE ELASTICITIES OBTAINED IN OUR ANALYSIS APPLY EQUALLY TO EVERY URBAN REGION, LET ALONE TO ANY PARTICULAR PROJECT."**
>
> *(HANSEN AND HUANG, 1997)*

Based on the comprehensive review of the literature and research on induced travel demand, the following conclusions can be made:

- A reliance on systemic review studies appears to have contributed to guidance that is to some extent contradicted by empirical evidence, including findings from the original research contained in the review study.
- The causal relationship between increases in road capacity and induced travel demand is more tenuous than suggested by State guidance.
- The theory and empirical observations collectively suggest that lane miles is a relatively poor proxy for induced travel demand, regardless of area type, when compared to a reduction in travel time.

INDUCED VMT SENSITIVITY ANALYSIS

While various regulatory bodies and competitive transportation grant programs acknowledge the importance of assessing induced VMT, there remains a gap in clear guidance for rural counties. The TAF indicates that the use of the NCST Calculator is not applicable to the rural regions outside of a Metropolitan Statistical Area (MSA) or Metropolitan Transportation Planning Organization (MPO) boundary; however, the use of the NCST Calculator is recommended in rural areas within MSA or MPO boundaries to estimate induced VMT. Although two sets of independent panels validated the methodology for the NCST Calculator, a validation of the tool itself was never performed. NCST considered three validation procedures for the Calculator. Ultimately, none of the three validation approaches were performed based on data quality concerns or the lack of data.[1]

To assess the Calculator's sensitivity to rural projects, a comparative exercise was performed analyzing the outcomes of past projects against the tool's predictions (i.e., direct comparisons of VMT before and after road capacity expansion).

1 Presentation by Jamey Volker, Postdoctoral Researcher, ITS-UC Davis, to the Caltrans SB 743 Implementation Working Group, on September 7, 2022.

The analysis revealed several discrepancies between historical observations and the NCST Calculator outputs, with the NCST Calculator consistently contributing to an overestimation in VMT regardless of whether the improvement was located in a non-MSA county or an MPO region.

Notably, the overestimation persisted irrespective of the forecast period, although the magnitude of these errors tended to decrease over time. Small capacity increases typically resulted in relatively small overestimates of induced VMT, wherein larger projects exhibited even greater discrepancies suggesting an oversensitive response by the NCST Calculator. Three of the fifteen study projects were selected for a more comprehensive examination of causal factors.

> "THE ANALYSIS PRESENTED HERE USES AGGREGATE STATE-LEVEL TIME-SERIES DATA TO DETERMINE RELATIONSHIPS TO VMT. THE ANALYSIS IN THIS PAPER DOES NOT IMPLY THAT ANY SPECIFIC PROJECT WILL GENERATE ADDITIONAL TRAFFIC. **OBVIOUSLY SPECIFIC PROJECT LEVEL ANALYSIS IS NEEDED TO ASSESS IMPACTS OF SPECIFIC TRANSPORTATION PLANS.**"
>
> *(NOLAND 1998)*

INDUCED DEMAND ANALYSIS RECOMMENDATIONS

Based on a comprehensive review of literature and research findings, the primary recommendations of this study are:

- Aggregate elasticity-based methods (like the NCST Calculator) should be used with caution for CEQA Project Level Analysis (Rural or Urban). The use of such methods for project-level analysis is not supported by the literature and generally lacks the requisite context and specificity required for CEQA project-level analysis.
- Capacity-increasing projects that do not exhibit the following requisite conditions for an induced effect should not be analyzed for induced effects or penalized by grant funding scoring criteria, Caltrans CSIS criteria, or funding decisions by the CTC or other State agencies.
    - » Presence of significant recurring congestion resulting in latent demand;
    - » Improvement has the potential to yield significant travel time savings (15 minutes or more per motorist); and,
    - » Increases access to existing or future marketable/developable land (i.e., land not constrained by topography or regulation).
- For programmatic regional analyses (i.e., programmatic Environmental Impact Report (EIR) and Sustainable Community Strategy (SCS) analyses), the application of the NCST Calculator should be predicated on whether the factors that cause induced demand resulting from capacity increases are present (per proposed screening presented in the report). If factors are present, hybrid approaches are proposed that appropriately temper the application of an NCST-type elasticity approach based on the potential for a short- and/or long-term induced demand response to new roadway capacity relative to the availability of a validated travel demand model or other more sophisticated modeling approaches (travel model with feedback to a land use allocation model).

RECOMMENDATIONS TO UPDATE STATE GUIDANCE DOCUMENTS

The study proposes a recommended approach for estimating induced VMT regardless of area type (rural or urban). These findings and recommendations strongly support the need to amend or revisit existing state guidance documents.

- The CAPTI should consider expanding the list of appropriate improvement projects to include rural area projects that are not deemed likely to induce VMT. This includes roadway capacity-increasing projects with societal co-benefits (e.g., greater accessibility to needed services and facilities, evacuation, etc.).
- Guidance in the California Regional Transportation Plan (RTP) Guidelines for validating and calibrating regional travel demand models (TDM) should be updated to be more sensitive to addressing induced VMT. The RTP Guidelines should include guidance regarding if and how the NCST Calculator should be used in conjunction with a travel demand model. The Guidelines should also provide guidance for performing dynamic validation of modeling processes that include a feedback mechanism between the travel demand model and a land use allocation model.
- Lastly, the OPR CEQA SB 743 Implementation Guidance and Caltrans TAF and TAC should also be amended to incorporate the findings and recommendations from this study.

RECOMMENDATIONS TO UPDATE NCST CALCULATOR

The following steps are recommended for improving the applicability of the NCST tool:

- **Flexible Interface:** Develop a more interactive user interface that allows the analyst to input which induced demand effects and elasticity values are appropriate for a given analysis context. This would allow the analyst to exclude components of induced demand deemed inappropriate for a given analysis (i.e., goods movement) or are already addressed through travel demand modeling.
- **Context-Specific Elasticities:** Develop a more nuanced approach that incorporates context-specific elasticity values. To improve accuracy, recognize regional variations and project-specific conditions.
- **Incorporate Travel Time Changes:** Enhance the tool to factor in changes in travel time/cost more explicitly. Consider using analytical tools (demand or simulation models) that can capture the impact of travel time reductions or increases due to the project.
- **Account for Latent Demand:** Improve the estimation of latent demand by including more detailed data on potential users who are not currently traveling due to existing congestion (Origin-Destination analysis—big data or demand models).
- **Validation and Calibration:** Regularly validate and calibrate the tool against real-world data and outcomes from completed projects. This will help ensure that the tool remains accurate and reliable over time.

By implementing these recommendations, the NCST Calculator can provide more contextually relevant estimates of induced VMT, although the sole use of an elasticity-based approach should be limited to a program-level evaluation whenever possible.

1>
INTRODUCTION

1.0. INTRODUCTION

In response to Senate Bill (SB) 743 and the guidance issued by the Office of Planning and Research (OPR), Caltrans has determined that VMT is the most appropriate metric for determining transportation impacts for capacity-increasing transportation projects on the State Highway System (SHS). When evaluating transportation impacts on the SHS, Caltrans guidelines require evaluating the "Induced Travel," or the overall change in VMT attributable to the individual transportation project. Caltrans Transportation Analysis Framework guidelines and the CALSTA Climate Action Plan for Transportation Infrastructure (CAPTI), emphasize the reduction of VMT by supporting projects that do not significantly induce demand. However, the guidelines and certain analysis tools recommended to estimate the induced VMT may not appropriately address rural contexts and could potentially overestimate VMT and limit the competitiveness of rural projects for state funding programs. The Rural Induced Demand Study was commissioned by the Rural Counties Task Force (RCTF) in response to concerns regarding the State guidance on the implementation of SB 743, in particular, the emphasis on induced demand as a likely outcome of road improvement projects. The purpose of the study is to determine the extent to which induced demand occurs in rural areas and to formulate recommendations for whether and how this phenomenon should be included in the environmental analyses of road projects in rural areas or factor into funding decisions at the State or regional level.

This report reviews academic research on induced demand and state guidance, identifies and evaluates case studies of past projects' actual effects, and provides technical recommendations on estimating induced VMT for highway improvement projects in rural counties.

1.1. REPORT ORGANIZATION

The report includes the following sections:

1. **Literature Review** presents a discussion on the current State policy regarding induced demand, as well as the results of a review of the academic literature on induced demand, focusing primarily on the aspects of various studies most relevant to rural areas.

2. **Review of the Guidance Documents** summarizes the results of our review of State guidance on implementing SB 743, focusing on the guidance most relevant to rural areas. The section also describes the potential influence that VMT measurement has on transportation funding opportunities.

3. **Induced VMT Sensitivity Analysis** conducts sensitivity analysis to evaluate the reliability of the NCST Calculator in estimating induced VMT resulting from the expansion of Caltrans facilities in rural areas. The section also presents a comprehensive examination of three study projects with a focus on investigating other causality factors.

4. **Technical Recommendations** provide guidance for assessing induced VMT based on a literature review on induced demand and causality of infrastructure projects for inducing travel demand. The study provides recommendations for screening projects, determining whether the requisite conditions for an induced effect to occur are present. It also provides analysis recommendations in the event an induced demand assessment is warranted. Lastly, recommendations for how to improve the NCST Calculator are provided.

2> LITERATURE REVIEW

2.0. LITERATURE REVIEW

This section begins with a discussion of how academic literature was used in the formulation of current State policy regarding induced demand. It then gives a broader view of induced demand as a field of academic research. That is followed by a discussion of the methodology used to select the studies to be reviewed in this report and the findings from this review.

2.1. ORIGINS OF CURRENT STATE POLICY

Guidance from the major State agencies involved in SB 743, namely Caltrans, the Governor's Office of Planning and Research (OPR), and the California Air Resources Board (CARB), have settled on an elasticity[1] of 1.0 for project evaluation of freeways on the State Highway System[2] (SHS) and an elasticity of 0.75 for lower-order non-access-controlled state highway facilities. A reader perusing the State guidance documents might understandably interpret these elasticities as indicative of a consensus perspective, seemingly substantiating the notion that traffic demand will inevitably expand to occupy any supplementary road capacity. However, these elasticities do not in fact represent the consensus within the broader research community, nor do they fully reflect the conclusions of the original paper they are based on. For this reason it is useful to examine the contextual background by asking, "How did we get here?"

2.1.1. USE OF REVIEW STUDIES IN THE DEVELOPMENT OF STATE GUIDANCE

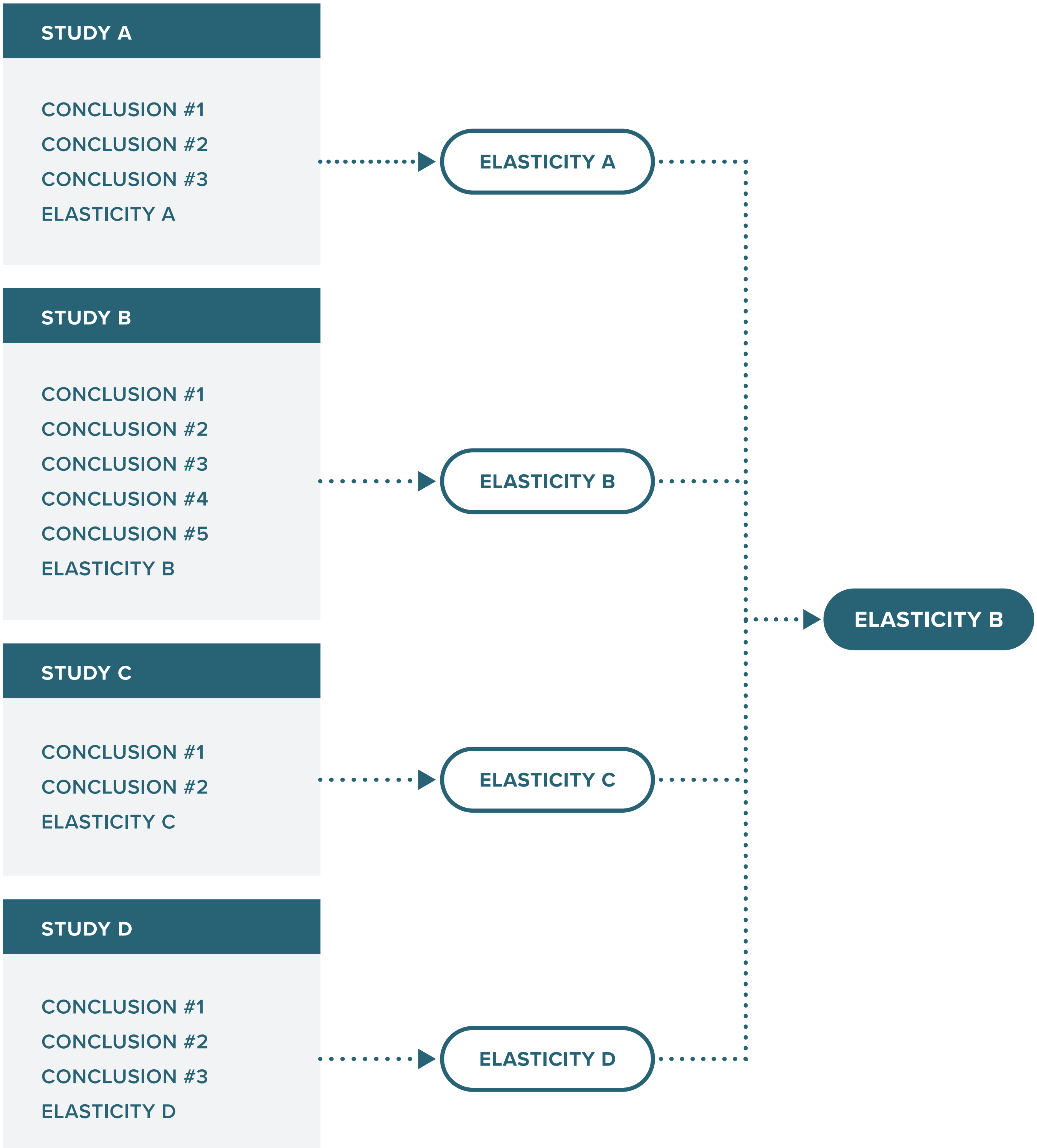
Review studies, or studies-of-studies, summarize the findings of original research studies for an audience that may not have the time or inclination to read through the original research papers. They serve an important function in making the results of research available to policymakers in an easily digestible form. However, this convenience may come at the cost of filtering out other relevant information found in the original studies. Depending on the subject matter and reviewer, the process of selecting what information to pass on to the audience (and what to exclude) can introduce distortions.

Figure 1 shows this schematically. In the figure, four studies are reviewed, from which the review study extracts the elasticities from each and then, from those elasticities, selects one for use. Quoting an elasticity from a paper while leaving out the caveats, qualifications, and context that appear in the original work may create a very different impression of the findings than presented in the original work, even when the sub-set of data passed to the audience is reported accurately.

1 An elasticity is the percentage change in one variable that is the result of a percentage change in a different variable. An elasticity of 1.0 means that a 10 percent increase in lane miles will be followed by a 10 percent rise in VMT in the long term.

2 This figure is referenced in OPR's *Technical Advisory on Evaluating Transportation Impacts in CEQA* (page 24). While the Advisory acknowledges that studies on induced travel reveal a range of elasticities, the 1.0 figure is the only one shown in the section on evaluating roadway projects. The 1.0 figure is also used in Caltrans' Transportation Analysis Framework (TAF). While the TAF acknowledges that the amount of induced demand is open to debate, the induced-demand calculator used by Caltrans uses the 1.0 figure from the Policy Brief.

FIGURE 1. THE FILTERING EFFECT OF REVIEW STUDIES



The selection of 1.0 as the elasticity for use in studies of the State Highway System came from a similar filtering process.

2.1.2. ORIGIN OF THE 1.0 ELASTICITY USED IN STATE POLICY

The elasticity of 1.0 enters State policy through a policy brief for CARB entitled *"Impact of Highway Capacity and Induced Travel on Passenger Vehicle Use and Greenhouse Gas Emissions"*[1]. The Brief references 21 source papers, from which six were selected for inclusion in the summary table (Table 1 in the brief). In this initial filtering, the authors screened out studies that focused on ADT or on the relationship between VMT and travel time, claiming that *"... they do not have a direct relationship with greenhouse gas emissions."*[2] This assertion is noteworthy, given that travel time is a key component of both route selection and destination selection, which are major factors in an individual traveler's VMT, and ADT is a key component of a road segment's VMT. This screening criterion eliminated many valid studies from consideration. The fact that the bulk of the research was screened out is not mentioned in the Policy Brief but is instead found in a separate document, the Technical Background Document. Consequently, many readers of the Policy Brief will be unaware that the results being presented are from a small subset of the research.

Table 1 in the Policy Brief shows the elasticities from the six papers. The accompanying Policy Brief text states that:

> "THE **MORE RECENT STUDIES HAVE PRODUCED THE HIGHEST ESTIMATES OF LONG-RUN ELASTICITIES** USING MORE SOPHISTICATED METHODOLOGIES THAT ARE BETTER ABLE TO ILLUMINATE THE IMPACT OF HIGHWAY CAPACITY ON VMT (AS DISCUSSED IN THE ACCOMPANYING TECHNICAL BACKGROUND DOCUMENT). **THUS, THE BEST ESTIMATE FOR THE LONG-RUN EFFECT OF HIGHWAY CAPACITY ON VMT IS AN ELASTICITY CLOSE TO 1.0**, IMPLYING THAT IN CONGESTED METROPOLITAN AREAS, ADDING NEW CAPACITY TO THE EXISTING SYSTEM OF LIMITED-ACCESS HIGHWAYS IS UNLIKELY TO REDUCE CONGESTION OR ASSOCIATED GHG IN THE LONG-RUN."

TABLE 1. COMPONENTS OF INDUCED DEMAND

COMPONENT	LOW-END ESTIMATE	HIGH-END ESTIMATE
INCREASE IN TRUCK TRAFFIC	0.19	0.29
CHANGES IN INDIVIDUAL BEHAVIOR	0.09	0.39
MIGRATION OF PEOPLE BETWEEN REGIONS	0.05	0.21
RE-ROUTING OF TRAFFIC	0.00	0.10
TOTAL	**0.33**	**1.00**

1 Handy and Boarnet, 2014

2 Handy and Boarnet, 2014

From these six papers all of which are based on metropolitan area data, the Policy Brief recommends the elasticity from the Duranton and Turner for use.

There are several problems with this. Firstly, the consensus view would be better represented by taking the average of the studies' elasticities rather than the highest value. Secondly, the stated reason for selecting the highest value is that it was from the most recent study, which is not in of itself a strong rationale for its selection. It is notable that although the newest study in the table had the highest figure, the second-newest study in the table[1] had the lowest elasticity figure (0.39). This shows that there was no general progression where newer studies found higher elasticities.

A third problem is that the paper from which the 1.0 elasticity was taken, *The Fundamental Law of Road Congestion: Evidence from U.S. Cities,* presents a more nuanced view of the elasticity than is presented in the Policy Brief. It concluded that induced demand consisted of four components, as shown in **Table 1**.

It is worth considering these four components individually in relation to SB 743. The State's goals for greenhouse gas reduction require a reduction in state-wide VMT. Migration of people and re-routing of traffic measure a shift of VMT from one part of the state to another or from one road to another, respectively. This shift would be considered an induced demand on the roads studied in the paper, which used individual metropolitan areas as the geographic unit of analysis, but such shifts do not induce demand at the state level and have no effect on green-house gas emissions overall. Also, the induced demand related to truck traffic is not considered a VMT impact under SB 743, nor is it relevant to SB 375.[2] Thus, only one of the four components of the 1.0 elasticity – changes in travel behavior – is relevant to SB 743. Note also that although the original paper presented their estimated elasticities as a set of ranges, as we show in **Table 1**, only the high end appeared in the Policy Brief. If for instance the average of the range as the best representation of the range as a whole, then an elasticity of 0.24 (the average of 0.09 and 0.39), not 1.0, is the best interpretation of the Duranton and Turner work for CEQA purposes.

1 Cervero, 2003

2 Section 15604.3 (a) of the CEQA Guidelines specifies, "For the purposes of this section, "Vehicle Miles Traveled" refers to the amount and distance of automobile travel attributable to a project."

To summarize, the most widely used elasticity in the State guidance was the result of excluding 15 of 21 reviewed papers (71 percent) from consideration and then selecting the highest elasticity available from the remaining six. That high elasticity itself came from adding together the high end of the range for each component, three out of four of which, it could be claimed, are irrelevant under SB 743.

Additionally, pursuant to CEQA Guidelines Section 15187(d): *The environmental analysis shall take into account a reasonable range of environmental, economic, and technical factors, population and geographic areas, and specific sites. The agency may utilize numerical ranges and averages where specific data is not available, but is not required to, nor should it, engage in speculation or conjecture.*

The above discussion shows that when guidance is based on studies of studies, distortions can be introduced, and important information lost. This issue appears to be particularly pronounced in the context of induced demand. Every paper reviewed in this study had other findings besides an elasticity that are worthy of consideration. Later in this section, some of the findings that did not receive as much attention are presented to serve as a better-informed basis for policy development.

2.2. OVERVIEW OF INDUCED DEMAND AS A FIELD OF STUDY

Induced demand as a field of academic research was a significant research focus from the early-1990s to the early 2000s. At the time it seemed to offer a plausible explanation for why highway construction did not result in permanent congestion relief. Conversely, that the highways themselves were creating new demand. Some studies found long-term elasticities of up to 1.0, meaning that every percent increase in highway capacity was met with an equal percent increase in traffic demand.

However, reviews of the first generations of studies concluded that most had serious methodological flaws that rendered their findings suspect. Among other things, researchers had to grapple with the fact that there was (and is) no universally-accepted definition of “induced demand”, the phenomenon they were attempting to measure[1]. As studies became better designed and other factors became better accounted for, the residual effect that could be attributed to induced demand declined. For example, in the two Cervero papers cited in the Policy Brief, the estimated short-term elasticity dropped from 0.59 to 0.10, and the estimated long-term elasticity dropped from 0.79 to 0.39, when consideration of induced investment (discussed later in this report) was added.

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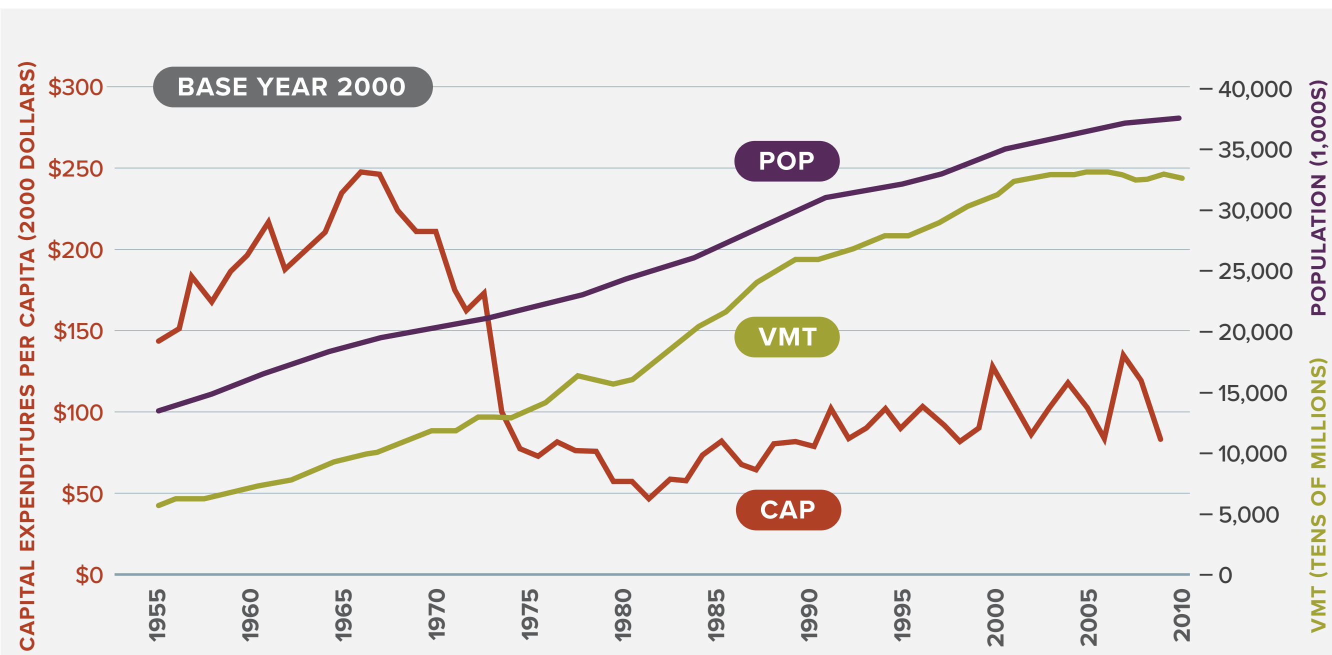
1 For example, a common response to major highway capacity improvement projects was that traffic diverted from other routes or from other times of the day to take advantage of the new capacity during the peak hour. Some papers considered this demand to be induced, while other considered it to be a rearrangement of existing demand. The debate over whether the release of existing demand that goes unserved due to capacity constraints, or is served by a different road or at a different time, should be considered “induced”, or whether the term “induced demand” should only apply to demand associated with new development that would not have occurred in the absence of new road capacity, continues to this day.

This is not to say that the research did not find that induced demand did not exist at all; rather, it was not the dominant explanatory factor as once purported. Moreover, induced demand had the effect of diverting policy attention away from other factors that had a greater impact on travel behavior. Dr. Cervero's 2003 article, "Are Induced- Travel Studies Inducing Bad Investments?" marked the point when induced demand was replaced with the theory that it was not the presence of road capacity but rather the absence of the sort of walkable mixed- used communities found in other parts of the world that accounted for America's auto dependency.

This "Smart Growth" theory offered a solution to a key weakness with the idea that over-provision of roads was driving VMT growth. Namely the fact that in recent decades roads have, in fact, not been over-provided. On the contrary, lane-miles per capita have experienced a sustained decline in California over the years, while VMT per capita has shown an upward trajectory, which explains the escalating congestion levels (see **Figure 2**).

FIGURE 2. HISTORICAL POPULATION, TRAVEL, AND PER CAPITA HIGHWAY CAPITAL EXPENDITURES (1955-2010)*



* Includes expenditures for local assistance and State highway capital outlay.

Source: California Transportation Plan 2040

2.3. METHODOLOGY USED FOR THE CURRENT LITERATURE REVIEW

2.3.1. HOW STUDIES WERE SELECTED

Hundreds of academic papers have been written about induced demand. Given the impracticality of reviewing the entirety of this extensive literature for the present study, several dozen of the most relevant studies were selected for examination. The selection was based on the following factors:

1. Identification as major papers with frequent citations in subsequent or later papers;
2. Citation in State guidance as part of the foundation for the guidance; and/or,
3. They appeared in web searches for studies of induced demand for rural areas.

While not comprehensive, this review is considered broad enough to draw conclusions about what can be usefully gleaned from the existing academic literature on induced demand.

2.3.2. HOW STUDIES WERE ANALYZED

The literature review is structured by key findings rather than by paper. In some cases, passages are quoted from the studies that were considered particularly telling, but this was only done when the passage was reasonably brief. Note that this findings-based approach results in some reviewed papers not being mentioned, given that their key findings either lack relevance to rural projects or because their main findings were already covered by other papers.

2.4. KEY FINDINGS

The key findings gleaned from the literature review are described below. Where quotes are provided, the use of bold font indicates text of particular relevance.

2.4.1. RELATIONSHIP BETWEEN LATENT DEMAND AND INDUCED DEMAND

The research paper "Closing the Induced Vehicle Travel Gap Between Research and Practice" by Milam, Birnbaum, Ganson, Handy, and Walters[1] delves into the intricate dynamics of induced demand and latent demand within transportation systems. Induced travel, as defined in the study, refers to the additional travel that ensues following capacity expansions, driven by decreased costs, while latent demand characterizes the suppressed travel demand due to high associated costs. The relation between induced travel and latent demand indicates that if capacity increases, more people will travel, tapping into the latent demand.

1 Milam, Birnbaum, Ganson, Handy, Walters, 2016

The phenomenon of induced travel is particularly pronounced when traffic volumes approach or exceed capacity thresholds, resulting in heightened congestion and increased travel times, creating latent demand. Conversely, in uncongested conditions, with limited to no expected decrease in travel time, there may not be latent or suppressed demand and, in turn, no induced demand. The research study identifies that:

> "WHILE INCREASING LANE-MILES IS A SUPPLY CHANGE, NOT ALL LANE MILE CHANGES HAVE THE SAME INFLUENCE ON **TRAVEL TIMES**, WHICH **IS THE KEY VARIABLE FOR INFLUENCING TRAVELER RESPONSE.**"
>
> *(MILAM, BIRNBAUM, GANSON, HANDY, AND WALTERS, 2016)*

The level of congestion serves as a critical determinant of induced vehicle travel. In summary, the paper underscores the importance of considering latent demand and changes in travel time when evaluating the impact of network capacity expansions on travel behavior.

The level of congestion serves as a critical determinant of induced vehicle travel. In summary, the paper underscores the importance of considering latent demand and changes in travel time when evaluating the impact of network capacity expansions on travel behavior.

2.4.2. EARLY CONTRADICTORY STUDIES

The first major study of the relationship between highway expansion, traffic generation, and air quality in California was a 1993 study[1] sponsored by Caltrans and undertaken by the University of California Transportation Center at UC Berkeley. Although this study is widely known and frequently cited in induced demand literature, no mention is made of the fact that it was originally circulated in Caltrans with a cover letter[2] from the Caltrans project manager overseeing the study, the Chief of Environmental Engineering in the Environmental Program at Caltrans Headquarters. The letter opens with this statement regarding the induced demand elasticities:

> "I SHARE THIS REPORT WITH SOME TREPIDATION. **I DO NOT BELIEVE THAT THE DATA IS STRONG ENOUGH TO SUPPORT THE FINDINGS** (SEE ATTACHMENT)."
>
> *(BORROUM, 1995)*

The letter then goes on to show several graphs based on data from Caltrans' Office of Transportation Improvements, Caltrans' Accounting division, and the California Department of Finance, Financial & Economic Research division.

1 Hansen, Gillen, Dobbins, 1993

2 Borroum, 1995

These graphs led the author to conclude:

> "**THERE DOES NOT APPEAR TO BE ANY SIGNIFICANT, DIRECT RELATIONSHIP BETWEEN HIGHWAY IMPROVEMENTS AND** EITHER TOTAL POPULATION (OR) **PER CAPITA VMT** (FIGURES 1 AND 2 OF ATTACHMENT). THESE PATTERNS ARE REFLECTED IN ALL OF CALIFORNIA'S MAJOR REGIONS, ON AN INDIVIDUAL BASIS."
>
> ***(BORROUM, 1995)***

The next section discusses one reason why non-academics who review the research are skeptical of the results.

2.4.3. DATA QUALITY

Researchers in the social sciences have become accustomed to the fact that data on human behavior, such as the decision on how often and how far to drive, never has the exactitude that can be found in the physical sciences. It may not occur to them that if a study based on behavioral data is submitted to a profession based on physical data (engineering), the recipients may give more credence to the studies than they really deserve. As such, it is important for those who are not academics to understand the quality of the data used in induced demand studies.

Some examples of data quality issues:

- "The enormous jump in vehicle miles traveled (VMT) reported by the 1990 U.S. Nationwide Personal Transportation Survey (NPTS) caused a great deal of concern among planners and policy analysts. Such a jump seemed to portend an era of ever increasing travel, pollution, and energy consumption. Later re-analyses of the NPTS data **revealed that the VMT jump was a statistical error.** The 1990 NPTS oversampled new vehicles and under-sampled old ones. Since new vehicles are driven two to three times as much as old ones, the sampling bias will overestimate VMT." (Lave, 1994)
- In some studies, the existing traffic on lower order facilities, which were simply reclassified to higher order facilities were counted as "new" VMT induced by "new" highway capacity. (Cervero, 2003)
- "Unfortunately, the quantity and quality of total VMT data are limited. We could locate such data only for the years 1980, 1982, 1986, 1988, and 1989. In addition to reducing the overall volume of data, the lack of observations before 1980 strips our data set of much of the longitudinal variation in State Highway Lane Miles. Furthermore, **total VMT is estimated mainly on the basis of gasoline sales rather than vehicle counts, and is therefore of dubious reliability**." (Hansen and Huang, 1997)

It was not the fault of the researchers that the quality of the data available to them was poor. It was their response to the limited options that is important. Specifically, the choice to use lane miles as the independent variable in induced demand studies was driven primarily by the lack of data on better metrics. This is discussed in the next section.

2.4.4. USE OF LANE MILES AS AN INDEPENDENT VARIABLE

The theoretical basis for induced demand is that when the price of something goes down, then, all else being equal, people will consume more of that thing. When referring to induced growth in VMT, when road expansion reduces the travel time cost, people will presumably respond by driving more. This point is made in, for example, Caltrans' TAF[1]. Other papers concur:

> "**IT IS NOT THE LANE MILES OF ROADS THAT PROMPT PEOPLE TO TRAVEL MORE, HOWEVER.** RATHER IT IS THE BENEFITS THAT THE LANE MILES CONFER. ONLY IF TRAVEL SPEEDS INCREASE AND TRAVEL TIMES FALL WILL MOTORISTS GRAVITATE TO AN IMPROVED CORRIDOR."
>
> ***(CERVERO, 2001)***

> "LANE-MILES OF CAPACITY ARE COMMONLY USED TO REPRESENT THE BENEFIT OF HIGHWAY IMPROVEMENT. IN TRUTH, **BENEFITS ARE BEST EXPRESSED BY OUTPUTS (E.G., TRAVEL-TIME SAVINGS) NOT INPUTS (LANE ADDITIONS).** AN ADDITIONAL HALF-MILE OF LANE ON A CROWDED BRIDGE CROSSING WILL PROVIDE MUCH MORE BENEFIT THAN A HALF-MILE OF LANE IN THE UNCONGESTED EXURBS. THE NOTION THAT LANE MILES THEMSELVES CAPTURE SUPPLY IMPROVEMENTS IS PRESUMPTUOUS."
>
> ***(CERVERO, 2001)***

> "THUS THE CONTEXT OF THE CAPACITY ADDITION IS OF PRIME IMPORTANCE IN ESTIMATING INDUCED TRAVEL DEMAND, AND TRAVEL TIME IS THE PREFERRED INDEPENDENT VARIABLE FOR MORE RELIABLE ESTIMATES OF TRAVEL DEMAND ELASTICITY. CONSEQUENTLY, **USE OF ELASTICITIES BASED ON LANE-MILES IS UNDESIRABLE FOR POLICY ANALYSIS**, AND IT IS SUGGESTED THAT FUTURE RESEARCHERS FOCUS ON REFINING ELASTICITIES BASED ON TRAVEL TIME RATHER THAN LANE-MILES."
>
> ***(DECORLA-SOUZA, 2000)***

1 California Department of Transportation, 2020, Figure 2.

The challenge for induced demand researchers is that although they would prefer to find the relationship between travel time and VMT, there is no source of data on travel times across long enough periods and for enough facilities to form a foundation for analysis. So they use lane-miles as a proxy:

> "… **STUDIES THAT HAVE EMPLOYED LANE-MILES AS A PREDICTOR TREAT IT AS A STAND-IN, OR PROXY, FOR TRAVEL-TIME SAVINGS FOR PRACTICAL REASONS.** LANE-MILES CAN GENERALLY BE MEASURED WITH A FAIR DEGREE OF ACCURACY, HOWEVER MEASURING TRAVEL TIME IS FRAUGHT WITH DIFFICULTIES."
>
> *(DECORLA-SOUZA, 2000)*

> "IN TRUTH, ACCURATELY MEASURING TRAVEL TIMES OVER NUMEROUS TIME POINTS CAN BE A DAUNTING TASK. TRAVEL TIMES VARY CONSIDERABLY BY TIME-OF-DAY, DAY-OF-WEEK, AND SEASON OF YEAR; IN CONTRAST, A FIXED AMOUNT OF ROAD CAPACITY DOES NOT VARY."
>
> *(CERVERO, 2001)*

Given that lane-miles is used as a proxy for changes in travel time, its use would not be valid in cases where travel times do not significantly change:

> "**ADDING NEW LANE MILES TO UNCONGESTED HIGHWAYS** (FOR EXAMPLE, TO IMPROVE SAFETY) **WILL NOT RELEASE ANY SUPPRESSED DEMAND AND WILL THEREFORE NOT PRODUCE INDUCED TRAVEL.** ONLY WHEN CAPACITY CHANGES RESULT IN A REDUCTION IN TRAVEL TIME "PRICE" BORNE BY THE TRAVELER CAN ANY NEW TRAVEL BE INDUCED. FOR EXAMPLE, WIDENING I-90 THROUGH THE STATE OF MONTANA WILL PRODUCE NO INDUCED TRAVEL, SINCE I-90 HAS LITTLE TO NO CONGESTION."
>
> *(TRANSPORTATION RESEARCH BOARD, 1995. EXPANDING METROPOLITAN HIGHWAYS: IMPLICATIONS FOR AIR QUALITY AND ENERGY USE, SPECIAL REPORT 245, NATIONAL RESEARCH COUNCIL, NATIONAL ACADEMY PRESS, WASHINGTON DC)*

> "BUT THE AREAWIDE STUDIES SUFFER FROM AT LEAST TWO CRITICAL DEFICIENCIES; FIRST, THEY USE A SINGLE RELATIVELY SIMPLE MEASURE OF CAPACITY INCREASES (SUCH AS LANE-KILOMETERS OR LANE-MILES) THAT ARE **INSENSITIVE TO THE POTENTIALLY SIGNIFICANT DIFFERENT DEMAND EFFECTS THAT WOULD OCCUR IF THE SAME INVESTMENT IS MADE IN THE CENTER OF THE REGION VERSUS THE FRINGES."**
>
> *(DOWLING AND COLMAN, 1995)*

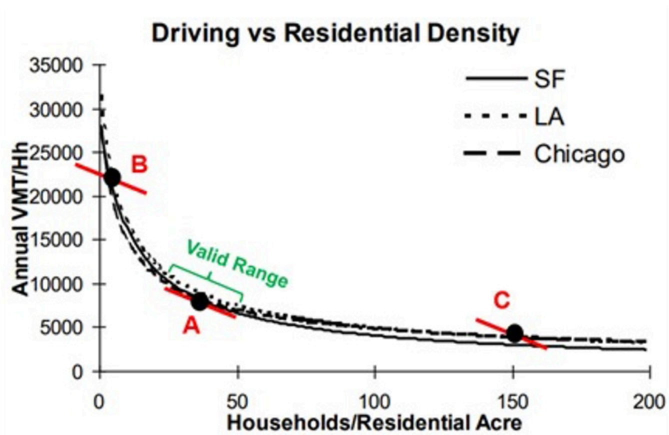
The key finding here is that lane-mile-based analyses, which form the basis of State policy, are not relevant for uncongested areas. The next section further examines the issue of whether conclusions from studies from one location should be applied to other locations.

2.4.5. MIS-APPLICATION OF ELASTICITIES

A review of the induced demand literature found many cases where, even if an author's findings were entirely correct, they would be of limited applicability. This is particularly true for elasticities, which are a mainstay of induced demand literature.

An elasticity describes the relationship between changes in an independent variable, such as gasoline prices, to changes in a dependent variable, such as VMT. The background graph in **Figure 3** is from a well-known study of the relationship between residential density and per-household VMT[1]. If a researcher computed the elasticity at any point on this curve, say Point A, then that elasticity would be a reasonable approximation of the effect of density on VMT/Household (HH) for neighborhoods whose densities were similar to Point A's. However, if someone then tried to use the elasticity from Point A to estimate the effect of increasing density at a place with a higher density, such as Point B, they would greatly over- estimate the effect of increasing density.

FIGURE 3. RELATIONSHIP BETWEEN VMT/HOUSEHOLD AND RESIDENTIAL DENSITY



The point here is that even when data is collected and analyzed properly, the results may simply be irrelevant for places dissimilar to where the data were collected. As one researcher puts it:

> "... MOST AREAWIDE STUDIES ASSUME A CONSTANT ELASTICITY OF DEMAND, PROBABLY DUE TO THE LACK OF ENOUGH DATA POINTS TO ESTIMATE ANYTHING ELSE. INTUITION SUGGESTS THAT THE **ELASTICITY IS NOT NECESSARILY CONSTANT, BUT INSTEAD DEPENDS ON THE AMOUNT OF CURRENT CONGESTION AND CAPACITY OF THE SYSTEM, THE TIMEFRAME INVOLVED (SHORT- VS. LONG-TERM), THE TRIP PURPOSES OF ROAD USERS, AND POSSIBLY OTHER FACTORS.**"
>
> *(DOWLING AND COLMAN, 1995)*

1 Holtzclaw, Goldstein, Clear, Haas, and Dittmar, 2002

Elasticities measured in one location are unlikely to have much predictive value in another. This fact was borne out in the California Smart-Growth Trip Generation Rates Study[1]. That study evaluated several elasticity-based VMT estimator tools developed for the analysis of land use development projects, all of which were based on regression constructs similar to those used by Duranton and Turner. The purpose of the study was to test aggregate elasticity-based tools in order to determine which one(s) Caltrans could endorse for use in forecasting traffic for projects on the state highway system. The study found that none of the models worked well enough to be endorsed for use; each produced forecasts that were significantly off for different individual sites/locations. The best-performing of the tools had an average absolute error of 27 percent. Hence, elasticities are typically not transferable to locations with characteristics that differ from those used in their development.

The fact that VMT elasticities are extremely context-sensitive is a major issue for rural areas since nearly all of the research on VMT and induced demand is based on data collected in major metropolitan areas. The elasticities found in these studies, even if perfectly correct within their context, may be misleading if applied to rural areas.

1 https://dot.ca.gov/-/media/dot-media/programs/research-innovation-system-information/documents/final-reports/ca13-1940-finalreport-a11y.pdf

The importance of context caused several authors to reject outright the use of elasticities from regional or state-level databases for project-level analyses:

"SIMPLE MODELS OF THE KIND PRESENTED HERE CANNOT SUPPLANT THE DETAILED ANALYSES NEEDED TO EVALUATE SPECIFIC PROJECTS. **IT SHOULD NOT BE ASSUMED THAT THE AGGREGATE ELASTICITIES OBTAINED IN OUR ANALYSIS APPLY EQUALLY TO EVERY URBAN REGION, LET ALONE TO ANY PARTICULAR PROJECT.**"

(HANSEN AND HUANG, 1997)

"THE ANALYSIS PRESENTED HERE USES AGGREGATE STATE LEVEL TIME-SERIES DATA TO DETERMINE RELATIONSHIPS TO VMT. **THE ANALYSIS IN THIS PAPER DOES NOT IMPLY THAT ANY SPECIFIC PROJECT WILL GENERATE ADDITIONAL TRAFFIC. OBVIOUSLY SPECIFIC PROJECT LEVEL ANALYSIS IS NEEDED TO ASSESS IMPACTS OF SPECIFIC TRANSPORTATION PLANS.**"

(NOLAND, 1998)

Other authors made the same point. These two quotes were selected because they are from authors cited in the documentation for the UC Davis NCST Induced Travel Calculator[1]. The Calculator applies aggregate elasticities for project evaluation, which appears to be contrary to the recommended practice.

2.4.6. INTERVIEWS WITH THE ACTORS INVOLVED CAST DOUBT ON THE UNDERLYING MECHANISMS

In most papers, the assumed mechanisms by which an increase in road capacity results in an increase in VMT is that motorists make more trips or select more distant destinations and that developers select sites for development based on roadway improvements. However, interviews with motorists and developers cast doubt on this. One paper that interviewed drivers found that they are not nearly as responsive to changes in traffic conditions as had been supposed and that they hardly respond at all when the travel time changes are small (under 15 minutes):

[REACHING A CONCLUSION FROM SURVEYS OF HUNDREDS OF CALIFORNIA DRIVERS]
"THE RESULT OF THIS IS THAT **90 PERCENT TO 95 PERCENT OF THE TRIPS WOULD BE UNCHANGED** OR WOULD HAVE SCHEDULE CHANGES IN RESPONSE TO TRAVEL TIME INCREASES AND REDUCTIONS OF 15 MINUTES OR LESS."

(DOWLING AND COLMAN, 1995)

1 Updating the Induced Travel Calculator, Volker and Handy, 2022

"**SURVEY RESPONDENTS INDICATED A HIGH DEGREE OF RESISTANCE TO CHANGE IN THEIR TRAVEL BEHAVIOR WHEN OFFERED TRAVEL TIME SAVINGS OF BETWEEN FIVE AND FIFTEEN MINUTES PER TRIP.** A FIVE MINUTE TRAVEL TIME SAVINGS (ON AVERAGE) RESULTED IN A THREE PERCENT INCREASE IN DAILY TRIPS MADE PER PERSON, AND A 15 MINUTE TIME SAVINGS RESULTED IN A FIVE PERCENT INCREASE IN TRIPS/PERSON/DAY. SINCE MOST TRIPS IN METROPOLITAN AREAS ARE UNDER 15 MINUTES DURATION AND REALISTIC TIME SAVINGS ON SUCH SHORT TRIPS WOULD RARELY EXCEED FIVE MINUTES, **IT APPEARS UNLIKELY THAT NEW HIGHWAY CAPACITY WOULD SIGNIFICANTLY REDUCE TRAVEL TIMES FOR THE MAJORITY OF TRIPS.**"

(DOWLING AND COLMAN, 1995)

A paper that interviewed developers cast further doubt on the assumed mechanisms. It was found that developers were looking for cheap land that had some access to the roadway system and that, in most cases, they were indifferent to congestion levels. This means that their development plans are unresponsive to road widenings that reduce congestion but do not increase access:

"WHILE THE EXISTENCE OF THE FACILITY ITSELF IS CRUCIAL, **THE LINK BETWEEN THE EXPANSION OF A HIGHWAY AND GROWTH AND DEVELOPMENT IN THE CORRIDOR IT SERVES APPEARS TO BE MUCH WEAKER**, OR AT LEAST LESS DIRECT."

(HANSEN, GILLEN, AND DOBBINS, 1993), UNDERLINING IS ORIGINAL

"LAND COST AND AN ATTRACTIVE RURAL ENVIRONMENT APPEAR TO BE THE OVERRIDING FACTORS MOTIVATING HOUSING DEVELOPMENT IN ALL FOUR CASE STUDY REGIONS. OUTLYING AREAS WITH LOTS OF UNDEVELOPED LAND GENERALLY GREW FASTER THAN MORE DEVELOPED COMMUNITIES. **THESE TYPES OF FACTORS APPEAR TO BE MORE DIRECTLY RELEVANT TO THE PROJECT DECISIONS OF REAL ESTATE DEVELOPERS THAN THE LEVEL OF HIGHWAY CONGESTION IN THE AREA.**"

(HANSEN, GILLEN, AND DOBBINS, 1993)

> "WHILE THE EXPANSION OF I-580 IS SEEN AS A BONUS TO DEVELOPERS IN THE AREA, **ALL INDICATE THAT THEIR PROJECTS WOULD STILL HAVE BEEN CONSTRUCTED IN THE ABSENCE OF THE FREEWAY IMPROVEMENT."**
>
> *(HANSEN, GILLEN, AND DOBBINS, 1993)*

The interview findings cast doubt as to whether the purported mechanisms for induced demand are valid.

2.4.7. CHANGES IN THE WORKFORCE OFTEN NOT ACCOUNTED FOR

A frequent refrain in the literature is the fact that there are other factors besides road supply that influence travel behavior and that the predominant causes of the growth in VMT lie with these other factors. It is critical to the analysis that these other factors be controlled for since most studies attribute any otherwise unexplained differences in VMT growth to induced demand.

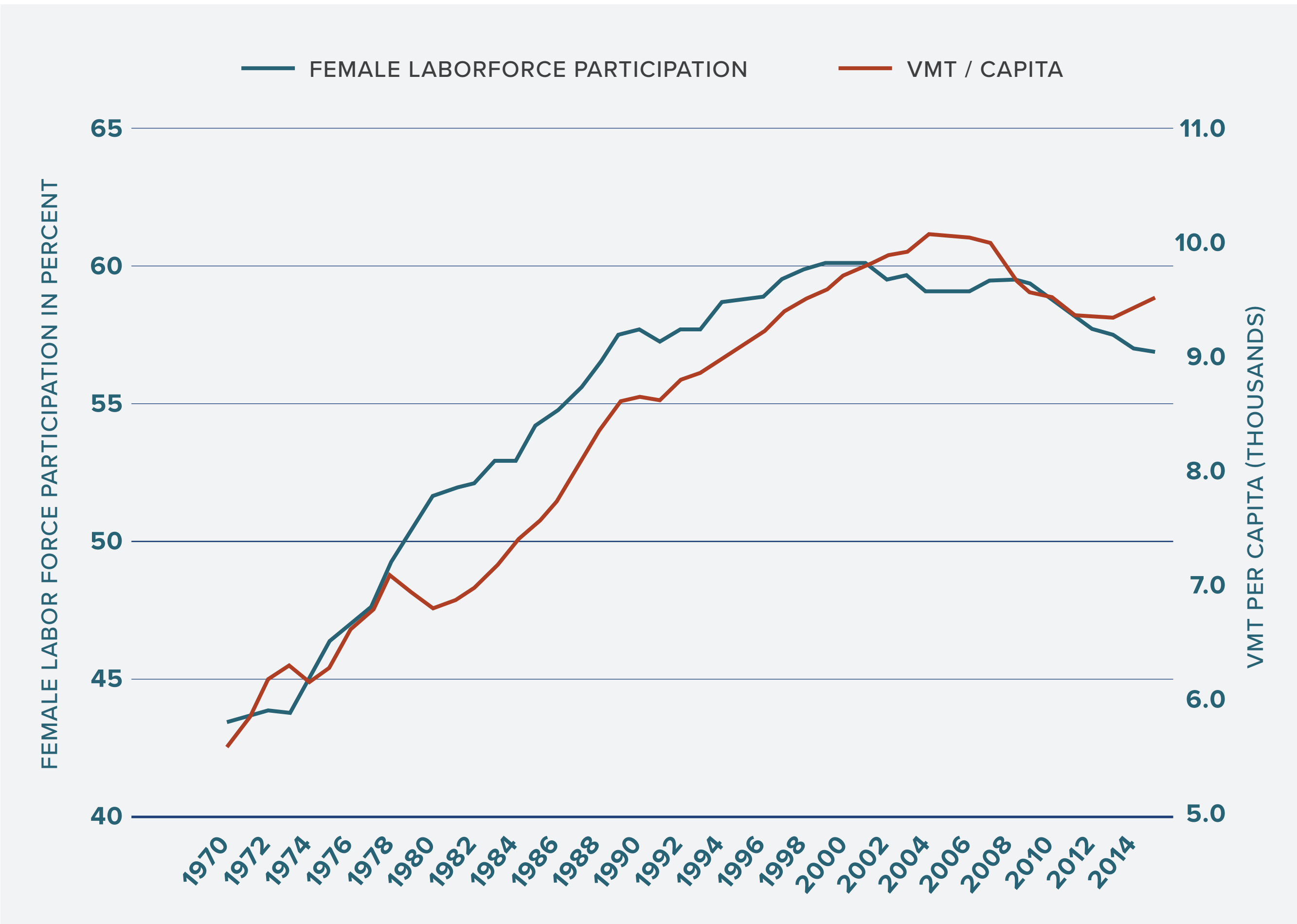
While many studies controlled for population, per capita income, and gasoline prices when examining regional VMT growth, very few controlled for labor force participation. Thus, the increase in dual-income households, which coincided with a period of rapid expansion of the highway system, appears to have led, in some cases, to increases in VMT/capita that were incorrectly attributed to induced demand. Note that controlling for per-capita income will not effectively capture this effect because there is a big difference in VMT between a household whose income doubled because the head of household got a raise and one whose income doubled because a second person started working.

One study that looked at changes in labor force participation shows why this factor is crucial to understanding historical changes in VMT:

> **"A PRINCIPAL REASON WHY OUR HIGHWAYS ARE BECOMING INCREASINGLY CONGESTED IS THAT THE NUMBER OF WORKERS HAS RISEN DRAMATICALLY.** WHILE THE POPULATION IN THE SIX-COUNTY METROPOLITAN AREA ONLY INCREASED FROM 1970 TO 1990 BY A MERE FOUR PERCENT, THE NUMBER OF WORKERS ROSE BY OVER 20 PERCENT. STATED DIFFERENTLY, WE EXPERIENCED A LABOR-FORCE INCREASE OF MORE THAN 600,000 WORKERS AT A TIME IN WHICH THE POPULATION INCREASED BY APPROXIMATELY HALF THIS NUMBER."
>
> *(URBAN TRANSPORTATION CENTER, UNIVERSITY OF ILLINOIS, 1999)*

The main reason why the number of workers increased at a much higher rate than the population was because the study covered a period when women were entering the paid labor force in much greater numbers than before. This was further investigated using data from the U.S. Census and the Federal Reserve Bank of St. Louis. As can be seen in **Figure 4**, the relationship between changes in VMT/capita and female labor force participation is striking (R-square over 90 percent – high level of correlation). The conclusion drawn from this analysis is that studies that failed to control for the effect of changes in labor force participation almost certainly attributed to induced demand changes to VMT that actually arose from an entirely difference cause.

FIGURE 4. RELATIONSHIP BETWEEN FEMALE LABOR FORCE PARTICIPATION AND VMT/CAPITA



The literature review included a study that controlled for female labor force participation and other exogenous factors (demographic changes, local economic growth, growth controls, etc.) that might not be fully accounted for in aggregate studies. It did this by comparing traffic growth on California state routes that were widened with similar roads in the same area that were not widened. The results suggest that the induced demand found in other studies may have come from exogenous factors that were not properly controlled for:

> "**WE FOUND THE GROWTH RATES BETWEEN THE TWO TYPES OF SEGMENTS TO BE STATISTICALLY AND PRACTICALLY INDISTINGUISHABLE**, SUGGESTING THAT THE CAPACITY EXPANSIONS, IN AND OF THEMSELVES, HAD A NEGLIGIBLE EFFECT ON TRAFFIC GROWTH OVER THE PERIOD STUDIED."
>
> *(MOKHTARIAN., SAMANIEGO, SHUMWAY, WILLITS, 2002)*

2.4.8. CAUSALITY RUNS IN BOTH DIRECTIONS

Besides labor force participation, perhaps no other factor has been more overlooked, especially in the early studies, than the fact that land development spurs road construction. In other words, there is induced supply as well as induced demand. A large-scale example is the fact that the growth in VMT/capita outstrips the growth in lane-miles/capita in California, indicating that supply is chasing demand, not the reverse.

> "ONE OF THE MAJOR SPECIFICATION PROBLEMS CONFRONTED BY ALL INDUCED DEMAND STUDIES IS THE CONFLATION OF CAUSE AND EFFECT. UNTIL RECENTLY, EFFORTS TO MEASURE INDUCED DEMAND EFFECTS COULD BE CRITICIZED FOR IGNORING ISSUES OF CAUSALITY. DISENTANGLING CAUSE AND EFFECT IN THE INTERACTION BETWEEN ROAD SUPPLY AND TRAVEL DEMAND IS EXCEEDINGLY DIFFICULT. **ROAD INVESTMENTS ARE NOT MADE AT RANDOM BUT RATHER AS A RESULT OF CONSCIOUS PLANNING BASED ON ANTICIPATED IMBALANCES BETWEEN DEMAND AND CAPACITY. THIS IMPLIES THAT, IRRESPECTIVE OF ANY TRAFFIC INDUCEMENT EFFECT, ROAD SUPPLY WILL GENERALLY CORRELATE WITH ROAD USE. SKEPTICS CAN EASILY CLAIM THAT ALL OR MOST OF THE OBSERVED RELATIONSHIPS BETWEEN TRAFFIC AND ROAD INVESTMENT DERIVE FROM GOOD PLANNING RATHER THAN TRAFFIC INDUCEMENT.**"
>
> *(CERVERO, 2001)*

A number of studies have pointed out that the construction of major highways often lags land development rather than leading it:

> [SPEAKING OF THE GROWTH OF SUBURBS IN THE CHICAGO REGION] "THE PRINCIPAL CONCLUSION OF THIS SECTION IS THAT DECENTRALIZATION STARTED WELL BEFORE THE ADVENT OF THE LIMITED-ACCESS HIGHWAY SYSTEM. POPULATION GAINS, IN AREAS NOW IN PROXIMITY TO MAJOR LIMITED-ACCESS HIGHWAYS, OCCURRED LONG BEFORE THE CONSTRUCTION OF THE HIGHWAYS AND THESE HIGHWAYS WERE LOCATED IN AREAS WHERE FUTURE GROWTH WAS ANTICIPATED. **GIVEN THESE POINTS, IT IS DIFFICULT TO ARGUE THAT HIGHWAYS CAUSED THE DECENTRALIZATION OF POPULATION.**"
>
> *(URBAN TRANSPORTATION CENTER, UNIVERSITY OF ILLINOIS, 1999)*

Accounting for induced supply reduces the residual VMT growth that is attributed to induced demand:

> "THAT IS, A SIGNIFICANT SHARE OF THE STATISTICAL CORRELATION BETWEEN TRAVEL DEMAND AND ROAD SUPPLY HAS LONG BEEN ASSIGNED TO INDUCED DEMAND EFFECTS; HOWEVER, WHEN A PATH-MODEL FRAMEWORK IS ADOPTED THAT ACCOUNTS FOR INTERMEDIATE STEPS AND INDUCED INVESTMENT EFFECTS, **LONGER-RUN ELASTICITIES OF VMT GROWTH TEND TO BE SMALLER, MATCHED BY HIGHER "INDUCED INVESTMENT" ELASTICITIES.**"
>
> *(CERVERO, 2001)*

2.4.9. LACK OF A NO PROJECT SCENARIO

From a CEQA practitioner's perspective, the lack of a No Project alternative in most academic studies can be an issue. One might argue that they are implicit in the studies that compute elasticities. However, as mentioned earlier, there are potentially many other factors that affect VMT that make this presumption quite tenuous. As one researcher put it:

> "WHILE SOME INDICATORS OF THE BACKGROUND FACTORS MENTIONED ABOVE HAVE BEEN INCORPORATED INTO AGGREGATE, REGION-LEVEL MODELS OF TRAFFIC GROWTH, **ANY SUCH MODEL WILL INEVITABLY FAIL TO MEASURE (OR WILL MEASURE INCOMPLETELY) SOME OF THE FACTORS THAT MAY BE IMPORTANT TO THE OBSERVED PATTERNS.** IN THAT CASE, THE POSSIBILITY CANNOT BE RULED OUT THAT THE **INCLUSION OF ADDITIONAL EXPLANATORY VARIABLES COULD MATERIALLY ALTER THE RESULTS BY REDUCING THE WEIGHT (PERHAPS TO NEGLIGIBILITY) ATTRIBUTED TO THE CAPACITY IMPROVEMENTS IN EXPLAINING INDUCED TRAFFIC."**
>
> *(GOODWIN, 1996)*

Matched-pair analysis compares similar corridors to see how different changes or improvements work while keeping other variables constant. In the study, the segments were paired with control segments that matched the improved segments to unimproved ones with regard to facility type, region, approximate size, and initial volumes and congestion levels.[1] This type of analysis leads to the conclusion that induced demand may not be an issue under CEQA:

> "THE MOST NOTABLE FACT THAT EMERGES FROM THESE TESTS IS THAT **IT IS NOT POSSIBLE TO DETECT A STATISTICALLY SIGNIFICANT DIFFERENCE IN TRAFFIC GROWTH FOR IMPROVED AND UNIMPROVED SEGMENTS.** ...INDEED, THE DATA ARE SURPRISING IN THAT, IF ANYTHING, THEY SHOW THE GROWTH OF UNIMPROVED SEGMENTS BEING SLIGHTLY LARGER THAN THAT OF THE IMPROVED SEGMENTS."
>
> *(MOKHTARIAN., SAMANIEGO, SHUMWAY, WILLITS, 2002)*

1 Mokhtarian, Samaniego, Shumway, Willits, 2002

The interview study mentioned earlier reinforces the idea that the with and without project alternatives under CEQA should use identical projected land use assumptions based on latest planning assumptions when analyzing widening projects:

> "WHILE THE EXPANSION OF I-580 IS SEEN AS A BONUS TO DEVELOPERS IN THE AREA, **ALL INDICATE THAT THEIR PROJECTS WOULD STILL HAVE BEEN CONSTRUCTED IN THE ABSENCE OF THE FREEWAY IMPROVEMENT.**"
>
> *(HANSEN, GILLEN, AND DOBBINS, 1993)*

2.4.10. LACK OF SUBSTANTIAL EVIDENCE THAT INDUCED DEMAND OCCURS IN RURAL AREAS

When induced demand in rural areas gets mentioned at all, it is usually with an unstated assumption that whatever is true in large metropolitan areas probably holds true in rural areas as well:

> "OVERALL, **THE FEW STUDIES TO DATE THAT HAVE TRIED TO STATISTICALLY MEASURE HOW ROAD INVESTMENTS INTERACT WITH OTHER FACTORS TO INDUCE TRAVEL DEMAND HAVE YIELDED INCONCLUSIVE RESULTS.** A LITERAL INTERPRETATION OF EMPIRICAL FINDINGS WOULD BE THAT INDUCED DEMAND EFFECTS DO NOT VARY TREMENDOUSLY ACROSS SETTINGS – WHETHER DENSELY POPULATED, HIGHLY CONGESTED URBAN AREAS OR SPARSELY INHABITED, LESS CONGESTED EXURBS. **WHILE COMMON SENSE SUGGESTS THIS IS NOT THE CASE**, SO FAR THE COLLECTIVE RESEARCH COMMUNITY HAS BEEN UNABLE TO JETTISON THIS "NULL HYPOTHESIS." THIS IS PROBABLY **MORE OF AN INDICTMENT OF METHODOLOGICAL TOOLS AND THEIR INABILITY TO PROVIDE FINE-GRAIN INSIGHTS INTO THE INDUCED DEMAND PHENOMENON THAN AN ASPERSION OF THE IDEA THAT INDUCED DEMAND IMPACTS VARY.** CLEARLY, MORE AND BETTER RESEARCH IS NEEDED ON HOW INDUCED DEMAND EFFECTS VARY ACROSS DIFFERENT SETTINGS AND CONTEXTS."
>
> *(CERVERO, 2001)*

This study identified one induced demand study that explicitly distinguished between rural and urban area types. This study utilized national data spanning from 1998 to 2008[1]. It applied simultaneous equation models to predict VMT across a range of factors and roadway characteristics. The findings showed that elasticities vary significantly between rural and urban lane mile additions. A one percent increase in rural lane miles yielded a de-minimis 0.083 percent increase in VMT. The impact of increasing urban lane miles was found to be more than three times higher (an elasticity of 0.267). The salient point being it is not so much the values of the elasticities but the fact that they are significantly different.

Note that the 0.267 elasticity is also much less than the 1.00 elasticity applied in the NCST calculator to Class I facilities and the 0.75 elasticity applied to Class II and Class III facilities.

The absence of definitive evidence regarding induced demand in rural areas presents a significant challenge within the framework of CEQA, which mandates that findings be grounded in substantial evidence. The question arises: does the absence of evidence indicating induced demand in rural areas signify its non-existence in these regions? Or should the lack of evidence that rural areas are different from urban areas be interpreted to mean that studies of urban areas can be applied to rural areas? CEQA does not require lead agencies to study phenomena whose existence is not supported by substantial evidence. By this standard, induced demand might not be viewed as a significant impact under CEQA in rural areas.[2]

2.4.11. EFFECT DIMINISHING OVER TIME

Early studies, which analyzed data from the 1960's and 70's, attributed a much larger contribution of VMT change to a possible induced effect compared to later studies using more recent data. One study that segmented data by era[3] found that induced demand effects accounted for 44 percent of VMT growth in California for the period 1977-1980, dropping to just 10 percent for 1980-1985 and then eight percent for 1985-1990. The fact that land development in California went from unregulated booms in the 1970s to becoming a highly regulated industry by 1990 undoubtedly affected the market's ability to respond to accessibility changes resulting from new roadway capacity.

1 Rentziou, Gkritza, Souleyrette, 2011

2 CEQA Guidelines Section 15187(d) - The environmental analysis shall take into account a reasonable range of environmental, economic, and technical factors, population and geographic areas, and specific sites. The agency may utilize numerical ranges and averages where specific data is not available, but is not required to, nor should it, engage in speculation or conjecture.

3 Hansen and Huang, 1997

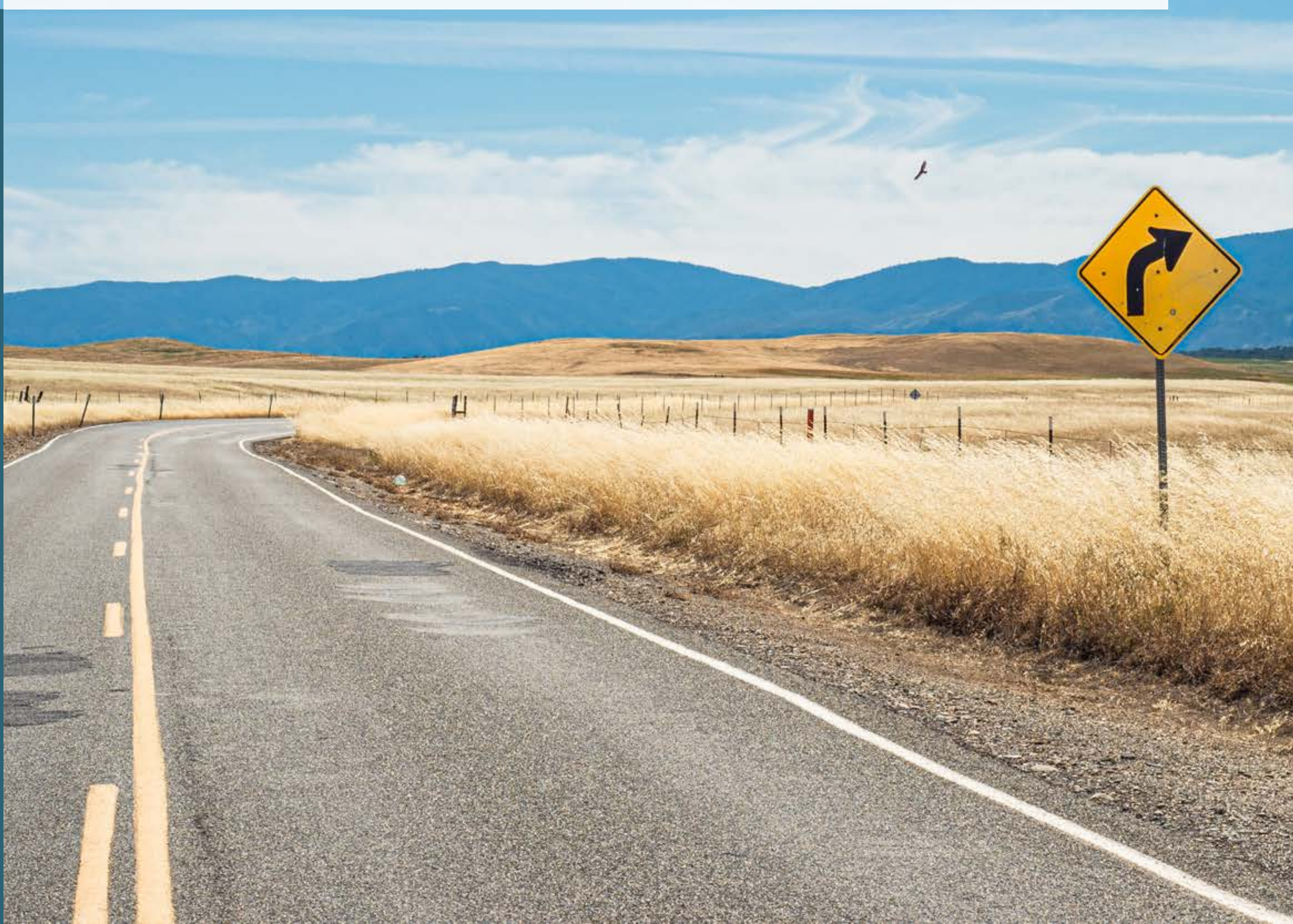
2.5. CONCLUSIONS FROM THE LITERATURE REVIEW

Based on a comprehensive review of the research on induced demand, the following conclusions can be made:

- The reliance on review studies appears to have resulted in guidance that is contradicted by empirical evidence, including the findings from researchers cited within the guidance.
- The idea that increases in road capacity will induce increases in demand on a one-for-one percentage basis (i.e., an elasticity of 1.0) is not supported by much of the induced demand research.
- The theory and empirical observations collectively indicate that changes in lane-miles is a poor indicator to predict induced demand regardless of area type. If induced demand occurs, it predominantly stems from the presence of latent demand that is "released" as a result of significant reductions in travel times. Notably, highway enhancements that fail to substantially decrease travel times are unlikely to induce demand.

In summary, the absence of clear evidence that induced demand occurs in rural areas strongly suggests that application of current state VMT policies may prevent or disadvantage projects that are being proposed pursuant to other State objectives. This is particularly concerning for emergency evacuation and safety initiatives, where the preservation of lives takes precedence.

3> REVIEW OF GUIDANCE DOCUMENTS



3.0. REVIEW OF GUIDANCE DOCUMENTS

Navigating California's environmental policy landscape involves a critical evaluation of transportation impacts, particularly under the CEQA. This review examines key guidance documents provided by OPR, Caltrans, and CARB. The focus of this section is on understanding how these documents address the intricate challenge of assessing vehicle miles of travel (VMT) impacts, particularly in rural areas, as mandated by SB 743. The review includes the diverse methodologies suggested, the gaps in guidance for rural counties, and the implications for regional transportation planning agencies and grant applicants.

3.1. OPR'S TECHNICAL ADVISORY ON EVALUATING TRANSPORTATION IMPACTS IN CEQA[1]

SB 743 assigned[2] the OPR the task of preparing revisions to the CEQA guidelines to, "… promote the reduction of greenhouse gas emissions, the development of multimodal transportation networks, and a diversity of land uses." OPR duly prepared the revisions, along with a Technical Advisory describing the practices it recommends for evaluating the VMT impacts for land use and transportation projects.

Although the Advisory offers detailed advice regarding projects in urbanized areas, it provides only two pieces of guidance on how SB 743 is to be applied in rural areas:

- It suggests (page 19) that, *"In rural areas of non-[Metropolitan Planning Organization (MPO)] counties (i.e., areas not near established or incorporated cities or towns), fewer options may be available for reducing VMT, and significance thresholds may be best determined on a case-by-case basis."*
- On page 24, where the Advisory discusses an elasticity-based technique for forecasting induced demand, it says, *"This method would not be suitable for rural (non-MPO) locations in the state which are neither congested nor projected to become congested."*

The effect of this guidance is to absolve rural counties of the need to follow the guidance provided for urban projects, but it does not identify alternative methodologies that should be used instead.

This is an issue considered by earlier looks at SB 743 by OPR. A 2021 working group session contained notes regarding VMT in rural areas:

> *"Most (or perhaps all) research around induced VMT comes from metropolitan-area settings (including rural portions of MSAs).*
>
> *While it is reasonable to assume induced travel is possible in rural counties, reliable means for capturing the phenomenon are lacking. Where demand models exist, they*

1 https://opr.ca.gov/docs/20190122-743_Technical_Advisory.pdf

2 Public Resources Code §21099(b)(1)

require some method for determining land use scenarios. In places without demand models, the analyst must make a qualitative case for VMT assessment.

In many cases, based on existing knowledge, we would expect to see little VMT effect from widening in rural counties. (Rural land use development, however, may well induce travel.)

Some potential ways to justify a no-impact finding include:

» *Pointing to a lack of congestion in the project area. If the project would not speed up traffic at completion or in the future, it should not induce more or longer trip-making.*

» *Pointing to barriers to land use change, such as topography or government ownership of affected land. (Such an assertion should address commercial as well as residential land uses and might need to also take into account other drivers of induced travel.)*

» *Developing projects that do not add VMT-inducing capacity. For example, if evacuation routes can be improved by strengthening shoulders or parallel bike-ped paths for emergency use, no day-to-day VMT effect should pertain.*

» *Projects that are determined to be exempt from federal air quality conformity per 40 CFR 93.126 and 40 CFR 93.127.*

These findings may not address all instances where induced VMT is unlikely or difficult to measure. It may be necessary to pursue additional research to better describe conditions that cause induced demand in rural counties."[1]

As described below, these intimations of a lack of research are effectively as close to firm guidance that OPR and Caltrans have offered.

3.2. CALTRANS' TRANSPORTATION ANALYSIS FRAMEWORK[2] AND TRANSPORTATION ANALYSIS UNDER CEQA[3]

Caltrans has developed practices for complying with SB 743 for projects on the State Highway System. Caltrans' current guidance is found in their Transportation Analysis Framework and Transportation Analysis under CEQA (TAC). As with OPR, Caltrans' guidance on rural projects is limited:

- Section 5.6.1 of the TAC says, in its entirety, *"For projects within the rural, non-MPO counties, significance should be addressed on a case-by-case basis, taking into account context and environmental setting."*
- **Table 2** of the TAC states that in rural counties, induced demand should be assessed using a travel demand model or other quantitative methods (pictured on the following page). However, while the table does not mention qualitative methods, an example on page 45 states that a qualitative analysis can be completed.

1 https://dot.ca.gov/-/media/dot-media/programs/sustainability/documents/sb743-working-group-090921-2-a11y.pdf

2 https://dot.ca.gov/-/media/dot-media/programs/transportation-planning/documents/sb-743/2020-09-10-1st-edition-taf-fnl-a11y.pdf

3 https://dot.ca.gov/-/media/dot-media/programs/transportation-planning/documents/sb-743/2020-09-10-1st-edition-tac-fnl-a11y.pdf

TABLE 2. SELECTION MATRIX FOR INDUCED TRAVEL ASSESSMENT METHOD FOR PROJECTS ON THE SHS

<table>
<tr><th>PROJECT TYPE ▶
PROJECT LOCATION ▼</th><th>GP OR HIGH OCCUPANCY VEHICLE (HOV) LANE ADDITION TO INTERSTATE FREEWAY</th><th>GP OR HOV LANE ADDITION TO CLASS II & III STATE ROUTES</th><th>OTHER VMT INDUCING PROJECTS AND ALTERNATIVES</th></tr>
<tr><td>COUNTY WITH MSA WITH CLASS I FACILITY</td><td>Apply the NCST Calculator by MSA and/or TDM benchmarked with NCST Calculator</td><td rowspan="2">Apply the NCST Calculator by county and/or TDM benchmarked with NCST Calculator</td><td rowspan="2">Apply TDM or other quantitative methods</td></tr>
<tr><td>OTHER MSA COUNTY</td><td>Apply TDM or other quantitative methods</td></tr>
<tr><td>RURAL COUNTY</td><td colspan="3">Apply TDM or other quantitative methods</td></tr>
</table>

- The TAF also uses **Table 2**. The table indicates that the elasticity-based NCST calculator is to be used for analyses of non-interstate highways in all counties except for 21 rural counties listed in **Table 3** of the TAF[1] below.

TABLE 3. THE 21 RURAL COUNTIES WHERE THE NCST CALCULATOR DOES NOT APPLY

ALPINE	INYO	NEVADA
AMADOR	LAKE	PLUMAS
CALAVERAS	LASSEN	SIERRA
COLUSA	MARIPOSA	SISKYOU
DEL NORTE	MENDOCINO	TEHAMA
GLENN	MODOC	TRINITY
HUMBOLDTH	MONO	TUOLUMNE

So, as with OPR's guidance, the effect of Caltrans' guidance is to absolve rural counties of the need to follow the methodologies established for urban projects, but it does not identify alternative methodologies that should be used instead. Conversely, MPOs with significant rural areas within their boundaries (e.g., MPOs in the San Joaquin Valley, Central Coast, Northern California, and Southern California) must adhere to the Caltrans' TAF.

1 A travel demand model can also be used, but must be benchmarked with the NCST calculator

3.3. CALIFORNIA AIR RESOURCES BOARD (CARB) SB 375 REGIONAL PLAN CLIMATE TARGETS

The State's primary goal for reducing VMT is to reduce Greenhouse Gas (GHG) emissions from the transportation sector. SB 375 requires CARB to develop and set regional targets for GHG emission reductions from passenger vehicles. The current targets for VMT reduction are published on CARB's website[1]. Targets are set for each MPO area, with reductions ranging from four percent to 19 percent depending on the region. MPOs are required to comply with these targets in planning Sustainable Communities Strategies (SCS) as part of the Regional Transportation Plan process.

An approved RTP is required in order for MPOs to access the vast majority of state and federal funding programs. Additionally, an approved SCS is required in order for MPOs to access the vast majority of state grant funding. MPOs with significant rural areas within their boundaries are still required to meet VMT reduction targets established by CARB. VMT is a primary metric used by CARB in evaluating SCSs. While the SCS Evaluation Guidelines affirm that professional judgment may be used regarding induced travel, CARB requires that MPOs document the methodology, assumptions, and datasets used to evaluate these effects. In practice, MPOs that include capacity-increasing projects in their financially constrained capital improvement list have had their third round of SCS approvals held up for not explicitly applying the NCST Calculator to estimate induced VMT and reflect that increment towards their GHG emission reduction assessment. This was even the case for several MPOs that demonstrated the appropriate model feedback loop with a land use allocation model – considered the most effective process for estimating the long-term effects of induced VMT in the Caltrans Traffic Analysis Framework guidance.

MPOs that cannot meet the reduction goal "in any feasible way" must submit an Alternative Planning Strategy (APS) in lieu of an SCS. An APS can assume changes in law and funding beyond an SCS. However, an APS is still required to show that with significant changes and additional resources, the MPO can meet CARB's GHG reduction requirements.

Regional transportation planning agencies (RTPAs) outside MPOs are not required to submit SCSs. According to the 2020 California Public Roads Data, the largest four of the 18 MPO regions (SCAG, SANGAG, MTC, and SACOG) generate 78 percent of the light-duty vehicle VMT in California and 85 percent of the on-road mobile source GHG emissions[2]. The remainder of the state contributes roughly 22 percent of the State's estimated VMT[3]. Non-MSA rural counties generate about four percent of the Statewide VMT.

Rural areas must still comply with SB 743. Hence, individual projects are still evaluated under the CEQA environmental review process.

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1 https://ww2.arb.ca.gov/our-work/programs/sustainable-communities-program/regional-plan-targets

2 2022 Progress Report | California's Sustainable Communities and Climate Protection Act, CARB, 2022

3 https://dot.ca.gov/-/media/dot-media/programs/research-innovation-system-information/documents/california-public-road-data/prd-2020-a11y.pdf

3.4. GRANT REQUIREMENTS FOR INDUCED DEMAND CALCULATIONS

SB 1 grants now feature a section describing state highway system impacts under SB 743 (this common language can be found in the SB 1[1] guidelines as part of the application for the Trade Corridor Enhancement Program (TCEP), Solutions for Congested Corridors (SCCP), and Local Partnership Competitive Funds (LPPC)).[1,2,3]

12. SB743 VEHICLE MILES OF TRAVEL (VMT) IMPACT ASSESSMENT

- ☐ **1. Project Environmental Document was approved prior to the implementation of SB 743 (or July 2020) and VMT analysis was not required. If checked, Stop. Proceed to Section 13.**
- ☐ **2. Project is screened as unlikely to induce traffic under Section 5.1.1 in Transportation Analysis under CEQA. If checked, Stop. Proceed to Section 13.**
- ☐ **3. Project is in a Metropolitan Statistical Area. If checked, proceed to step 3. If not, proceed to step 6.**
- ☐ **4. Project adds lane-miles to the SHS. If yes, proceed to step 4. If the project adds other types of traffic-inducing capacity, e.g. an interchange, proceed to step 6.**
- ☐ **5. Enter the project lane-miles in the NCST Induced Travel Calculator and report the result here. ____**
- ☐ **6. If the project team believes induced VMT will be different than what is shown in step 4, provide a best estimate based on guidance in the Transportation Analysis Framework and Transportation Analysis Under CEQA, and a brief justification here. Stop. Proceed to Section 13. ____**
- ☐ **7. Provide an estimate of the project's induced VMT based on guidance in the Transportation Analysis Framework and Transportation Analysis Under CEQA, and a brief justification here. Stop. Proceed to Section 13. ____**

As described above, the NCST Induced Travel Calculator is not applicable to many rural counties. The TAF and TAC documents in Step 6 give no firm guidance to an alternative method of calculating induced VMT other than travel demand modeling or "other method".

In fact, tracing the guidance further back results in the same answer: "flexible guidance." For a route to be eligible for SCCP funds, it must have a Comprehensive Multimodal Corridor Plan (CMCP). The SCCP guidelines state the following:

> *"Induced demand analysis methodologies vary among agencies and flexibility will be given for agencies to determine and use the method most appropriate for their region. One example of an induced demand analysis methodology that could be used: Appendix 2 of the Governor's Office of Planning and Research Technical Advisory on Evaluating Transportation Impacts in CEQA: http://opr.ca.gov/docs/20180416743_Technical_Advisory_4.16.18.pdf"*[4]

The guidance on using induced demand with flexible guidance is likewise echoed in federal grantmaking. The 2021 Infrastructure Investment and Jobs Act (IIJA) created the Promoting Resilient Operations for Transformative, Efficient, and Cost-saving Transportation Program (PROTECT) program, which supplements the existing Infrastructure for Rebuilding America (INFRA), Rural Surface Transportation, and Mega programs (now rolled into the single Multimodal Project Discretionary Grant (MPDG) program, as well as the Rebuilding American Infrastructure with Sustainability and Equity (RAISE) program (formerly Transportation Investment Generating Economic Recovery (TIGER)).

1 https://catc.ca.gov/-/media/ctc-media/documents/programs/sccp/08-17-22-adopted-2022-sccp-guidelines.pdf

2 https://catc.ca.gov/programs/sb1/trade-corridor-enhancement-program

3 https://catc.ca.gov/-/media/ctc-media/documents/programs/local-partnership-program/competitive/2022-guidelines-competitive/20220819-lpp-c-guidelines-2022-v2-a11y.pdf

4 https://catc.ca.gov/-/media/ctc-media/documents/120518-approved-cmcp-guidelines-a11y.pdf

PROTECT is administered in California through the CTC's Local Climate Transportation Adaptation Program, which states that VMT should be minimized while maximizing person throughput.

MPDG and RAISE programs share the same Federal discretionary grant program benefit-cost guidance, which simply states, "Forecasts should incorporate indirect effects (e.g., induced demand) to the extent possible."[1]

Caltrans' intake form for Federal grants also asks for VMT considerations:

> *"**VMT IMPACT:** The purpose of this question is to determine the Project's VMT impacts. Caltrans is looking to support projects that do not significantly increase motor vehicle travel, particularly in congested urbanized settings where other mobility options can be provided and where projects are shown to induce significant auto travel. These projects should generally aim to reduce VMT and not induce significant VMT growth (CAPTI page 17). In less congested rural areas, highway capacity expansion can be less likely to induce travel. Nevertheless, the benefits and drawbacks of widening roadways in this context must be weighed carefully. Describe how the Project proposes to reduce VMT and include alternatives to highway capacity expansion, such as providing multimodal and non-auto mode options in the corridor, employing pricing strategies, and using technology to optimize operations. Describe if the Project considers alternatives to general purpose lane, HOV, and High Occupancy Toll (HOT) lane additions that may potentially induce demand. Provide available data/exhibits."*[2]

Calculating the cost-benefit required for applying to these Federal programs can not rely on the Caltrans' Excel-based Cal-B/C to calculate VMT, as it indicates:

> *"The user should account for induced demand, if applicable, in the inputs provided since Cal-B/C does not estimate it automatically. Induced demand is an unintended effect that may occur if a project alleviates traffic congestion by increasing roadway capacity (e.g., building new roadways or adding lane miles). With induced demand, the roadway network experiences an increase in vehicle-miles traveled (VMT) because the added roadway capacity reduces travel delay or the "price" of travel, enticing motorists to drive more. If there is enough extra demand, congestion relief may be temporary as VMT increases. Cal- B/C users can account for the effects of induced demand by making sure the extra travel is included in the ADT for the Build scenario, shown in the Project Information tab."*

Again, the program asks for a calculated VMT impact for benefit-cost considerations. It is anticipated that grant programs will increasingly require induced VMT considerations. For rural counties, the State has offered "flexibility" without clear further guidance. While this seems to allow rural counties the option of exploring a new methodology, it also does not ensure that their submissions will be accepted. A clear statement that projects located in areas where the causal factors for latent demand are not clearly present, are not required to perform an induced demand analysis would resolve the matter and avoid needless costs incurred in doing unnecessary analyses.

1 https://www.transportation.gov/sites/dot.gov/files/2023-01/Benefit%20Cost%20Analysis%20Guidance%202023%20Update.pdf

2 https://dot.ca.gov/-/media/dot-media/programs/transportation-planning/documents/strategic-investment-planning/final-mpdg-raise-intake-form-04-2023-a11y.docx (Also mirrored in the Reconnecting Communities Pilot Grant Program Caltrans intake form).

3.5. CALIFORNIA ACTION PLAN ON TRANSPORTATION INFRASTRUCTURE (CAPTI) AND CALTRANS SYSTEM INVESTMENT STRATEGY (CSIS) GUIDANCE FOR CLIMATE CHANGE RELATED EXPENDITURES

The following Executive Orders focused on reducing on-road mobile source GHG emissions from California's transportation sector:

- Executive Order (EO) N-19-19 empowers the CALSTA to leverage discretionary state transportation funds to help meet the state's climate goals.
- Executive Order N-79-20 moves the transportation sector toward a zero-emission future by requiring all new cars sold in the state to be zero-emission by 2035 and all commercial trucks sold to be zero-emission by 2045.

Pursuant to EO N-19-19, the CAPTI Investment Framework aims to align the state transportation infrastructure investments with state climate, health, and social equity goals built on the foundation of the "fix-it-first" approach established in SB 1. To reduce emissions from transportation, the Investment Framework is premised on exacting significant reductions in VMT as stated in the key guiding principle of CAPTI:

> *"Promoting projects that do not significantly increase passenger vehicle travel, particularly in congested urbanized settings where other mobility options can be provided and where projects are shown to induce significant auto travel. These projects should generally aim to reduce VMT and not induce significant VMT growth.*
>
> *When addressing congestion, consider alternatives to highway capacity expansion, such as providing multimodal options in the corridor, employing pricing strategies, and using technology to optimize operations."*

The framework specifically states that historical investments in new roadway capacity in urbanized areas have promoted VMT growth and, in fact, "induced travel," which has failed to reduce congestion over the long term. The same research addressed in the Literature Review section of this report is cited to support this claim. Conversely, CAPTI explicitly acknowledges that "context", and specific project analysis and attributes are key to determining a project's VMT impacts. The CAPTI guiding principle focuses on whether a project induces significant travel as the key attribute of concern rather than whether it is simply a highway expansion project. It also acknowledges that though highway capacity expansion projects in congested urbanized settings have a particularly high tendency to result in inducing additional travel, in less congested rural areas, highway capacity expansion is much less likely to induce travel. This is particularly relevant given that improvement options such as transit, active transportation, and travel demand management strategies are simply not as viable in most rural areas of the state. More importantly, an important distinction is that roadway capacity improvements in rural areas are often not intended to address or relieve significant recurring congestion (a prerequisite for an induced effect to occur) but are driven more by safety, goods movement, evacuation, and access concerns.

Below are just a few examples of the various sustainable transportation solutions that CAPTI supports that could be applied in rural settings. In CAPTI Action S6.3 will facilitate further discussion about these and many other rural transportation solutions, with the goal of ensuring better state support for their deployment:

- Increasing transit and passenger rail service in a corridor through investments in bus service, vanpools, micro-transit or mobility on-demand services, park-and-ride facilities, and adjacent passenger rail improvements;
- Improving freight rail lines in major goods movement corridors to support mode shift from truck to zero-emission rail, increase passenger rail service, and promote zero- emission locomotives;
- Addressing safety through the multidisciplinary Safe System Approach that employs tools for speed management, such as road diets, conversion of intersections to roundabouts, and signal coordination to slow speeds;
- Eliminating project components that contribute additional risk and stress to bicyclists, pedestrians, and other vulnerable road users;
- Improving multimodal connectivity in local street networks (including overcrossing opportunities of Caltrans facilities) in order to enable more direct routing and efficient access to destinations for short trips, thereby removing trips from the state highway system;
- Adding and improving connected facilities for walking and bicycling in the corridor and for first/last-mile connections to local, interregional, and regional transit routes;
- Facilitating emergency evacuations through efficient traffic management strategies, such as the use of contra flow, use of two-way left turn lanes as through travel lanes, construction of full structural sections of shoulders, and installation of Transportation Management Systems (TMS) elements, such as Closed-Circuit Television (CCTV) cameras, Changeable Message Signs (CMS), and traffic detection equipment;
- Converting to truck-only lanes in major goods movement corridors, utilizing the Caltrans right-of-way or other lands to provide safe truck parking opportunities, and installing charging facilities that support zero-emission trucks, especially in neighborhoods burdened by poor air quality; and,
- Deploying zero-emission vehicle charging or fueling infrastructure —including battery electric, fuel cell (hydrogen) electric, and other zero-emission vehicle technologies.

Rural areas of the state lack clear guidance in terms of the State's SB 743 implementation guidance. On the positive side, this means that rural agencies are not bound by the guidance that many urban agencies must address. On the negative side, however, beyond "develop a sufficiently robust travel demand model", rural agencies have not been given any effective assistance in how to approach VMT analyses and have no State guidance they can point to in defense of their actions.

Rural agencies must decide for themselves how to evaluate projects, as stated in CEQA Guidelines §15064.3(b)(4) (new with SB 743):

> "METHODOLOGY. **A LEAD AGENCY HAS DISCRETION TO CHOOSE THE MOST APPROPRIATE METHODOLOGY TO EVALUATE A PROJECT'S VEHICLE MILES TRAVELED**, INCLUDING WHETHER TO EXPRESS THE CHANGE IN ABSOLUTE TERMS, PER CAPITA, PER HOUSEHOLD **OR IN ANY OTHER MEASURE.** A LEAD AGENCY MAY USE MODELS TO ESTIMATE A PROJECT'S VEHICLE MILES TRAVELED AND MAY REVISE THOSE ESTIMATES TO REFLECT PROFESSIONAL JUDGMENT BASED ON SUBSTANTIAL EVIDENCE. ANY ASSUMPTIONS USED TO ESTIMATE VEHICLE MILES TRAVELED AND ANY REVISIONS TO MODEL OUTPUTS SHOULD BE DOCUMENTED AND EXPLAINED IN THE ENVIRONMENTAL DOCUMENT PREPARED FOR THE PROJECT. THE STANDARD OF ADEQUACY IN SECTION 15151 SHALL APPLY TO THE ANALYSIS DESCRIBED IN THIS SECTION."
>
> ***EMPHASIS ADDED***

Establishing a defensible, replicable, and accepted precedent will be key in facilitating transportation improvements under future grant program guidelines.

Rural areas are relying on capacity-increasing projects to meet key goals surrounding access, safety, operations, goods movement, and evacuation. Rural areas have low VMT compared to large MPOs, have projects far less likely to significantly reduce travel times to induce VMT, and have fewer options for VMT mitigation. The overweighting of VMT reduction criteria and induced demand for selecting projects for grant funding or prioritization presents a significant equity issue for rural areas throughout the state.

In many cases, there simply are few or no other options for rural counties. Projects that add additional capacity to reduce bottlenecks and smooth traffic flow to reduce GHG emissions can remain consistent with the CAPTI and the goals of the Caltrans System Investment Strategy (CSIS).[1 2] While the CSIS does give some consideration to the unique challenges facing rural areas, there is no guarantee at this time that future grant scoring guidelines will continue to remain cognizant of rural needs. A narrow focus on VMT fails to adequately capture the full benefits of a project, which can significantly limit the ability of rural counties to seek and receive funding for vital safety, resiliency, and operational projects.

1 https://calsta.ca.gov/subject-areas/climate-action-plan

2 https://dot.ca.gov/-/media/dot-media/programs/transportation-planning/documents/strategic-investment-planning/draft-interim-csis-mar-2022-a11y.pdf

4>

INDUCED VMT SENSITIVITY ANALYSIS

4.0. INDUCED VMT SENSITIVITY ANALYSIS

The Caltrans' TAF provides guidance on assessing induced VMT resulting from capacity-increasing projects on state highway facilities. The TAF recommends two approaches – an empirical approach using the NCST Induced Travel Calculator and/or applying a regional or local area travel demand model based on the criterion described in the TAF.

The NCST calculator estimates induced travel by applying long-term aggregate elasticities based on empirical (before-after) studies from national databases and review studies.[1] The NCST Calculator elasticities rely solely on the addition of lane miles and are not sensitive to location-specific factors and the unique travel characteristics of a given project area. As such the Calculator does not account for socio-economic changes (i.e. population and employment growth), the land use context, existing congestion/bottlenecks, improvements providing shorter travel routes, or geographic constraints. Consequently, adding lane miles in rural areas with no congestion will produce the same induced VMT estimate as project areas with high levels/multiple hours of congestion. This will invariably result in over-estimating the induced effect in areas with no sensitivity to adjacent land use and lack of latent demand, particularly uncongested rural areas, resulting in an ecological fallacy.

To test this, a simple sensitivity analysis was performed to gauge the reasonableness of applying the NCST Calculator to estimate induced VMT resulting from the expansion of Caltrans facilities in both rural non-MSA areas as well as rural areas within MPO regions. Given the rural context, this analysis specifically focused on Federal Highway Administration (FHWA) Functional Class II and III facilities. For a given project located in a specified county, the VMT with induced effect projections was estimated using pre-construction year countywide Highway Performance Monitoring System (HPMS) VMT, which is then "grown" out three, 10, and 20 years into the future based on the countywide population growth rate[2] plus the added increment of induced VMT estimated by the NCST's induced Demand Calculator. These VMT estimates were then compared to the "actual" HPMS VMT estimate for each horizon year after the roadway capacity expansion project was completed and open to traffic. This analysis draws from readily available historical countywide HPMS data and DOF population estimates between 1990 and 2022.

The intent of this sensitivity exercise is simply to demonstrate how accurately future VMT would be estimated had the NCST tool been used at the time of the project approval process. The analysis also includes a more in-depth case-study evaluation of three of the capacity expansion projects where the NCST Calculator emulated or under-predicted actual VMT growth. The sensitivity analysis and the case studies underscore the need to understand local conditions to contextualize the findings from the Calculator, as noted in the documentation provided by the developers of the NCST Calculator.

1 Duranton, G., & M. A. Turner (2011).

2 Department of Finance

4.1. PROJECT SELECTION

The analysis included a comprehensive and systematic approach to project selection, collaborating with interested RTPAs, MPOs, and Caltrans Districts to identify and shortlist the projects. The candidate projects were selected based on the following criteria.

- **Capacity-increasing Improvements**. Each candidate project considered for inclusion in the study resulted in an increase in transportation capacity.
- **Rural Geographical Context**. The candidate projects are located in rural areas or rural parts of Metropolitan Planning Organizations (MPOs).
- **Temporal Consideration (Construction Period)**. Projects that were constructed at least five to 25 years ago, facilitating the examination of projects' long-term induced demand potential.
- **Available Project Data**. The candidate projects have the information required for the sensitivity analysis, e.g., the number of lanes added, improvement type, and year of construction.

The data request resulted in the submission of 43 projects, 14 of which met all the desired criteria. **Table 4** presents the list of the projects, project location, construction year, and the lane miles added. Five of the selected projects are in areas within a non-MSA RTPA region. Pursuant to the Caltrans TAF guidelines, these projects will not be required to apply the NCST calculator and would instead rely on a travel demand model or other analytical techniques. Nine projects are located within rural areas of an MPO region. These improvement if going through environmental clearance today would be expected to apply the NCST calculator to estimate induced demand. The regional differentiation underscores the diversity in the study's analytical framework.

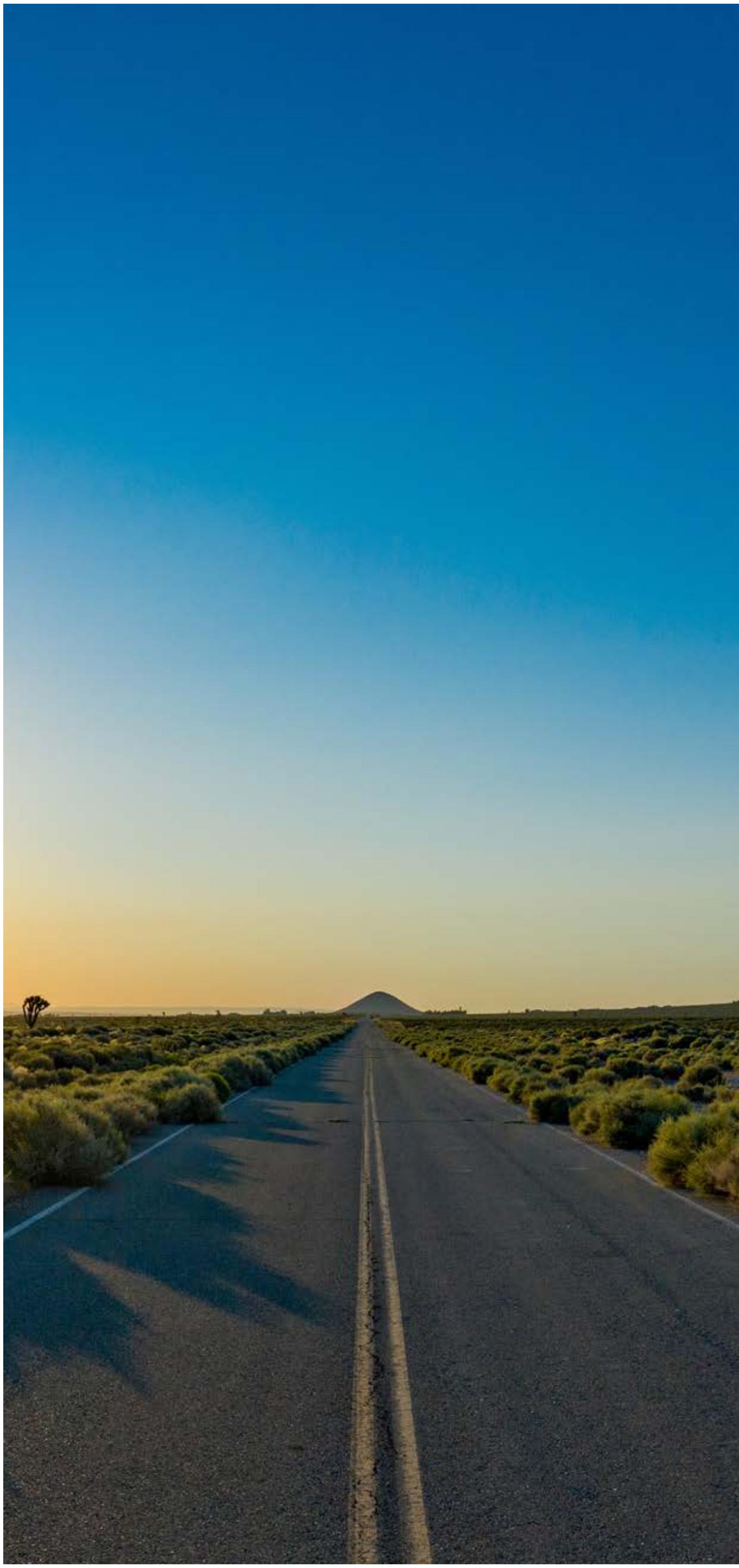


TABLE 4. CASE STUDY PROJECT LIST

PROJECT	PROJECT LIMITS	COUNTY	OPENING YEAR	LANE MILES ADDED
US 395	Various Segments	Mono	1999	48.6
US 395	Various Segments	Inyo	2007/2008	25.2
US 395	Various Segments	Inyo	2001	61.4
SR 267	I-80 to County Line	Nevada	2002	4.0
SR 49	Bear River to Wolf Crombie	Nevada	2007	4.4
SR 70	Various Segments	Sutter	2008	14
US 101 CUESTA GRADE IMPROVEMENT	US 101 n/o City of San Luis Obispo	San Luis Obispo	1998	14.4
SR 65 LINCOLN BYPASS	Industrial Boulevard to north of Riosa Road	Placer	2013	20.8
SR 46 LOST HILLS	Kern County Line to Brown Material Rd	Kern	2012	67.4
SR 14 N. OF MOJAVE	Cal City Blvd to Minard Trail	Kern	2007	8.6
SR 58 MOJAVE FREEWAY BYPASS	California City Cutoff to 25th Street	Kern	2004	9.0
SOUTH SR 41	SR 41 from Manning Ave to Conejo Ave	Fresno	1999	15.0
HWY 180 EAST	Hwy 180 East expansion between Clovis Ave and Temperance Ave	Fresno	2009	4.6
STATE ROUTE (SR) 149	SR 149 from SR 99 to SR 70	Butte	2003	16.0

Note: Projects in rows that are highlighted in light green are in non-MSA RTPA region and are excluded from applying NCST calculator per Caltrans TAF; Unhighlighted are in MPO regions

Source: DKS Associates, 2024

4.2. ANALYSIS METHODOLOGY AND RESULTS

The sensitivity analysis involved a comprehensive examination of the countywide VMT growth over distinct time horizons: a three-year, 10-year, and 20-year period. These analysis horizons were selected pursuant to the NCST Calculator guidance and other research on the duration needed to allow the long-term induced effect to fully play out. The objective was to compare the actual Highway Performance Monitoring System (HPMS) VMT growth against a countywide VMT estimate that combines the elasticity-based induced VMT estimate, plus a forecast based on the baseline HPMS VMT (prior to the improvement being open to traffic) that is "grown" to a given horizon period using the county's population growth rate. Countywide VMT and population growth trends between 1990–2022 for the counties selected for this analysis are shown in **Figure 5**. As shown, little to no growth trend in either VMT or population is evident for the rural non-MSA RTPA counties, while more variance was experienced between VMT growth and population growth in the rural MPO counties.

As described, this analysis applied multiple databases, including the HPMS for countywide VMT information, Caltrans' countywide lane miles for road infrastructure data, and the Department of Finance (DOF) for population statistics. The temporal scope of the data ranged from 1990 to 2022, providing a robust dataset for an examination of long-term trends. Five projects could not be included in the 20-year horizon assessment, simply because they have not been open to traffic for that duration.

All the study projects considered in this analysis pertain to Class II and Class III facilities and apply a 0.75 elasticity factor used in the NCST Calculator as appropriate.

Figures 6 through 8 present a visual representation over a three-year, 10-year, and 20-year comparison between actual countywide VMT growth in conjunction with population growth and elasticity-based induced VMT derived from the NCST Calculator. Each figure corresponds to a different time horizon.

As shown, the NCST Calculator exhibited consistent overestimation issues in rural areas, regardless of whether the project was within an MPO region or not. The Calculator consistently overestimated (100 percent overestimation rate) for projects in non-MPO rural areas. For rural area MPO projects, the overestimation occurred 50 to 70 percent of the time depending on horizon year. This overestimation trend persisted across different forecast periods, including three, 10, and 20 years, although there was a gradual reduction in the magnitude of the overestimation over time. A noteworthy observation was the NCST Calculator's heightened sensitivity to incremental small capacity increases, leading to worse performance as the project's significance increased. This suggests that the Calculator is acutely sensitive (i.e., the larger the capacity increase, the larger its induced demand overestimation) and overly reactive to capacity adjustments.

No other SHS capacity increasing projects, other than the identified improvements, are accounted for in this sensitivity assessment. If for a given county additional SHS lanes miles were constructed between 1990- 2022 and incorporated, the NCST Calculator would yield a greater induced VMT increment contributing to a greater countywide VMT estimate.

FIGURE 5. DAILY VMT AND POPULATION GROWTH TRENDS (RTPA AND MPO)

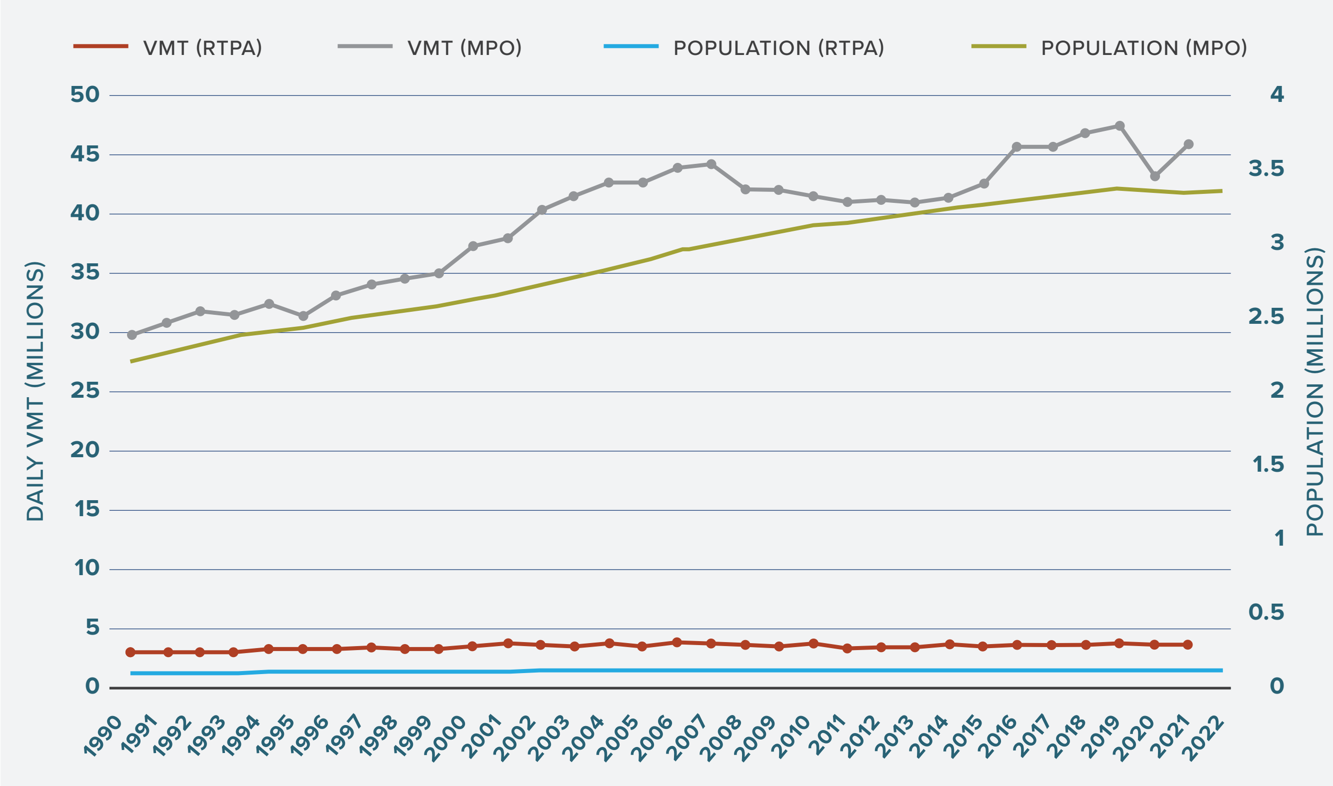


FIGURE 6. NCST CALCULATOR + POPULATION GROWTH VMT VS. HPMS VMT – 3-YEAR ESTIMATE COMPARISON

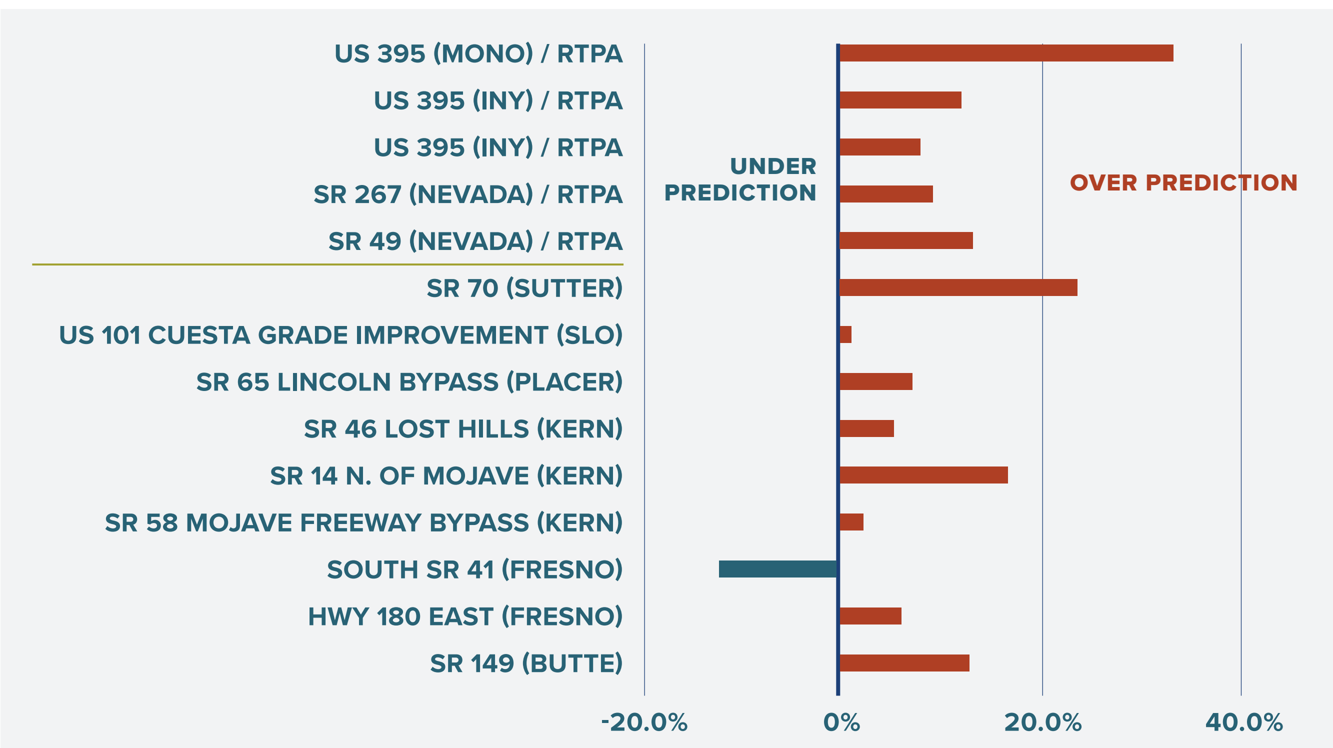


FIGURE 7. NCST CALCULATOR + POPULATION GROWTH VMT VS. HPMS VMT – 10-YEAR ESTIMATE COMPARISON

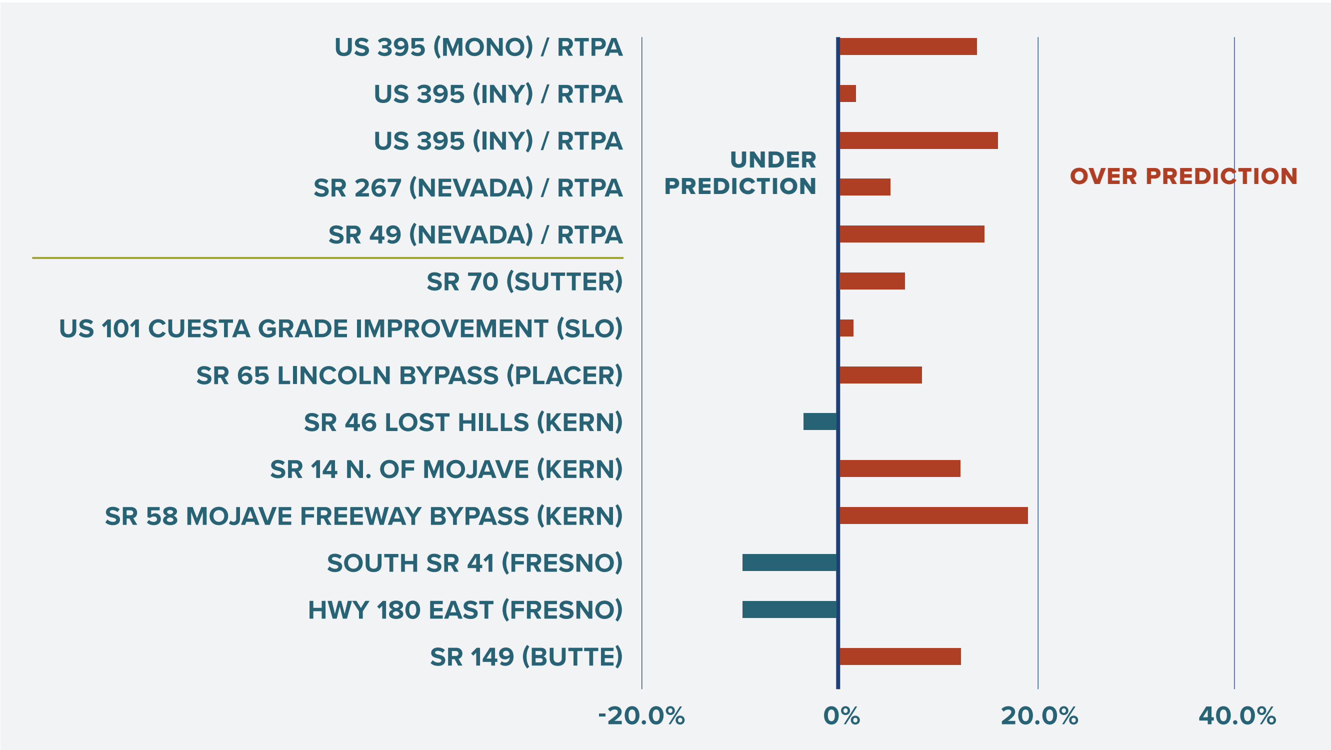
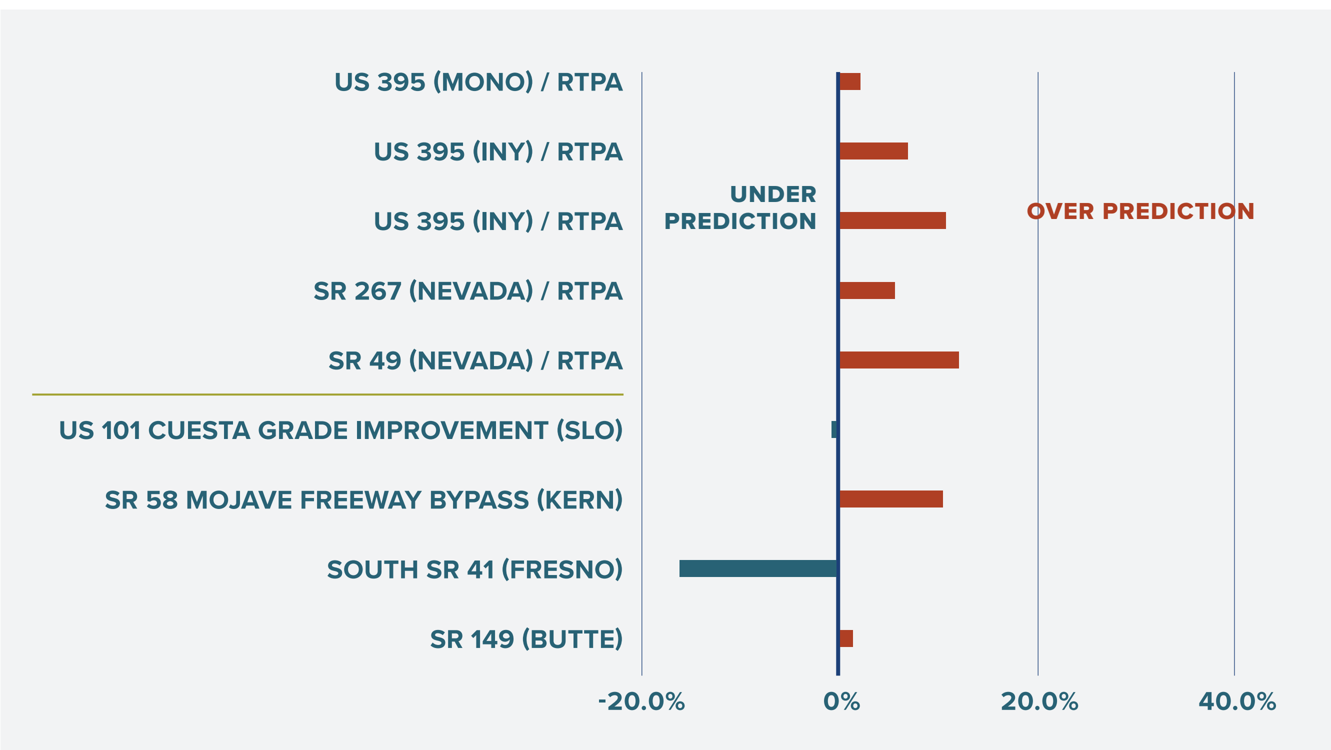


FIGURE 8. NCST CALCULATOR + POPULATION GROWTH VMT VS. HPMS VMT – 20-YEAR ESTIMATE COMPARISON



4.3. PROJECT SPECIFIC CASE STUDIES

Three of the 14 study projects were selected for a comprehensive examination with a focus on investigating the presence of congestion as a prerequisite condition. All three of these projects can be classified as "capacity expansion through widening." Each case study involves a before and after examination and makes findings on the underlying causal factors for VMT growth. These case studies underscore the need for the knowledge of local conditions to contextualize the findings from the Calculator, as noted in the documentation provided by the developers of the NCST Induced Demand Calculator. Lastly, two socio-economic exogenous factors affecting VMT growth in California are described.

CASE STUDY 1: US 395 INYO COUNTY

One expansion project where the Calculator came within two percent of the actual VMT with an assumed elasticity value of 0.75 is the US 395 widening (Project 7C) in Inyo County, completed in 2008. While the widening may have contributed to some induced demand, a careful review of the context points toward the major expansion of Broadband internet delivered by the CPUC's (California Public Utilities Commission) Digital 395 project as the most probable reason for the increase in residential and non-residential development and resulting VMT. Going as far back as 2001, the Inyo County General Plan called out the need for high-speed internet in the County as a necessary step to allow new development and business expansion in the County[1].

To address this need, the Digital 395 project was conceived in 2009 and completed in 2014 by the CPUC[2]. Since the completion of Digital 395, there has been a significant expansion in Broadband internet service, with 92.6 percent of households in the County currently served by broadband, up from close to zero households back in 2008 (when the highway expansion was completed). The VMT over-estimation in the three-year analysis (more than 10 percent) vs. the 10-year and timing of completion for the Digital 395 project (2014) is also consistent with the Digital 395 project being the major driver for new development and resulting VMT growth rather than the roadway expansion.

Overall, the results from projects in the non-MSA RTPA regions are consistent with the documentation provided as Frequently Asked Questions for the NCST's Calculator website, which state that "Calculator remains limited to use in California's 37 urbanized counties (counties within MSAs), since urbanized counties, urbanized areas, and MSAs were the units of observation and analysis used in the most relevant studies." The documentation provided with the Calculator based on Volker and Handy[3], along with the analysis presented in this report, makes it clear that the Calculator should not be used to estimate induced VMT outside of the 37 counties in the state that are served by an MSA. This is reconfirmed by the NCST calculator overestimation of all projects located in the non-MSA RTPA region.

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1 GP Goals and Policy Report 12.2001.Pdf. Inyo County USA. https://www.inyocounty.us/sites/default/files/2020 -02/GP%20Goals%20and%20Policy%20Report%2012.2001.pdf. Accessed Feb. 12, 2024.

2 California Broadband Cooperative. http://www.cbccoop.com. Accessed Feb. 12, 2024.

3 Volker, J., and S. L. Handy. Updating the Induced Travel Calculator. 2022.

CASE STUDY 2: SR 41 SOUTH FRESNO COUNTY

Among the segments expanded from two lanes to four lanes, South SR 41 between Manning Avenue and Conejo Avenue is the only project where the Calculator consistently under-predicted the VMT increase over every time horizon. The project is part of the SR 41 corridor that connects the Naval Air Station (NAS) in Lemoore (Kings County, California) to the Fresno metropolitan area. The roadway expansion project was completed in 1999, and its completion almost coincided perfectly with the major expansion of the Naval Air Station in Lemoore. The Lemoore NAS was selected in July 1998 as the West Coast site for the F/A-18E/F Super Hornet strike-fighter aircraft, and the selection brought approximately 92 additional aircraft, 1,850 additional active-duty personnel, and 3,000 family members to NAS Lemoore over the subsequent years. The NAS also became home to four new fleet squadrons between 2001 and 2004[1].

Also, in 1994 the Santa Rosa Rancheria Tachi Yokut Tribe added slot machines at the Palace Indian Gaming Center just outside of Lemoore, which grew to 385 slots by 1997. In 2005, a major expansion was opened, and it was renamed as Tachi Palace. The following year, a seven-story, 255-room hotel was opened on the property. Employment grew to approximately 5,000 employees with the expansion.

These growth impacts may be seen in the total employment figures for the Kings County, CA employment data series shown as a 12-month moving average in **Figure 9**. There is a steep rise in employment starting in January 2000, coinciding with expansion at the NAS. The expansion of the NAS was certainly a strategic decision by the Navy. Similarly, the expansion of the Tachi Palace was also planned/inevitable. Hence neither must not be misconstrued as a development 'induced' by the South SR 41 expansion.

FIGURE 9. 12-MONTH MOVING AVERAGE EMPLOYMENT DATA SERIES FOR KINGS COUNTY[2]

1 NAS Lemoore Economic Impact. Navy.mil. https://cnrsw.cnic.navy.mil/Portals/84/NAS_Lemoore/Documents/NAS%20Lemoore%20Econ%20Brochure_E.pdf?ver=ojBwgOTy7bWxqOU9VgYdUw%3D%3D. Accessed Feb. 7, 2024.

2 Timelines Explorer - Data Commons. https://www.datacommons.org/tools/timeline#&place=geoId/06031&statsVar=Count_Person_Employed. Accessed Feb. 12, 2024.

It should also be noted that the expansion of the NAS Lemoore base coincided with the closure of the NAS Alameda base. Anecdotally, those closures resulted in lower traffic in Alameda (access routes to Alameda Island) during that time. This is an example of an issue raised earlier in the literature review that a shift in population and/or employment across jurisdictional boundaries should not be considered induced demand.

CASE STUDY 3: US 101 CUESTA GRADE

US 101 in San Luis Obispo County is one of the only rural routes where actual VMT matched closely with the NCST calculator's estimate of the expected VMT due to the addition of truck climbing lanes on Cuesta grade. The US 101 route where the truck climbing lanes were added connects the City of San Luis Obispo (the county seat) with the relatively sizeable northern communities of Atascadero and the burgeoning wine country of Paso Robles. The City of San Luis Obispo, in addition to being the county seat, is also home to large trip generators in the region, including the flagship CSU (California State University) campus (Cal Poly) and California Men's Colony prison. In the regional context, these north County cities (Atascadero and Paso Robles) function as bedroom communities to San Luis Obispo. This regional context may cause the VMT to rise following a capacity expansion on the only route connecting these bedroom communities with the Central Business District (CBD).

At the same time, there were other confounding factors that may cause VMT growth. For example, Cal Poly's enrollment increased 18.6 percent between 1998 and 2008 and 33.8 percent between 1998 and 2018[1]. Furthermore, the north county cities of Atascadero and Paso Robles were experiencing population growth above the county's growth even prior to the addition of the truck climbing lane. Housing stock data from the 1990s compared to the 2000s shows that North County cities (Atascadero and Paso Robles) saw a growth of 57.2 percent, while the City of San Luis Obispo observed a decline of 23.8 percent in their respective housing stock. The decline in the amount of housing being built in the City of San Luis Obispo resulted in median housing price growth of 84 percent from an already higher base, and the price increase was higher in percentage terms than both North County cities (~78 percent). While identifying the relative contribution of housing stock growth in the three

1 #Enrollment 15-Year Profile. Institutional Research. https://ir.calpoly.edu/enrollment-15-year-profile. Accessed Feb. 12, 2024.

cities on increased VMT is beyond the scope of this work, it does indicate that a significant amount of the VMT growth may be countered by pro-housing policies.

Truck climbing lanes are identified as a very effective crash safety countermeasure that reduces crashes by up to 43 percent (Crash Modification Factor (CMF) 0.57)[1]. The estimate is based on Haq et al.[2], and the study had a statistically rigorous safety evaluation process (based on its 4-star rating by the CMF Clearinghouse)[3]. This tradeoff between the "potential" for induced VMT or addressing a safety need through capacity expansion is being played out in many places in California. Should agencies forgo projects of such high safety benefits, especially since there may be other ways to mitigate VMT growth (in this example, through pro-housing policies near CBDs served by rural routes). On that front, it is a positive sign that, as of 2024, San Luis Obispo is recognized by the state of California as a pro-housing city[4].

CASE STUDY SUMMARY

In general, the findings from this analysis are consistent with how the NCST Induced Travel Calculator is intended to be used. The FAQs for the Calculator note that it is NOT intended to be used outside of the 37 California counties part of the MSAs.

Even on rural routes that fall within MSAs, it appears that the Calculator significantly overestimates the VMT increases in general.

In such cases, a careful review of context becomes critical. In areas where central business districts and bedroom communities are connected by rural routes, there may be a potential for a long-term induced effect. However, jobs-housing imbalances, geographically disparate housing markets and home prices and/or other exogenous factors including military base or university expansions are the actual drivers to increased travel demand.

Also, two examples of exogenous socioeconomic factors currently influencing VMT change in California include: Expansion of Indian Gaming in California; and Emergence of Transportation Network Companies (TNCs). The expansion of Indian gaming over the last 25 years is particularly applicable to rural areas of the State whereas the emergence of Transportation Network Companies like Uber and Lyft is most applicable to metropolitan areas.

EXPANSION OF INDIAN GAMING IN CALIFORNIA

Indian gaming in California significantly impacts VMT within the state due to the popularity and geographical distribution of casinos operated by Native American tribes. These gaming establishments serve as major attractions, drawing visitors from various regions, including urban centers and out-of-state areas. The attraction of casinos, coupled with the increased travel distances to rural and suburban areas where

1 CMF Clearinghouse. https://www.cmfclearinghouse.org/detail.php?facid=10074. Accessed Feb. 12, 2024.

2 Haq, M. T., M. Zlatkovic, and K. Ksaibati. Evaluating Safety Effectiveness of Truck Climbing Lanes Using Cross-Sectional Analysis and Propensity Score Models. Transportation Research Record: Journal of the Transportation Research Board, Vol. 2673, No. 7, 2019, pp. 662–672. https://doi.org/10.1177/0361198119847987.

3 CMF Clearinghouse. https://www.cmfclearinghouse.org/score_details.php?facid=10074. Accessed Feb. 12, 2024.

4 City News Center | City of San Luis Obispo, CA. https://www.slocity.org/Home/Components/News/News/10311/2359. Accessed Feb. 12, 2024.

many casinos are located, can lead to an increase in VMT. Conversely, the presence of more casino locations within California can reduce long-distance travel within the state and to neighboring states (i.e., Nevada).

A study[1] by the University of Nevada emphasizes the profound economic and social changes brought about by Indian gaming on reservations in California. While VMT is not the direct focus of this study, it highlights the broader impact of Indian gaming beyond its economic effects, illustrating its role in reshaping travel behaviors and mobility patterns in California. Another study[2] examines the economic and competitive effects of tribal casinos in California on Nevada's gaming industry. The expansion of tribal casinos in California starting in the 1990's has led to a significant shift in travel and gaming patterns. The study found that the accessibility of these tribal casinos has reduced the need for Californians to travel to Nevada, resulting in fewer long-distance trips but more regional trips within California, thereby contributing to higher VMT within the state. These casinos not only draw local visitors but also attract tourists from neighboring states, increasing travel distances and frequencies.

EMERGENCE OF TRANSPORTATION NETWORK COMPANIES

The emergence of Transportation Network Companies like Uber and Lyft has drastically transformed urban mobility by offering users greater convenience and flexibility. An Empirical Bayes approach study[3] examined the changes in VMT in Atlanta, estimating the impact of TNC operations on travel demand by comparing VMT changes to a hypothetical scenario without TNCs. The study indicates that TNC activity promotes VMT growth, challenging the expected benefits of TNCs in reducing car ownership and overall vehicle use through improved shared mobility. Based on a study performed by Fehr & Peers[4] revealed that in September 2018, TNCs accounted for approximately two and three percent of total VMT in Los Angeles and San Francisco regions respectively. When looking solely at the core county (Los Angeles County and San Francisco County), the share of TNC VMT is approximately three and 13 percent respectively. These findings reveal that TNCs contribute to higher VMT and greenhouse gas emissions, mainly due to deadheading and additional trips that would not have occurred without TNC services. Furthermore, TNCs have been found to decrease public transit usage, as some users opt for the convenience of TNCs over public transportation and non-motorized modes like walking and biking.

These are two just examples of exogenous socioeconomic factors that can have a significant influence on VMT change in California irrespective of roadway capacity expansion. Academic studies on induced demand would need to control for these factors or their residual effects could be misinterpreted as "induced" demand.

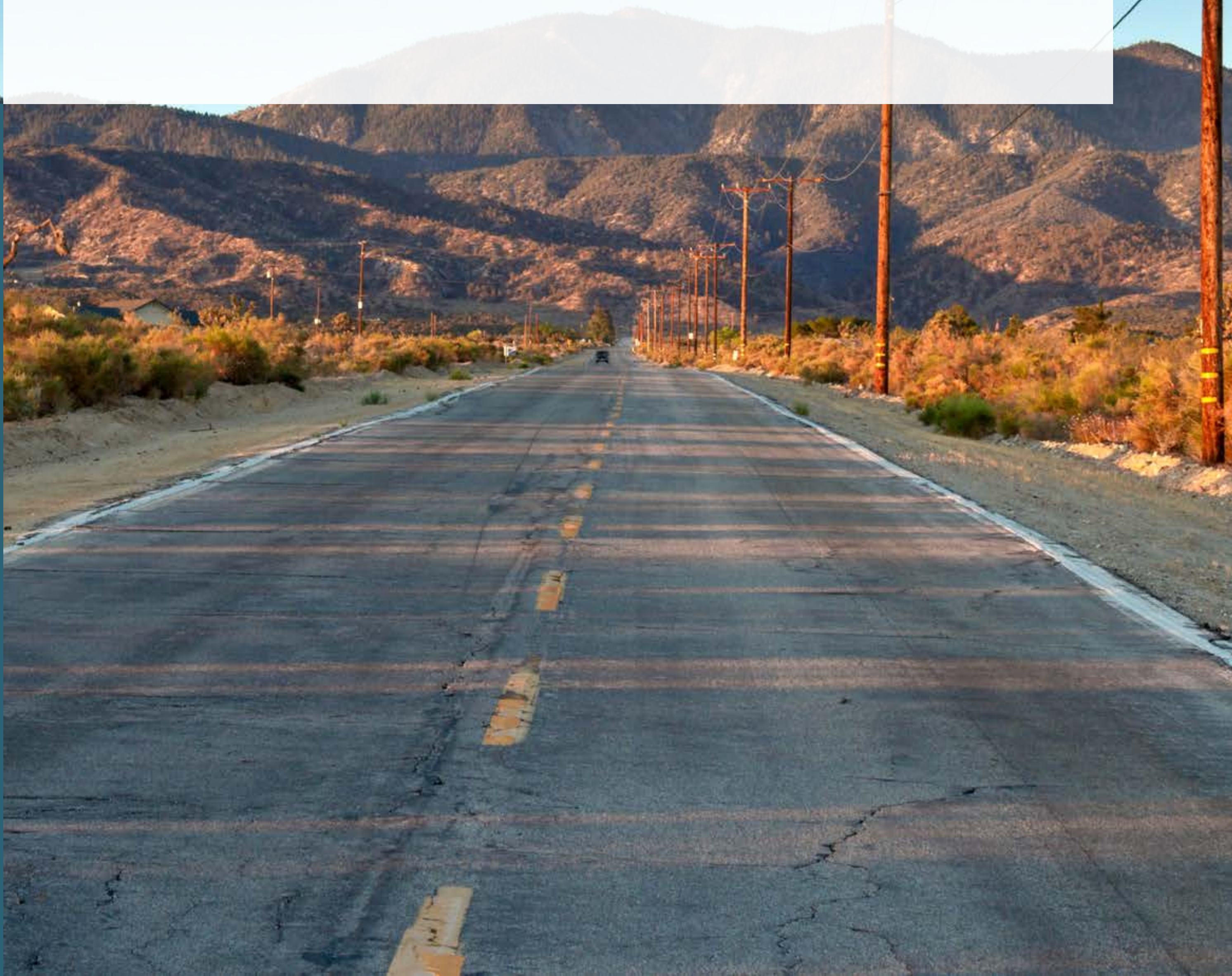
1 Randall A., Katherine S., Jonathan B. T., Social and Economic Changes on American Indian Reservations in California: an Examination of Twenty Years of Tribal Government Gaming, 2014

2 William R. E., Richard H. W., Derek G., Estimating the Impact of California Tribal Gaming on Demand for Casino Gaming in Nevada, 2010

3 Choi Y., Guhathakurta S., Pande A., An empirical Bayes approach to quantifying the impact of transportation network companies (TNCs) operations on travel demand, 2022

4 https://www.fehrandpeers.com/what-are-tncs-share-of-vmt/

5 >
TECHNICAL GUIDANCE



5.0. TECHNICAL GUIDANCE

This section reviews current recommended methods to estimate induced VMT and provides recommendations and insights to assist practitioners and decision-makers in assessing the induced travel resulting from transportation capacity-increasing projects. The guidance draws upon the in-depth literature review and sensitivity testing performed in the earlier section.

5.1. CURRENT METHODS TO ASSESS INDUCED VMT

The Caltrans' TAF provides two approaches to assess the induced VMT attributable to a capacity-increasing state highway project: an aggregate elasticity approach using the NCST Calculator and applying a regional or local area travel demand model. Both the calculator and the travel demand models have strengths and limitations when estimating induced VMT depending on the specific corridor under analysis. Therefore, the reviewer needs to consider both the corridor context and analysis limitations when using VMT forecasts from either method.

The NCST Calculator elasticities rely solely on the addition of lane miles and are not sensitive to location-specific factors and the unique travel characteristics of a given project area. As such they do not account for the land use context, existing congestion/bottlenecks, improvements providing shorter travel routes, and geographic constraints.

Three validation procedures were considered during the development of the NCST Calculator. This included a simple comparison of VMT in the relevant area (county or MSA) before and after (e.g., 10 years after) a major capacity expansion project using HPMS data (similar to the sensitivity method performed as part of this study), a difference-in-differences analysis using facility level traffic flow data, and an interrupted time series technique using facility level traffic flow data. Ultimately, none of the three validation approaches were performed based on concerns over data issues, or the lack thereof, and technical challenges.

The NCST Calculator uses an elasticity of 1.0 for Class I facilities. Based on a review of the supporting research[1], components of the induced effect can be classified into four types of travel behavior responses, of which three can be stratified into either a Short-Term (i.e., capacity improvement elicits an immediate behavioral response) or Long-Term (i.e., full response takes three to 20 years to fully play out) induced effect. These are summarized below.

COMPONENTS OF INDUCED DEMAND

CHANGES IN COMMERCIAL DRIVING	= 19 to 29%
CHANGES IN INDIVIDUAL OR HOUSEHOLD DRIVING (SHORT-TERM EFFECT)	= 09 to 39%
DIVERSION OF TRAFFIC (SHORT-TERM EFFECT)	= 00 to 10%
CHANGES IN POPULATION – GROWTH AND MIGRATION (LONG-TERM EFFECT)	= 05 to 21%

Travel demand models are specifically built to reflect the local context of a given area. This includes roadway network detail and roadway attributes (functional classification, number of lanes, capacity) as well as parcel level land use data and land use projections that are based on the latest planning assumptions and economic and demographic

1 Duranton, G., & M. A. Turner (2011).

forecasts of the area. Travel demand models are developed to be sensitive to trip-making behavior in response to changes in accessibility, travel times, and other cost impedances. As such, travel demand models are sensitive to the short-term effects of highway capacity-increasing projects and account for VMT changes resulting from diversion (diversion from other facilities[1], diversion from other modes, consolidation of trips) and the induced VMT caused by a change in origin-destination and trip lengths due to changes in accessibility/travel time (i.e., accessibility improvements that result in travel time reductions allow a given motorist to travel longer distances while maintaining their overall all travel costs). The use of a calibrated/validated 4-step or activity-based travel demand model is more appropriate for capturing these short-term induced demand effects[2] for a given project or program of projects. In fact, care must be taken to ensure that these effects are not double-counted if a travel demand model is used in conjunction with an elasticity-based method like the NCST Calculator. Conversely, most travel demand models do not include a feedback mechanism to the regional land use allocation process. As such, changes in accessibility resulting from network changes (i.e., capacity improvements), would not exact a change in land use. For example, a constrained corridor with worsening accessibility characteristics may result in a long-term private/public market response that otherwise would differ if the corridor operations were improved. Hence, travel demand models in themselves do not explicitly have the ability to capture the long-term induced effect, which based on NCST research, constitutes up to a maximum of 21 percent of the 1.0 elasticity. The lack of land use response to the individual project network changes may result in the model not capturing the expected induced travel due to potential changes in land-use allocations over the planning horizon.

5.1.1. TRAVEL DEMAND MODELS

Travel demand models are specifically built to reflect the local context of a given area or region. This includes travel demand characteristics (via household travel surveys and other locally generated data), roadway network and roadway attributes (functional classification, number of lanes, capacity) as well as parcel level land use data and land use projections that are based on the latest planning assumptions and economic and demographic forecasts of the area. Travel demand models are also held to a high standard of use when applied for federal or state funded or mandated planning purposes. Before being applied, travel demand models must demonstrate that they meet established federal/state calibration/ validation criteria. Several travel demand model application topics that relate to induced VMT are described below.

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1 Motorist choice of alternative routes to avoid congestion may be on routes with shorter travel times but require longer distances to travel. Improvements to roadways of a higher functional classification (i.e., state highway facilities) that reduce travel times relative to available non-state parallel routes will invariably attract these trips back onto the primary facility which will lower VMT. New roadway connections such as a river bridge can also significantly lower VMT by establishing are more direct route for travelers who would make the trip regardless of the improvement, or conversely, increase VMT by tapping into latent demand caused by the congested bridge. Given that these effects can work both ways, a more plausible/defensible induced demand range for diversion of traffic would be -10 to 10 percent rather than 0 to 10 percent.

2 3-step travel demand models capture all the short-term induced effect of 4-step models less diversion to other modes (reflected as part of: Changes in Individual or Household Driving). Given that transit service and service frequencies in rural areas are less than in urban areas and that choice ridership (those that would otherwise drive if not for transit service) is relatively less in rural areas than urban, application of a 3-step model in a relatively rural county/area does not introduce significant error to the travel forecasting process.

5.1.2. DYNAMIC TRAFFIC ASSIGNMENT

Travel demand models typically employ static traffic assignment procedures when assigning trips onto the model roadway network. Travel models use aggregate link-level travel time information over a few time-of-day periods to assign traffic. This results in every vehicle traveling over the same set of links within a particular period. Although volume-to-speed curves (i.e., BPR curves) specific to link type (i.e., functional classification) are applied for static assignments, these can only affect the pathing/routing of trips when meeting a given origin-destination (O-D) pair. Ultimately, all O-D pairs must be satisfied, which may result in some links (i.e., roadways) experiencing a volume/capacity ratio greater than 1.0. This may result in an overestimation of the degree of future year congestion as many motorists would vary their departure times to avoid congested peak periods. This might exaggerate the estimated operational benefits of a capacity increasing project. Conversely, dynamic traffic assignment utilizes finer demand slices (such as 15 minutes) and a shortest path algorithm (travel time, delay) to accommodate route changes and varying times of departure to avoid congestion. It reflects realistic traveler behaviors such as time of departure and route selection. However, the use of dynamic traffic assignment will have a negligible impact on daily VMT estimation given that the temporal changes in trip making (i.e., from peak to the off-peak periods) will not result in a change in total number of daily trips.

5.1.3. VMT BENCHMARKING

The Caltrans TAF guidance suggests if the induced VMT estimate from a travel demand model is within 20 percent of the NCST Calculator estimate, the travel demand model estimates can be used for CEQA purposes. If the travel demand model induced VMT estimate differs by more than 20 percent relative to the NCST Calculator, the NCST Calculator should be either be used exclusively or be used to benchmark the travel demand model.

Benchmarking is the process of modifying the travel demand model's inputs (i.e., land use inputs) to generate induced VMT results that come within 20 percent of NCST Calculator estimate. This is done by adding "hypothetical" land use in order to increase model vehicle's trips (and therefore VMT) along the improved corridor. Select link analysis is used to identify the origin and destination zones that would generate trips that would be assigned to the improved facility/corridor. Additional land use is then incrementally (and artificially) added to the origin and/or destination zones until the model achieves the target-induced VMT.

Benchmarking is concerning given the questionable modeling practice of arbitrarily adding land use inputs to zones that are inconsistent with the local jurisdiction's General Plan or the regional RTP/SCS land use to generate a pre-conceived outcome. It is also concerning to artificially "jerry rig" a calibrated/validated model that reflects the local context in order to emulate the results of a non-calibrated/validated aggregate elasticity-based tool devoid of local context. Benchmarking also introduces the potential for double counting of the short-term induced demand responses. Given that a calibrated/validated travel demand model can effectively capture the short-term induced effects, which constitute approximately 50 percent of the 1.0 elasticity for Class I facilities, the within 20 percent tolerance threshold for triggering the need for benchmarking appears too stringent – particularly if these are superior to the aggregate elasticity-based method for accurately estimating induced VMT.

5.1.4. CALTRANS TAF MODEL CHECK LIST

The TAF provides a checklist for evaluating the adequacy of travel demand models for estimating induced travel related to state highway facilities. This list does not differentiate between short-term or long-term induced effects as applicable to desired/recommended modeling features. For instance, travel demand models that meet the calibration/validation criteria documented in the 2024 Regional Transportation Plan Guidelines for Metropolitan Planning Organizations (CTC, January 2024) and Regional Transportation Planning Agencies (CTC, January 2024) respectively are capable of capturing the short-term induced effects resulting from new roadway capacity and can be applied for that purpose (see also Section 5.3).

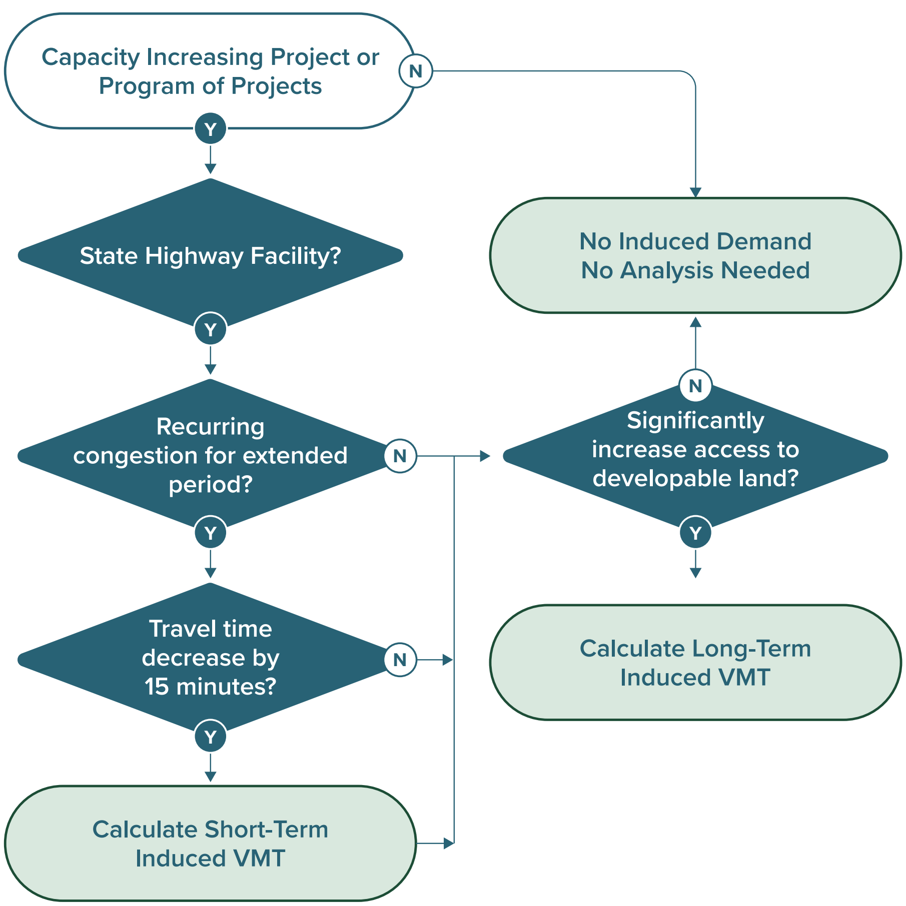
As stated in the previous section, travel demand models cannot explicitly capture the long-term induced effect. The TAF checklist, which includes the requirement of land use response to network changes (i.e., a feedback mechanism between the travel model and a land use allocation model) only applies to this long-term induced increment which based on NCST research constitutes 21% of the elasticity of 1.0. This suggests that combining travel demand model and aggregate elasticity-based tools may be more appropriate when a long-term induced effect is at play. Use of hybrid approaches are described in Section 5.3.

5.2. INDUCED VMT SCREENING CRITERION

Based on the research presented earlier in the document, it is clear that not all lane miles are created equal. In other words, lane mile additions do not automatically result in induced VMT. This is particularly plausible in rural areas where many of the key factors that need to be present if an induced effect is even possible generally do not exist. The induced demand effect is dependent on various factors – the most significant being the presence of significant recurring congestion on the corridor (i.e., latent demand), travel behavior dynamics, availability of developable land, and other factors. Understanding these complexities is essential for screening projects susceptible to induced VMT. **Figure 10** presents a proposed screening criterion for determining when an induced VMT analysis is warranted[1].

If a project or program of improvements cannot be screened from having to perform an induced VMT analysis, the following section provides recommendations to more appropriately apply the NCST Calculator (or any aggregate elasticity approach).

FIGURE 10. INDUCED VMT SCREENING CRITERION



1 Other important considerations should also include whether the project results in approved development or if the project will result in a diversion that reduce VMT rather than increasing it.

5.3. RECOMMENDED APPROACHES TO ADDRESS INDUCED DEMAND

The literature notes a critical consideration regarding Caltrans's existing methodology for estimating induced VMT, emphasizing its potential unsuitability for rural counties. The literature suggests that any assessment of potential VMT in rural areas should account for factors influencing travel behavior, such as travel time/congestion and the specific land use context, indicating the need for a more nuanced and context-sensitive approach. This statement should be broadened to all areas – rural and urban but is most prevalent for rural areas.

Travel demand models are built upon actual and planned land use, existing roadway network, and local/regional travel characteristics (i.e., household surveys) ostensibly calibrated/validated to state/ national criteria governing the use of travel demand models. Travel demand models are specifically designed to capture the short-term induced effect associated with changes in accessibility (i.e. added network capacity). Given their greater comprehensiveness and technical veracity, travel demand models should be considered superior to one-variable aggregate elasticity-based methods for estimating short-term induced demand.

Hybrid approaches that apply both a travel demand model and an elasticity-based method have been proposed. Hybrid approaches attempt to match the appropriate analytical method depending on the type of induced VMT effect anticipated (short-term, long-term, or both). The analysis approach will depend on the modeling capabilities available. Hybrid methods have been explored in the paper "Balancing Congestion Relief and Induced VMT."[1]

The premise of any hybrid approach is that a well-calibrated/validated travel demand model is capable of capturing short-term induced demand resulting from increased roadway capacity. Recent research from the University of Kentucky reinforces the applicability of travel demand models in estimating short-term induced VMT. As shown in **Figure 11**, models developed and applied in the 1980s were less effective at forecasting VMT than models applied since 2005. This may be the result of advancements in travel modeling (i.e., the use of activity-based constructs and/or more robust data inputs) and/or land use being more regulated (i.e., allowing future land use growth patterns to be better understood/predictable). The figure illustrates that since 2008 travel demand model forecasts on average are doing a better job emulating if not slightly over-predicting actual ground-truth VMT growth (and any short-term induced effect that may be contributing to that growth).

Hence, assuming the availability of a validated travel demand model, the following hybrid approach is proposed. This approach is designed to be used in conjunction with the screening process shown in **Figure 10**.

- **Areas with 4-step or Activity-Based Travel Demand Models**
  - » Use travel demand model to estimate short-term induced effect (less commercial truck component)
  - » If the long-term induced effect is applicable, use a maximum induced elasticity of 0.21[2].
  - » If no long-term induced effect is anticipated, no adjustment is needed.

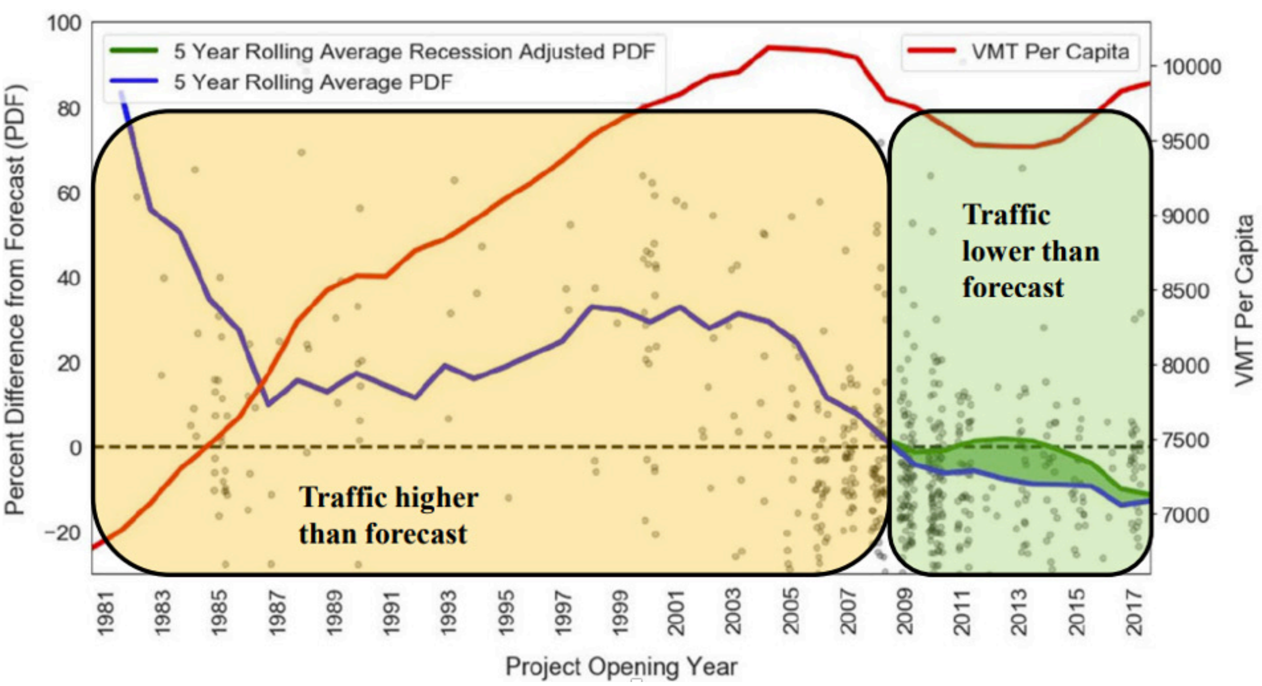
1 Milam, Walters, Gill, 2022

2 Source: NCST Calculator – high end of the long-term effect "Changes in Population" component.

- **Areas with 3-step Travel Demand Models**
  - » Use travel demand model to estimate short-term induced effect (less commercial traffic component)
  - » If the short-term induced effect is applicable, use a maximum induced elasticity of 0.09[1].
  - » If the long-term induced effect is applicable, use a maximum induced elasticity of 0.21[2] (urban area).
  - » If no long-term induced effect is anticipated, no adjustment is needed.
- **Areas with Land Use Allocation model with validated feedback mechanics[3]**
  - » No adjustments are needed for long-term induced effects.
- **Areas with no travel demand model (statistical trends, statewide model, big data)**
  - » Apply qualitative analysis tools.

Note that this approach is indifferent to area type and should be applied regardless of area type, whether urban or rural. However, it is applicable to rural or urban areas within an MPO region only. Rural counties outside of MPO should not use the NCST Calculator consistent with Caltrans' TAF.

FIGURE 11. TRAVEL DEMAND MODELS ESTIMATING SHORT-TERM INDUCED VMT



Source: Hoque, et al. The Changing Accuracy of Traffic Forecasts. Transportation, 2021.

1 Given that 3-Step models cannot reflect mode shift from transit to driving, this elasticity reflects the low-end elasticity response of "Changes in individual or household driving" (0.9).

2 Source: NCST Calculator – high end of the long-term effect "Changes in Population" component.

3 Dynamic validation: to demonstrate that the land use allocation process is sensitive to changes in accessibility

5.4. TRAVEL MODEL VALIDATION REQUIREMENTS

To ensure the reliability of a travel demand model in forecasting traffic, it must undergo thorough validation to closely replicate existing traffic patterns in the region. This validation process entails comparing the model's output with observed data and necessary adjustments to the model parameters (calibration) until the outputs fall within an acceptable range of error. The Caltrans 2024 Regional Transportation Planning RTP Guidelines provide recommendations on travel demand model quality control and consistency. The guidance includes static validation and dynamic validation (model sensitivity) criteria to check the model's predictive capabilities before it is used to generate forecasts. The static validation checks recommended in the RTP guidelines are presented in **Table 5**.

In addition, the validation criterion recommended in the Caltrans RTP guidelines, the Travel Model Validation and Reasonability Checking Manual (FHWA 2010b), recommends additional checks, including screenline/cutline checks and VMT by functional class and Annual Average Daily Traffic (AADT). The VMT metric is important for validating transportation models as it serves as a key indicator of the accuracy and reliability of the model's predictions. VMT is also utilized for environmental impact assessment, policy development, and assessing and mitigating the impacts of transportation projects, funding allocation, and potential gas-tax revenues. As such, it should be included in the model validation process. However, VMT validation should only be applicable to agencies that can generate boundary-based countywide VMT estimates (to match the countywide VMT HPMS estimate) and that have 90-10 HPMS sample precision level (i.e., Federal non-attainment areas of the National Ambient Air Quality Standards classified as Serious or above). Modeled regional baseline VMT should generally be within three percent (plus or minus) of the observed regional VMT estimate.

The TAF Guidelines recognize modeling processes that include a travel demand model with direct feedback to a land use allocation model for estimating long-term induced demand. As such, the Caltrans RTP guidelines should be amended to include guidance on dynamic validation methods that, if applied, adequately demonstrate the modeling process is appropriately sensitive to generate differing development patterns as a result of changes in accessibility.

TABLE 5. RECOMMENDED STATIC AND DYNAMIC VALIDATION CRITERION

VALIDATION METRIC	THRESHOLDS
PERCENT OF LINKS WITH VOLUME-TO-COUNT RATIOS WITHIN CALTRANS DEVIATION ALLOWANCE	At Least 75%
CORRELATION COEFFICIENT	At Least 0.88
PERCENT ROOT MEAN SQUARED ERROR (RMSE)	Below 40%
DIFFERENCE BETWEEN ACTUAL COUNTS TO MODEL RESULTS FOR A GIVEN YEAR BY ROUTE GROUP (E.G., LOCAL BUS, EXPRESS BUS, ETC.)	+/- 20%
DIFFERENCE BETWEEN ACTUAL COUNTS TO MODEL RESULTS FOR A GIVEN YEAR BY TRANSIT MODE (E.G., LIGHT RAIL, BUS, ETC.)	+/- 10%

5.5. RECOMMENDED CHANGES TO THE NCST CALCULATOR

Caltrans has provided further guidance that induced demand associated with goods movement (i.e., commercial truck activity) should not be reflected in any SB 743 or SB 375 analysis of induced demand[1]. Given findings from the literature review of this study, it is also recommended that if a validated travel demand model is available, the short-term induced demand will likely be double counted if used in conjunction with the NCST Calculator. Given these issues, it is recommended that a more flexible user interface be developed for the NCST Calculator that allows the analyst to determine which induced demand effects and elasticities should apply for a given analysis.

Additionally, Research Report 717, "Assessing Induced Road Traffic Demand in New Zealand," (a study that employs the same foundational research[2] as the NCST Calculator to calculate induced VMT), emphasizes that causal factors vary based on the project context, often resulting in elasticity values less than 1.0. The report underscores the substantial impact of incorporating roadway volumes, changes in travel time due to the project, and the potential for traffic diversion on induced demand.

This research considers estimating induced VMT due to new lane additions but also warns of several limitations. The generalized assumption can lead to biases due to regional variability and changes over time. The tool accounts for user input on travel costs (a generalized cost that combines travel time and vehicle costs) changes, as well as diverted traffic/latent demand, to estimate the induced VMT for a given roadway expansion project. The tool also cautions that utilizing an elasticity-based approach is more suitable for program-level rather than project-specific evaluations.

The following steps are recommended for improving the applicability of the NCST tool:

- **Flexible Interface:** Develop a more interactive user interface that allows the analyst to input which induced demand effects and elasticity values are appropriate for a given analysis context.
- **Context-Specific Elasticities:** Develop a more nuanced approach that incorporates context-specific elasticity values. To improve accuracy, recognize regional variations and project-specific conditions.
- **Incorporate Travel Time Changes:** Enhance the tool to factor in changes in travel time/cost more explicitly. Consider using analytical tools (demand or simulation models) that can capture the impact of travel time reductions or increases due to the project.
- **Account for Latent Demand:** Improve the estimation of latent demand by including more detailed data on potential users who are not currently traveling due to existing congestion (Origin-Destination analysis—big data or demand models).
- **Validation and Calibration:** Regularly validate and calibrate the tool against real-world data and outcomes from completed projects. This will help ensure that the tool remains accurate and reliable over time.

By implementing these recommendations, the NCST Calculator can provide more contextually relevant estimates of induced VMT, although the use of an elasticity-based approach should be limited to a program-level evaluation whenever possible.

1 https://dot.ca.gov/programs/esta/sb-743/resources/ncst-truck-adjustment

2 Duranton, G., & M. A. Turner (2011).

6> CONCLUSION

6.0. CONCLUSION

Caltrans adopted VMT as the primary metric for evaluating transportation impacts on the SHS in response to SB 743 and OPR guidance. The guidelines emphasize assessing induced travel effects, yet tools and guidelines may not suit rural contexts, potentially hindering rural project competitiveness for state funding. In many rural highway corridors, congestion isn't a significant issue, with no latent demand present. Consequently, the focus of rural improvements tends to prioritize safety, operational efficiency, goods movement, and evacuation preparedness rather than congestion relief.

Based on the evidence presented in the literature review, aggregate elasticity-based approaches, particularly those that rely solely on lane-mile addition (e.g., the NCST Calculator), are inadequate for project-level induced VMT analysis. While lane-mile additions may serve as a proxy for travel time reductions in congested urban areas, the NCST Calculator does not adequately address projects in regions where changes in travel time and the presence of latent demand are not significantly present for induced demand to occur.

The literature review highlights shortcomings in current approaches to assessing induced demand, particularly in rural contexts, and emphasizes the importance of incorporating relevant findings into policymaking. The report highlights numerous relevant findings that haven't been incorporated into current guidance, which is essential for policymaking. Findings include recognizing that lane miles is an imperfect measure for travel time savings, as induced travel primarily results from reduced travel times rather than increased capacity. Moreover, regulatory guidance from entities like OPR and Caltrans lacks specificity for rural projects, leaving evaluation methods ambiguous. While various regulatory bodies acknowledge the importance of assessing induced VMT, there's a need for tailored methodologies and further research to address rural transportation challenges effectively.

Based on a comprehensive review of literature and research findings, a screening criterion has been developed to delineate the primary factors that must be met before considering performing an induced VMT analysis. The study recommends an approach for screening whether an induced effect is possible for a given roadway improvement project – regardless of area type – and further technical guidance for estimating induced VMT through a hybrid approach. These findings and recommendations strongly support the need to amend or revisit existing state guidance documents.

INDUCED DEMAND ANALYSIS RECOMMENDATIONS

Based on a comprehensive review of literature and research findings, the primary recommendations of this study are:

- Aggregate elasticity-based methods (like the NCST Calculator) should be used with caution for CEQA Project Level Analysis (Rural, Suburban, or Urban). The use of such methods for project-level analysis is not supported by the literature and generally lacks the requisite context and specificity required for CEQA project-level analysis.
- Capacity-increasing projects that do not exhibit the following requisite conditions for an induced effect should not be analyzed for induced effects or penalized by grant funding scoring criteria, Caltrans CSIS criteria, or funding decisions by the CTC or other State agencies:
  - » Presence of significant congestion to generate latent demand;
  - » Potential to yield significant travel time savings (15 minutes or more per motorist); and
  - » Increases access to existing or future marketable/developable land (i.e., land not constrained by topography or regulation).
- For programmatic regional analyses (i.e., programmatic EIR's and SCS analyses), the application of the NCST Calculator and lane mile input variables should be predicated on whether the factors that cause induced demand resulting from capacity increases are present (per proposed screening presented in Figure 10 of the report), including the availability of a validated travel demand model.

RECOMMENDATIONS TO UPDATE STATE GUIDANCE DOCUMENTS

The study proposes a recommended approach for estimating induced VMT regardless of area type (rural or urban). These findings and recommendations strongly support the need to amend or revisit existing state guidance documents.

- The CAPTI should consider expanding the list of appropriate improvement projects to include rural area projects that are not deemed likely to induce VMT. This includes roadway capacity-increasing projects with societal co-benefits (e.g., greater accessibility to needed services and facilities, evacuation, etc.).
- Guidance in the California Regional Transportation Plan Guidelines for validating and calibrating regional travel demand models should be updated to be more sensitive to addressing induced VMT. The RTP Guidelines should include guidance regarding if and how the NCST Calculator should be used in conjunction with a travel demand model. The guidelines should also provide guidance for performing dynamic validation of modeling processes that include a feedback mechanism between the travel demand model and a land use allocation model.
- NCST Calculator benchmarking should not be a recommended practice.
- Lastly, the OPR CEQA SB 743 Implementation Guidance and Caltrans' TAF and TAC should also be amended to incorporate the findings and recommendations from this study.

RECOMMENDATIONS TO UPDATE NCST CALCULATOR

The following steps are recommended for improving the applicability of the NCST tool:

- **Flexible Interface:** Develop a more interactive user interface that allows the analyst to input which induced demand effects and elasticity values are appropriate for a given analysis context.
- **Context-Specific Elasticities:** Develop a more nuanced approach that incorporates context-specific elasticity values. To improve accuracy, recognize regional variations and project-specific conditions.
- **Incorporate Travel Time Changes:** Enhance the tool to factor in changes in travel time/cost more explicitly. Consider using analytical tools (demand or simulation models) that can capture the impact of travel time reductions or increases due to the project.
- **Account for Latent Demand:** Improve the estimation of latent demand by including more detailed data on potential users who are not currently traveling due to existing congestion (Origin-Destination analysis—big data or demand models).
- **Validation and Calibration:** Regularly validate and calibrate the tool against real-world data and outcomes from completed projects. This will help ensure that the tool remains accurate and reliable over time.

By implementing these recommendations, the NCST Calculator can provide more contextually relevant estimates of induced VMT, although the use of an elasticity-based approach should be limited to a program-level evaluation whenever possible.

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