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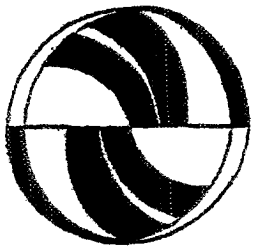

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Assessing the Need for Highways

Behind all debates over the adequacy of highway revenues lies the tricky issue of how much money states and the federal government *ought* to spend on highways. States and the federal government have historically tried to determine revenue needs with technical reports known as "needs assessments." These studies usually conclude with a dollar figure that represents the revenue required to bring all roads up to some set of maintenance and performance standards. Even though a great deal of careful technical analysis can go into needs analyses, most do not actually address the question of what total level of spending would be best. Needs assessments typically identify how much money would be required to meet certain standards or to build desired lists of projects, but generally do not address whether or not such standards or lists are optimal. Drawing on examples from California, this paper reviews the evolution of both highway needs studies and fluctuations in highway funding over the past half century We find, despite efforts to increase the rigor of highway needs analyses, needs studies are often simply "wish lists" of locally popular projects. In particular, cost-benefit analyses have long been proposed to improve the quality and rigor of needs assessments, but have been very slow to be adopted. While a cost-benefit approach to assessing highway needs would inevitably create winners and losers relative to current, engineering and *ad hoc*-oriented methods of assessing needs, such analyses would provide invaluable information to decision-makers in determining how to spend limited transportation resources most effectively and efficiently

". . . needs are an art statement and not necessarily a science statement . . ."

Mortimer L. Downey, Deputy Secretary
U. S. Department of Transportation (1994)

by Mary C. Hill, Brian D. Taylor, Asha Weinstein, and Martin Wachs

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Behind all debates over the adequacy of highway revenues lies the tricky issue of how much money states and the federal government *ought* to spend on highways In other words, what is the optimal or most desirable level of highway investment? The state of California, for example, is spending far less on highways than it used to, but that is not in and of itself proof that current spending levels should be increased. States and the federal government have historically tried to determine revenue needs with technical reports known as "needs assessments " These studies usually conclude with a dollar figure that represents the revenue required to bring all roads up to some set of maintenance and performance standards Even though a great deal of careful technical analysis can go into needs analyses, most do not actually address the question of what total level of spending would be best Thus, needs assessments typically identify how much money would be required to meet certain standards or to build desired lists of projects, but generally do not address whether or not such standards or lists are optimal

No matter how rigorously conducted, highway needs studies necessarily incorporate subjective assumptions and are as much a matter for public policy debate as they are supporting technical or financial analysis. In the narrowest sense, one could consider "needs" to be those projects that can be completed within the boundaries of current revenue sources. At the other end of the spectrum, "needs" might be defined as those projects that would bring all roads up to the highest engineering and performance standards, and completely eliminate congestion In practice, however, needs studies are almost always "wish lists" rather than objective statements of findings or fact.

In many states the debate over needs has been complicated by the lack of political consensus over the level of automobility that should be accommodated In particular, there is a widespread lack of consensus about the need to build additional road capacity. One position is that the state ought to build the infrastructure to accommodate personal vehicles as much as possible, because other modes are feasible alternatives in only a tiny minority of cases [1] Others argue that for environmental reasons the state should encourage increased use of public transit, ride-sharing, cycling, and walking—and that building substantial new road capacity runs counter to these objectives [2]

This paper examines the assessment of highway needs We begin by tracing the significant fluctuations in highway funding over the past half-century. We then describe and critique the evolution of highway needs studies While all states and the federal government have generated transportation-needs studies, there are no federal requirements on how the state studies are produced, so the methods vary widely. We then turn to a case study of the declining role of formal highway needs assessments in California Finally, we review the potential for cost-benefit analyses to improve needs assessments and make recommendations for improving the methods for determining and tracking highway needs

Changing Revenues, Changing Needs?

While the appropriate level of highway investment is subject to considerable debate, political, and hence financial commitment to highways has caused highway expenditures to vary significantly over the past half century. While overall highway revenues and expenditures have increased substantially over

the years, considering both the effects of inflation and dramatic increases in vehicle travel since 1960, the buying power of highway revenues has declined substantially For example, to restore the buying power of the motor fuels tax (the principle source of highway revenues) in constant dollar terms per vehicle mile of travel to the height of the highway building era, a 27 3¢ increase in the average current state impost would be needed That is, an average state fuel tax of nearly 48¢ per gallon would be required to account for both inflation and travel increases between 1960 and 1997. Similarly, the federal fuel tax would need to be raised by 26 9¢ to almost 45¢. The state of California would require an even larger increase of 29 9¢ in order to restore revenues to their 1960 level Table 1 shows the California state fuel tax rate, as well as the average state and federal fuel tax rates needed to restore revenues per vehicle mile traveled to their 1950, 1960, 1970, 1980, and 1990 levels

Although average state and federal fuel tax levies have been raised substantially over the years, inflation-adjusted and vehicle-travel-adjusted revenues are nowhere near previous levels. Taking into account both state and federal fuel taxes, drivers in the U.S currently pay much less per mile to drive than they did nearly four decades ago, though they rely today much more on the safety and accessibility of the roadways than they did in 1960 However, while highway revenues are lower in the late 1990s than in 1950, 1960, and 1970, the average driver contributes more to total federal and state fuel revenues today than in 1990 Such findings do not tell us whether the federal government or the states spend too much or too little on highways, only that far less is spent than in previous decades, but a bit more than a few years ago Do such fluctuations in revenues reflect fluctuations in highway needs? Probably not But since motor fuel tax revenues are gradually eroded by both inflation and increased

Table 1: Changes in Motor Fuels Taxes Needed in 1997 to Restore Inflation-Adjusted Revenues per Vehicle Mile of Travel to the Level of Prior Years

Year		*California*	*Average State*	*Federal*
1950	*1997 Fuel Tax Needed*	*43 0 cents*	*47 0 cents*	*19 6 cents*
	Increase Required	*+25 0 cents*	*+26 3 cents*	*+1 3 cents*
1960	*1997 Fuel Tax Needed*	*47 9 cents*	*47 6 cents*	*45 2 cents*
	Increase Required	*+29 9 cents*	*+27 3 cents*	*+26 9 cents*
1970	*1997 Fuel Tax Needed*	*37 8 cents*	*44 1 cents*	*35 2 cents*
	Increase Required	*+19 8 cents*	*+27 3 cents*	*+26 9 cents*
1980	*1997 Fuel Tax Needed*	*18 9 cents*	*23 3 cents*	*15 2 cents*
	Increase Required	*+0 9 cents*	*+2 9 cents*	*-3 1 cents*
1990	*1997 Fuel Tax Needed*	*11 7 cents*	*21 9 cents*	*15 9 cents*
	Increase Required	*-6 3 cents*	*+6 1 cents*	*-2 4 cents*

Source Authors' calculations based on data from *Highway Statistics* 1950-1997 and the Consumer Price Index

vehicle fuel efficiency, perceptions of needs fluctuate between periods of adequacy and crisis in relation to the last fuel tax increase Thus, perceptions of highway needs, based on both needs assessments and public opinion, drive the campaigns for fuel tax increases every few years Once fuel taxes are increased, revenues are again deemed adequate, and no increases are sought until the next needs "crisis " Such a boom/bust cycle of highway finance, however, does not directly reflect either the use of or needs for highways To consider this relationship between of needs and revenues more in depth, we now turn to the evolving methods of assessing the need for highways

The Evolution of Needs Assessments

In 1965 the Senate directed the Federal Highway Administration (FHWA) to prepare a biennial report to Congress with estimates of the nation's future highway needs (Joint Resolution 81, Public Law 890139), and the first report was produced in 1968 Because of time constraints, the FHWA relied entirely on existing data provided by the states for this 1968 report As a result, this report summed up the wish lists provided by each state [3] However, since that first version the reports have gradually become much more sophisticated

In the late 1970s needs-assessment procedures improved with the creation of the Highway Performance Monitoring System (HPMS) The HPMS was developed by the FHWA and the states to provide a systematic, national approach for identifying highway conditions, estimating capital investment needs, and measuring changes in highway conditions over time. The system uses data from a statistical sample of about 100,000 highway sections across the country For each segment, the states report about 70 pieces of data on pavement condition, traffic levels, and physical design characteristics The FHWA uses computer models to analyze these data and develop needs estimates

In the 1981 report, the FHWA started using minimum conditions standards to calculate the investment levels necessary These minimum standards were defined as "full highway needs " Standards were set for both roadway pavement condition and the level of service provided Each road segment in the HPMS was compared to these standards, and the sum of improvements needed to bring all segments up to the standards was defined as the systemwide need. This system of comparing existing conditions to some minimum acceptable standard has been widely used by states, including California, in their own needs reports Also in the 1980s, a sophisticated simulation model, the *Analytic Process*, was made available to evaluate the impact of alternative investment strategies on system conditions and performance [4] Two such highway investment scenarios included in the FHWA report are "Cost to Improve" and "Cost to Maintain "

Needs assessments are also produced at the state level, and we now turn to a case study of needs assessments in California to explore in more detail the practice of assessing highway needs

Needs Assessment in California

The issue of transportation funding needs in California has surfaced in several published reports authored by transportation agencies, commissions, and interest groups in recent years However, with few exceptions most of these reports are based, at least in part, on the findings of the Transportation Consensus Project [5] The Transportation Consensus Project was a joint venture led by Californians for Better Transportation (CBT), a coalition of business, labor, and government leaders founded in 1981 Local and regional transportation agencies were also in-

volved in the Transportation Consensus Project

The focus of the Transportation Consensus Project report is annual unfunded transportation needs for transportation operation, maintenance, and rehabilitation throughout California Unfunded capital-project needs were not addressed in this report, but rather only those funds necessary to maintain the system without further degradation in performance A summary table presented in the report estimated these annual unfunded needs to be approximately $1 5 billion per year for state highways, local streets and roads, and public transportation Table 2 summarizes these funding needs

Few other studies have been published since the CBT report that quantify transportation funding needs However, several reports have been released that argue that California needs more money for transportation projects Most of these reports cite the status of the State Transportation Improvement Program (STIP) and the State Highway Operations Protection Program (SHOPP) as well as the quantified needs in the CBT report, rather than calculating new or different estimates For example, in January 1996, the Commission on Transportation Investment (CTI) published a report on the state of infrastructure and finance in California One of the specific charges of the CTI report was to consider transportation needs in California [6] While it was acknowledged that the commission would not engage in original data collection or primary analysis, the only quantified needs mentioned in the study were those published in the CBT report Similarly, a 1996 report by the Senate Transportation Committee concludes with a statement of needs identical to that appearing in the CBT report [7] No other estimates of needs were presented in this report either

One partial exception does exist In a 1997 report assessing VMT fees as an alternative transportation revenue source, the California Department of Transportation (Caltrans) Transportation Planning Program produced a 20-year estimate of both capital and non-capital transportation needs. According to a Caltrans representative, this needs assessment was a quick exercise and was not based on sophisticated modeling or in-depth analysis Needs were collected from regional transportation plans, Caltrans Transportation System improvement programs, and, not surprisingly, from the Transportation Consen-

Table 2: Summary of Statewide Transportation Needs: Operation, Maintenance, and Rehabilitation (millions of $1994)

	Maintenance & Operation		Rehabilitation	
	Existing Expenditures	Unfunded Annual Needs	Existing Expenditures	Unfunded Annual Needs
State Highways[1]	780	120	300	133
Streets and Roads	337	261	591	303
Public Transportation [2,3]	2,733	377	1,522	313
Total	$3,850	$758	$2,413	$749

[1] *Includes bridge rehabilitation*

[2] *Public transportation includes bus/urban rail, commuter rail, and intercity rail*

[3] *Public transportation maintenance and operation figures are expressed in 1996 dollars*

Source Californians for Better Transportation, 1995

sus Project report The report concluded that there were needed, unfunded transportation projects worth $8 6 billion, $3.7 billion of which was attributable to the state highway system.[8] Approximately 60% of the total calculated shortfall in funding was for capital projects

It is not surprising that this report relied on other sources, rather than performing original analysis, to determine needs. After all, the main purpose of the study was to explore the feasibility of implementing VMT fees, and needs were only a secondary concern However, it is perhaps surprising that Caltrans itself needed to collect information from a variety of sources outside of Caltrans, and that no in-house estimate of capital and non-capital needs was available.

In the past Caltrans published needs estimates Beginning in the late 1960s, Caltrans produced an annual report known as the *188 8 Study Highway Inventory Needs* The initial impetus for these studies came from the state administration and Caltrans leaders While these studies were originally mandated by the legislature, the mandate was withdrawn about 10 years ago because the new administration was not interested in spending additional money on transportation When these studies ended, the process of programming money became less based on analysis and more ad hoc and political in nature

As recently as 1992 Caltrans reported HPMS needs in its annual *Assembly of Statistical Reports* The FHWA's model was used to produce these estimates of needs for California's arterial and collector roads The model limited improvement types to resurfacing, reconstruction, adding lanes, widening, and minor realignments. New highways and interchanges, bridge rehabilitation, soundwalls, and landscaping needs were not considered. Transit needs were also not included However, the process did produce an estimate of current backlog and needs in five-year blocks for a 20-year period Later reports did not release these quantified needs estimates, although they did reveal some information on the number of roads with deteriorated pavement conditions. The state stopped calculating these 20-year needs estimates when the FHWA, which supplied the computer program to Caltrans, switched to a model that was not compatible with the state system. The Highway Economic Requirements System (HERS), which the FHWA began using in 1996, is also not compatible with the state system and has not been used by Caltrans to produce needs estimates

A newly mandated statewide report addresses one aspect of transportation needs in California. Senate Bill 45, which became effective January 1, 1998, requires Caltrans to prepare a 10-year state plan for the rehabilitation and reconstruction of all state-owned highways and bridges While the report is not very detailed and covers only those categories addressed in the SHOPP, it does provide some promise for the future of needs studies First, it provides specific quantified estimates of the revenue needed for the state highway program over the next 6 and 10 years Including traffic safety, roadway and roadside rehabilitation, and operations, the plan recommends spending $5 billion over the next six years and $8 6 billion over the next 10 years in order to reduce the number of accidents per year by 350-400, reduce and maintain the miles of deteriorated pavement from 14,100 to 5,500 miles in 1995, and improve operations through cost-effective projects One of the more promising elements of this plan is that the costs of each of the proposed project areas are to be weighed against the economic benefits of pursuing the projects While it is unclear from the report exactly how these benefits (or costs) are calculated, this plan may represent

the first effort at the state level to incorporate economic efficiency as a criterion in project selection

Incorporating Cost-Benefit Analyses Into Needs Assessments

Despite attempts to approach the identification of needs fairly and scientifically using models like those described above, most "needs" studies still resemble wish lists and rarely consider all of the benefits and costs of project completion Needs studies are traditionally based solely on engineering criteria, such as pavement condition, rather than on economic criteria such as the value of reductions in travel time or accidents The emphasis on engineering criteria favors the development of a transportation system of uniformly high quality, without regard to how this system is used

Cost-benefit analyses, in contrast, make it clear that not all highway improvements bring society equal benefit For example, spending $100 to improve a road used by only a few vehicles a day is probably of much less economic benefit to society than spending those same dollars to improve a road used daily by thousands of vehicles Decision-makers choosing among competing projects would be greatly aided by estimates of each project's value in terms of travel time reductions, income creation, employment growth, pollution reduction, or safety improvements [9] In some cases policy-makers might decide that the cost-effectiveness of improving certain roads would be so low that their improvement should not be considered a "need "

The federal government has recently begun to incorporate cost-benefit analysis into its transportation needs studies However, prior to the 1995 FHWA report, costs were developed for only two scenarios "Cost to Maintain" the system and "Cost to Improve" the system The FHWA's *1993 Status of the Nation's Transportation System* emphasized that these "investment analysis results should not be represented as either preferred or optimal investment strategies They represent investment and performance benchmarks to support further policy and budget analysis" [10]

As early as 1974 federal needs studies began mentioning the possibility of using performance as a measure of the effectiveness of highway investment In 1987 the General Accounting Office published a report. *Highway Needs An Evaluation of DOT's Process for Assessing the Nation's Highway Needs· Report to Congressional Requesters,* which suggested that needs studies begin to include cost-benefit analysis To address this issue of incorporating economic criteria into highway investment decisions, in 1988 the FHWA began a long-term effort to produce an alternative, economic-based HPMS simulation procedure called the Highway Economic Requirements System (HERS) Using HERS, the *1995 Status of the Nation's Highways Conditions and Performance Report to Congress* included an "Economic Efficiency" scenario along with the traditional "Cost to Improve" and "Cost to Maintain" scenarios This shift arose from a Congressional request that "more advanced economic analysis be provided in highway investment option analysis and that increasingly constrained national investment resources be efficiently allocated" [11]

HERS operates by selecting "the 'best' set of highway improvements to satisfy economically sound highway performance objectives" [12] HERS prioritizes highway improvement projects based on net contribution to social welfare, and considers funding constraints or other user-specified performance objectives while simultaneously maximizing highway-user benefits In order to evaluate projects, HERS uses a partial cost-benefit analysis approach. Cost-benefit analysis sums all of the benefits over time of a project and compares the total to

the sum of all costs over time The resulting ratio indicates whether or not a project is worthy of investment

Therefore, using cost-benefit analysis as a guide, HERS will include in the "Economic Efficiency" scenario only those projects for which "direct user and agency benefits exceed the initial cost of the improvement".[13] In the current HERS model, highway-user benefits include reductions in travel time, accidents, and vehicle operating costs Agency benefits are reduced maintenance costs, and the reduction in the cost of the section's next needed improvement. Costs that are considered by HERS include project design, right-of-way acquisition, and construction However, cost and benefits to those other than highway users are not considered Thus environmental and quality of life effects are not covered.

While the FHWA is beginning a transition towards economics-based methods of needs determination, similar efforts by states have generally been less successful In California, for example, the state Transportation Commission (CTC) is currently responsible for choosing projects for inclusion in the state's Interregional Transportation Improvements Plan Under the current system, engineering criteria are the main basis for project evaluation, and economic criteria are generally not included. Travel time reductions, income creation, employment growth, pollution reduction, or safety improvement effects of transportation projects are not systematically considered in choosing among projects.[14] In 1996 the Commission on Transportation Investment (CTI) discussed formally recommending to the CTC that cost-benefit analysis be used to determine needs and prioritize projects However, while reforming project prioritization was discussed in the final report, the CTI never formally recommended that the CTC switch to cost-benefit analysis.

Should cost-benefit analyses be applied more broadly in analyzing transportation needs, they would likely call into question the allocation of funds and projects on the basis of geographic equity both within and between states. For example, urban drivers generally "cross-subsidize" rural drivers, in that more transportation user fees are collected than spent in urban areas, while more transportation user fees are spent than collected in rural areas. Cost-benefit analysis, with its focus on net economic benefits, would tend to favor improvements to heavily used facilities (which are more likely located in urban areas) over lightly used facilities (which are more likely in rural areas) Consider the case of a lightly traveled rural highway with 10 miles of substandard pavement and a heavily used highway with just one mile of substandard pavement Engineering criteria would typically favor repairing the 10 miles of substandard rural highway over the one mile of substandard urban highway Cost-benefit analysis, on the other hand, would take into consideration the sum of all benefits to drivers on each highway, such as reductions in travel time and in vehicle wear and tear, and likely conclude that repairing one mile of substandard urban road would be the first priority. Policymakers might still choose to invest first in the rural highway for a variety of other reasons, but cost-benefit analysis would have informed their decision by directly comparing the collective benefits to travelers on each route.

Cost-benefit analysis is often criticized because it can be both difficult and subjective to quantify all benefits and costs of a project, especially those relating to quality of life. For example, adding sound barriers to a freeway has an easily quantifiable per-mile *cost*, but in order to weigh this cost against benefits,

one would have to determine the value of the reduction in noise pollution for adjacent neighborhoods Yet a general lack of consensus also exists "regarding the 'correct' values to be placed on travel time savings from highway improvements, especially for non-commercial time" [15] Finally, cost-benefit analyses can be biased by the exclusion of certain benefits and costs from the analysis For example, not including the cost of pollution in a cost-benefit analysis of building a new freeway might make an otherwise undesirable project appear desirable

Despite the difficulties associated with cost-benefit analysis, it is still true that incorporating economic criteria into the investment process provides decision-makers with more information on which to base investment decisions than currently exists As long as the assumptions and the process are both relatively transparent, this additional information can only better inform the debates surrounding transportation investment decisions. Such information can make it more difficult to make inefficient but politically popular transportation investment decisions, which may help to explain why many elected officials have been slow to embrace cost-benefit analysis as an analytic tool, some may perceive cost-benefit analysis as a diminution of their authority and discretion

Conclusion

Determining needs is clearly not a simple exercise, but some statement of the amount of revenue needed for transportation is an essential element of any policy on transportation finance As we note in our discussion of California, however, the nation's most heavily traveled state has not produced a comprehensive estimate of statewide transportation needs in years

The lack of comprehensive needs assessments in California may reflect the evolving role of states in transportation planning and programming Since the enactment of the federal Intermodal Surface Transportation Efficiency Act (ISTEA) legislation in 1991 and the subsequent Transportation Equity Act for the 21st Century (TEA-21) in 1998, regions have been acquiring substantially more responsibility for transportation planning and programming The ascending role of Metropolitan Planning Organizations (MPOs) in transportation programming may portend a shift in formal highway needs assessments in urbanized states to regions

Regardless of the institutional administration of needs assessments, however, such assessments should include economic (including environmental) criteria as well as engineering criteria. While an economic approach to assessing highway needs would inevitably create winners and losers relative to current, engineering and *ad hoc*-methods of assessing needs, such analyses would provide invaluable information to decision-makers in determining how to spend limited transportation resources most effectively and efficiently

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