TRANSPORTATION

High-occupancy toll lanes benefit all highway users—not just the affluent

HOT Lanes: A Better Way to Attack Urban Highway Congestion

By Robert W. Poole Jr. and C. Kenneth Orski

High-occupancy vehicle (HOV) lanes were once seen as innovative and beneficial. It was claimed that HOV lanes would encourage ridesharing and thereby reduce highway congestion, travel delays, and air pollution. But drivers, environmentalists, and transportation researchers increasingly question whether the benefits of HOV lanes exceed their costs. Underused HOV lanes irritate most drivers; environmental groups do not believe that HOV lanes reduce auto traffic; transportation researchers find that HOV lanes do little to relieve congestion; and elected officials are under increasing pressure to convert HOV lanes to general-purpose lanes.

As a result of disenchantment with HOV lanes, several metropolitan areas are experimenting with a new way of using the lanes: opening them to paying customers as high-occupancy toll (HOT) lanes. As of 2000, two such projects were in operation in California and another in Texas.

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HOT lanes promise to make better use of existing HOV lanes, to provide capacity more efficiently than either conventional HOV lanes or general-purpose lanes, and to reduce the number of lanes needed on new freeways by limiting peak-hour demand. In most cases, toll revenues should more than pay for the conversion of an HOV lane to a HOT lane. The addition of a HOT lane on the same grade as other lanes may also be self-supporting if no major interchanges need to be rebuilt.

Experience indicates that HOT lanes are politically feasible. HOT lanes benefit those drivers who use conventional lanes as well as those drivers who use the HOT lanes. HOT lanes can continue to serve as HOV lanes as long as carpools and buses continue to have good access to them. Some environmental groups actively support HOT lanes, realizing that they reduce emissions by reducing stop-and-go traffic. Experience also shows that HOT lanes are not used solely by the affluent: drivers at all income levels use HOT lanes when they really need to get somewhere on time.

HOV LANES UNDER FIRE

Irate Drivers See Waste Irate drivers see HOV lanes as an inefficient use of scarce road space. They claim that few drivers take advantage of carpool lanes, while thousands of solo commuters must endure stop-and-go traffic in adjacent general-purpose lanes. There is evidence to support that perception. According to the U.S. Department of Transportation's 1995 Nationwide Personal Transportation Survey, the number of commuters carpooling to work declined by 19 percent during the 1980s and the average occupancy of vehicles in metropolitan areas dropped from 1.17 persons per car in 1970 to 1.09 in 1990. Only 9 percent of work trips are made in multioccupant vehicles today, compared with 16 percent in the 1980s.

As a result of those trends, many HOV lanes are underused, that is, they do not carry as many people as adjacent general-purpose lanes. Because a freeway lane has a smooth-running capacity of 1,500-1,800 vehicles an hour, an HOV lane must carry at least 700-800 vehicles an hour in order to offer equivalent "person throughput," at an average of 2.1-2.2 persons per vehicle. However, an HOV lane carrying as many as 1,200 vehicles an hour can be perceived as underused when an adjacent unrestricted lane is seriously congested and carrying more than 2,000 vehicles an hour.

It is uncertain how many HOV facilities in the nation are underused. But the perception of "empty HOV lanes" is widespread, and opposition to HOV lanes is spreading as irate commuters stuck in regular lanes conclude that carpool lanes are intended to make life miserable for solo drivers.

Environmentalists Question Benefits HOV lanes also have come under attack from the environmental movement. Although environmentalists played a major role in the push for carpools and HOV lanes three decades ago, many environmentalists have come to view the building of HOV lanes as little more than an excuse for building more roads. Environmentalist critics of HOV lanes say that for every car diverted into a reserved lane another car fills the vacancy, causing more traffic rather than less, higher levels of air pollution, and greater suburban sprawl.

Academics Doubt Effectiveness Questions about the effectiveness of HOV lanes are being raised within the research community, as well. Joy Dahlgren, a researcher at the Institute of Transportation Studies at the University of California, Berkeley, has argued that adding an HOV lane rather than a general-purpose lane reduces congestion and emissions only if existing general-purpose lanes are severely congested and carry a high proportion of HOVs. Specifically, for a three-lane roadway, the proportion of HOVs must be about 20 percent of total one-way traffic if an HOV lane is to offer an advantage over an extra general-purpose lane. But the amount of traffic that shifts to an HOV lane must not be too large, lest it congest the HOV lane and erase its travel-time advantage over the general-purpose lanes.

In short, if the proportion of HOVs is too low, the benefit of adding an HOV lane is limited by low use. But if the proportion of HOVs is too high, the addition of an HOV lane does not make it worthwhile for people to shift to HOVs. People have an incentive to switch to HOV lanes only if general-purpose lanes remain congested—a notion that seems to mock the ostensible goal of reducing congestion through the use of HOVs lanes.

Politicians Respond Elected officials have responded to the concerns of motorists, environmentalists, and academics by attacking HOV lanes. In November 1998, Governor Whitman of New Jersey announced the elimination of two controversial HOV lanes on Routes I-287 and I-80. Following a hearing attended by many elected officials, the New Jersey congressional delegation succeeded in amending the federal transportation appropriations bill to relieve New Jersey of its obligation to repay the $240 million the federal government put up to build the lanes on the two interstate highways. The HOV lanes were converted to general-purpose lanes at the end of 1998.

A bill introduced in the California legislature in late 1998 (AB 44) would require the California Department of Transportation to redesignate all existing HOV lanes within the state as mixed-flow lanes. AB 44 also would prohibit construction or designation of any new HOV lanes unless a cost-benefit analysis shows that an HOV lane is the most efficient alternative. The bill is still pending.

The Minnesota Department of Transportation would be prohibited from designating any new carpool lanes, and existing carpool lanes on I-394 and 35W would be opened to regular traffic under a proposed 1999 bill. Governor Ventura, while campaigning for election, pledged repeatedly that opening carpool lanes to single-occupant vehicles would be one of his first actions as governor. But his proposal was defeated in committee in mid-March 1999, killing the bill for the 1999 legislative session.

In New York, Suffolk County and Nassau County legislators—citing New Jersey's abolition of the unpopular carpool lanes on I-287 and I-80—called on the state department of transportation to conduct a two-month experiment during which existing carpool lanes on the Long Island Expressway would be open to regular traffic. (The experiment was not done.) Governor Pataki—who in October 1997 canceled plans for an HOV lane on the Cross Westchester Expressway north of New York City—is expected to lend a sympathetic ear to the growing chorus of opposition to the carpool lanes.

The Virginia General Assembly voted overwhelmingly in January 1999 to lift high occupancy vehicle (HOV) restrictions on interstate highways in the Hampton Roads area. In northern Virginia, carpool lanes on the Dulles Toll Road that had been opened in December 1998 were attacked in their first few months. Frank R. Wolf, U.S. representative from Virginia's 10th Congressional District, said in a letter to Virginia's transportation commissioner that he has "serious reservations" about the carpool lanes. The business community in the booming and congested area around Dulles International Airport also is skeptical about the carpool lanes because many of the commuters in the Dulles area are high-tech employees who keep irregular hours, use their cars during the day, and get free parking at work—conditions that make it difficult to form carpools.

HOT LANES SHOW GREAT PROMISE

THE HOT LANES CONCEPT—FIRST ARTICULATED IN 1993 BY Gordon J. Fielding and Daniel B. Klein in a paper published by Reason Foundation—accomplishes several objectives:

- Relieving political pressure to convert HOV lanes to general use
- Diverting some solo drivers from adjacent general-purpose lanes and reducing congestion in those lanes
- Generating revenue for highway and mass-transit improvements
- Giving motorists the option of traveling on less-congested lanes, if they are willing to pay for the privilege.

As shown in Table 1, as of 1999 there were 23 HOT lanes projects in 11 states. Three of the projects were operational; the others were in various stages of planning and development.

HOT lanes apply the concept of value pricing, which a special report of the Institute of Transportation Engineers defines as "a system of optional fees paid by drivers to gain access to alternative road facilities providing a superior level of service and offering time savings compared to the free facility." A HOT lanes project may meet one of these four objectives:

- Absorb unused capacity on an existing HOV lane.
- Absorb extra capacity arising from a switch from HOV-2 to HOV-3.
- Relieve congestion on a highly congested freeway.
- Manage traffic on a new limited-access highway.

Converting an Underused HOV Lane As we discussed earlier, an HOV lane that carries fewer than 700 vehicles an hour is a candidate for conversion to a HOT lane. San Diego's I-15 HOV facility, for example, had been operating well below capacity since its opening in October 1988. The I-15 facility is an eight-mile stretch of two reversible lanes in the median of I-15, about 10 miles north of San Diego. The HOV lanes are open to southbound traffic from 5:45 to 9:15 A.M. and to northbound traffic from 3 to 7 P.M. The San Diego Association of Governments, wanting to make better use of the I-15 HOV lanes and to generate revenue for transit improvements in the I-15 corridor, proposed a high-occupancy toll (HOT) lane demonstration project for implementation under the federal Congestion Pricing Pilot Program.

The project, initially called ExpressPass and now known as FasTrak, was implemented in two phases. In the initial, 16-month phase, which began in December 1996, solo drivers were allowed to use the HOV lanes upon purchase of a permit that gave them unlimited use of the HOV lanes for a flat monthly fee. Verification and enforcement relied on visual inspection of a color-coded windshield decal. In June 1997, the decals were replaced by electronic transponders, which also made it easier to collect data about ExpressPass usage.

In the second phase of the demonstration project, which began in March 1998, the flat-rate monthly pass was replaced by a per-trip toll. Tolls vary from 50 cents to $8 per trip, fluctuating with traffic volume in the HOV lanes. Electronic signs in front of the entrance to the HOV lanes notify motorists of the current toll as they approach the toll lanes. A motorist who wants to use the HOV lanes simply passes through a special lane where overhead antennas scan the windshield-mounted transponder and automatically deduct the posted toll from the motorist's prepaid account.

Managing a Switch from HOV-2 to HOV-3 When HOV-2 lanes are converted to HOV-3 because of severe congestion, the change usually results in unused capacity. That

Table 1

Current HOT Lane Projects

STATE	LOCATION	FACILITY	STATUS
Arizona	Phoenix	All freeways	Study
California	Alameda Co.	1-680, I-880	Study
	Contra Costa	SR 4W	Study
	Los Angeles	Various	Post-study
	Orange Co.	SR 91 Express Lanes	Operational
	Orange Co.	SR 57	Study
	Riverside Co.	SR 91 extension	Study
	San Diego Co.	I-15	Operational
	Santa Cruz Co.	SR 1	Authorized
	Sonoma Co.	US 101	Post-study
Colorado	Denver	I-25	Study
Florida	Miami	I-95, SR 836	Study
	Orlando	I-4	Study
Maryland	Baltimore suburbs	Various	Study
Minnesota	Minneapolis	All freeways	Study
Oregon	Portland	Various	Study
Pennsylvania	Philadelphia	US 1	Study
Texas	Austin	I-35	Study
	Dallas	I-635	MIS
	Houston	I-10	Operational
	Houston	I-10 extension	MIS
Virginia	Hampton Roads	I-64	Approved
Wisconsin	Milwaukee	I-94	Proposed study

unused capacity can be managed by permitting vehicles with one or two occupants to use the HOV facility, for a toll. The toll is set to maintain a smooth flow of traffic on the HOV lanes.

The Katy HOV lane in Houston, Texas, is a 13-mile, barrier-separated, reversible HOV lane located in the median of I-10. After opening as an HOV-3 lane in 1984, the lane was designated HOV-2 in 1986. The designation for the morning peak period reverted to HOV-3 in 1988 because of heavy congestion. In 1991, the same change was made for the afternoon peak-travel hour. Those changes resulted in excess capacity, which led to Project QuickRide. Launched in January 1998, QuickRide allows a two-person carpool to use the HOV lane during peak hours for a $2 toll, which is collected electronically.

Adding Capacity to an Existing Freeway The addition of HOT lanes to an existing freeway is recommended where there is insufficient volume to justify HOV lanes. An example is the 91 Express Lanes project in Orange County, California—the first HOT lanes project in the nation to use value pricing. Opened in December 1995, the project is one of four private toll road ventures authorized by the California legislature in 1989. Project development and operating procedures are spelled out in a franchise agreement signed in 1990 between the state and the facility's operator, the California Private Transportation Company (CPTC).

Four HOT lanes (two lanes in each direction) were built in the median of State Route 91—a congested, eight-lane freeway. Tolls vary with time of day to ensure that the toll lanes remain uncongested at all times. To that end, tolls have been raised four times since 1995, most recently in January 1999. The eight-level toll for traveling the length of the 10-mile facility now ranges from 75 cents to $3.50.

To support California's ridesharing policy, vehicles with three or more occupants could travel free when the 91 Express Lanes first opened. But in January 1998 CPTC began charging those vehicles half the regular toll because toll revenues were not covering debt service.

Users of the 91 Express Lanes save 12-13 minutes of travel time, on average. But saving time is only one of several reasons for using the lanes. Other perceived benefits include greater reliability, better safety, and more predictable arrival times. An evaluation by Professor Edward Sullivan of California Polytechnic State University found that a large majority of motorists do not use the 91 Express Lanes regularly: only 23 percent use the facility every weekday, and a third use it less than once a week. Although there is some evidence that higher-income motorists use the facility more frequently than do other motorists, surveys find great diversity among the facility's users. All commuters, irrespective of income or occupation, tend to use the toll lanes to avoid being late for work, to arrive at appointments on time, or to pick up children at daycare facilities. In spite of the fears of critics, it seems that value-priced facilities are not just for well-to-do users.

Value pricing benefits not only the users of the 91 Express Lanes but also motorists in the adjacent general-purpose lanes, reports Professor Sullivan. Average peak-period speeds in the adjacent lanes have risen from 15 mph to 32 mph, and morning peak-period congestion in the general-purpose lanes has dropped from four hours to less than three hours.

Professor Sullivan's study also has shown that value pricing can be a powerful tool of freeway management. By metering vehicles to maintain free-flowing traffic at all times, variable pricing enables each toll lane to carry as many vehicles at 65 mph as a general-purpose lane carries at 32 mph.

Managing Demand on a New Limited-Access Highway A newly constructed limited-access highway in a highly congested travel corridor can be operated as an HOV/HOT facility. An example of such a facility is the proposed suburb-to-suburb Intercounty Connector in the congested Maryland counties of Montgomery and Prince Georges, suburbs of Washington, D.C. Without tolls, it is feared, the facility would quickly become swamped with traffic.

A facility like the Intercounty Connector can serve as a fast transitway (busway) while providing an option for solo drivers who are in a hurry. Variable tolls would control usage by single-occupant vehicles, thus ensuring that the lanes always operate at a specified throughput rate, even at peak-travel times. Electronic toll collection would afford tollgate-free access to the lanes.

ECONOMIC FEASIBILITY OF HOT LANES

HOV-TO-HOT CONVERSIONS ARE ALMOST ALWAYS FINANcially attractive. Adding new HOT lanes also can be attractive under a wide range of conditions. Effective public-private partnerships—and enabling laws—are key to the success of HOT lanes projects.

HOV-to-HOT Conversions The cost of converting an existing HOV lane to a HOT lane is relatively low. The main capital expenditures are for plastic pylons, changeable message signs, gantries, toll-reading and video-enforcement equipment, and computer hardware and software. The pavement and striping are already there, as are the ingress and egress signs. Drivers pay for the in-vehicle tags, although project operators have to buy the tags and lease or sell them to motorists. Operating costs arise from the sale or leasing of tags, operating and maintaining the collection system, advertising to explain and publicize HOT lanes, and enforcing the payment of tolls.

The I-15 conversion in San Diego had capital costs of $1.85 million, not including the transponders bought by drivers. The I-15 project is generating annual revenues of about $1 million. The capital costs were defrayed from federal grants; thus, all revenues are available to subsidize a new bus service that is operating on the HOT lanes.

New Capacity As for brand-new HOT lanes, thus far we have one fully operational project and one detailed feasibility study to draw from. Both suggest that in highly congested corridors where space for new, at-grade lanes is available in the median, the addition of HOT lanes can be financially feasible.

The 91 Express Lanes project in California added four, 10-mile-long lanes to the wide median of the Riverside Freeway at a total capital cost of $130 million. (That cost also covered a short stretch with an additional lane in each direction for HOV enforcement.) The private operator had to finance the project with taxable revenue bonds, borrowing at an interest rate of 9 percent. In spite of the high cost of debt service, the operator was covering all costs (including debt service) and beginning to show a profit after only three years of operation.

The consulting firm of Parsons Brinckerhoff Quade & Douglas, Inc., estimated costs and revenues for the proposed addition of HOT lanes to U.S. Route 101 in Sonoma County, California: a single HOT lane in each direction in the median. Parsons Brinckerhoff estimated that the 15-mile version of the project would cost $85-$119 million, and put the cost of the 24-mile version at $125-$177 million. The study found that, for either length, toll revenues from the lower-cost version would cover all costs; toll revenues from the higher-cost version might cover costs if the revenue estimates, based on variable rather than flat-rate tolls, were achieved. Parsons Brinckerhoff concluded that "this project is financially, physically, and operationally feasible."

Public-Private Partnerships The 91 Express Lanes was the first project developed under California's landmark public-private transportation partnership law, AB 680. The I-15 HOT lane conversion was developed by the San Diego Association of Governments (SANDAG); TransCore operates the system under contract to SANDAG.

Fifteen states now have enacted legislation similar to California's, under which state departments of transportation or other state agencies can contract competitively for private development and/or operation of transportation facilities. Such arrangements work well for several reasons. Contractors can use fast-track methods, such as design-build, with which government agencies are usually less familiar or even prohibited from using. Contractors also know how to use market incentives to ensure timely completion of projects. Because of their bottom-line orientation, contractors find ways to reduce total investment and operating costs (e.g., by using a higher quality of pavement at the outset if that will reduce maintenance costs over the life of the project). And contractors generally know how to market a project.

But early public-private partnership laws (such as AB 680) imposed unrealistic burdens on private-sector partners. Those laws required 100 percent of all capital costs to come from nontax sources—even the costs of environmental-impact studies, which must be done before a project can proceed, and which investors are understandably reluctant to fund. The early laws also required project revenues to cover costs that normally would be defrayed from state funds (e.g., law enforcement). Even more damaging to the prospects for financial feasibility, early partnership laws required the private partner to issue the project's revenue bonds—which meant issuing them at expensive taxable rates.

Second-generation partnership laws—such as those in Texas and Virginia—permit a state to cover risky initial expenses and, in certain cases, to partially fund construction costs. The more recent laws also provide for the issuance of tax-exempt toll revenue bonds, either through a state toll agency or a special-purpose nonprofit corporation. Until Congress modifies the federal tax code to permit private highway developer-operators to issue tax-exempt revenue bonds, state partnership laws should explicitly authorize the issuance of tax-exempt revenue bonds for public-private toll projects.

POLITICAL FEASIBILITY OF HOT LANES

A HOT LANES PROJECT MUST CLEAR THREE POLITICAL HURdles: user support for existing HOV lanes, opposition from environmentalists, and concerns about equity and elitism.

Support for Existing HOV Lanes As we discussed earlier, in many metropolitan areas it is becoming clear that HOV lanes do not foster ridesharing and, in many cases, carry fewer people per hour than regular lanes. An HOV facility may nevertheless have a large, established user group, which can wield significant opposition to a conversion project. How can such opposition be answered?

Mixed HOV/HOT use may be the only viable alternative to the conversion of HOV lanes to general-purpose lanes. Such conversions have taken place in New Jersey and have been proposed in California, Minnesota, and Virginia legislation.

Conversion may assuage users who would otherwise be excluded if a popular HOV-2 facility were converted to HOV-3 because of congestion. And should a HOT lane begin attracting so many vehicles that it begins to be congested, raising the toll can quickly restore uncongested conditions, as demonstrated by California's 91 Express Lanes and I-15 projects. Further, HOT lanes do not seem to undermine ridesharing; carpooling has increased on both California HOT lanes since their opening.

In metropolitan areas where HOV lanes have not yet been introduced, policymakers should consider the option of introducing tolled express lanes instead of HOT lanes. There will still be a strong incentive to carpool because tolls can be shared. But enforcement on tolled lanes is simpler and less costly than enforcement on mixed HOV/HOT lanes because it is not necessary to distinguish between paying customers and qualifying (free) carpools.

Environmental Concerns The 1991 Intermodal Surface Transportation Efficiency Act bars a highway project that adds capacity in a metropolitan area that is a "nonattainment area" for air quality unless the project is found to be in conformance with the state's air-quality implementation plan under the Clean Air Act. Converting an existing HOV lane to a HOT lane should not pose a problem, but the addition of new lanes configured as HOT lanes may require a finding of conformity.

Computer modeling may show that the addition of HOT lanes would result in less stop-and-go traffic in existing general-purpose lanes, offsetting emissions from traffic on the smooth-running HOT lanes. That kind of calculation was part of the conformity documentation for the 91 Express Lanes project, which added four new HOT lanes to a congested freeway.

In most cases, especially with the addition of a single HOT lane in each direction, new HOT lanes will have little effect on emissions. A 1995 report from the Transportation Research Board of the National Research Council's National Academy of Sciences concluded that changes in emissions resulting from road improvements—even major ones—are likely to be so small as to be unmeasurable.

There are environmental organizations on both sides of the HOT lane question. Some groups, such as the Chesapeake Bay Foundation, argue that even allowing carpools onto HOV lanes subverts their primary function as busways. Such groups will certainly oppose converting HOV lanes to HOT lanes. On the other hand, a number of environmental groups have in recent years become advocates of value pricing as a way of making auto users pay the full costs of highway use. Most notably, the Environmental Defense Fund (EDF) strongly supported the 91 Express Lanes project as a step toward wider use of road pricing—even though the project involved adding four lanes to an existing freeway. EDF also has argued for the addition of HOT lanes in several counties in the San Francisco Bay area. Other environmental groups have supported value pricing and HOT lanes in Oregon and in the New York City metropolitan area. Some of those groups support HOV-to-HOT conversions but not the addition of new HOT lanes.

Equity and Elitism Perhaps the most troubling argument against HOT lanes is the claim that they are elitist "Lexus lanes," which the rich can use to speed past the poor who remain stuck in traffic.

But another way to view HOT lanes is as a step toward a system that better meets users' unique needs. A mother racing to get to a daycare center to avoid paying dollar-a-minute late fees may well decide it is worth paying $2 to use a HOT lane. A plumber trying to fit one last appointment into a busy day may be able to do so only by speeding past congestion, gladly paying the HOT lane charge. Other people would prefer to remain in the regular lanes—which a HOT lane program does not take away—and pay in the form of time rather than dollars. Data from the 91 Express Lanes and I-15 projects indicate that people at all income levels use the lanes when saving time is important to them.

HOT lanes yield other general benefits:

- They reduce congestion in adjacent general-purpose lanes.
- Transit vehicles gain access to faster-moving lanes, which entices some commuters to switch from autos to express buses or commuter-shuttle vans.
- Further, toll revenues can be used to provide express bus service, as San Diego is doing in its I-15 HOT lane corridor.
- Emergency vehicles can reach their destinations much more quickly on HOT lanes.
- And, unlike general-purpose highways and HOV lanes, only the users of a HOT lane facility pay for it.

Thus, the equity argument against HOT lanes is far less worrisome than some have feared.

SUMMING UP

HOV LANES—UNDER ATTACK BY MOTORISTS, ACADEMICS, and environmentalists—may not survive politically. The alternative is HOT lanes, a policy innovation whose time has come. HOT lanes offer congestion-free highway use for a fee. Critics charge that HOT lanes benefit only the wealthy, but that is demonstrably untrue.

The HOT lanes concept is a rare policy innovation that improves economic efficiency and is politically feasible as well.

readings

- Committee for a Study of the Impacts of Highway Capacity Improvements on Air Quality and Energy Consumption. *Expanding Metropolitan Highways: Implications for Air Quality and Energy Use*. Special Report 245. Washington, D.C.: Transportation Research Board, 1995.
- Joy Dahlgren, "Are HOV Lanes Really Better?" *Access*, Spring 1995: 25.
- Gordon J. Fielding and Daniel B. Klein. *High Occupancy Toll Lanes: Phasing in Congestion Pricing a Lane at a Time*, Policy Study No. 170. Los Angeles: Reason Public Policy Institute, November 1993.
- Karen J. Hedlund. *The Case for Tax-Exempt Financing of Public-Private Partnerships*. Los Angeles: Reason Public Policy Institute, February 1998.
- Report of the Institute of Transportation Engineers (ITE) Task Force on HOT Lanes. "High-Occupancy/Toll Lanes and Value Pricing: A Preliminary Assessment." *ITE Journal*, June 1998: 30.
- Alan Pisarski. *Commuting in America II*. Washington, D.C.: Eno Transportation Foundation, 1996.
- Robert W. Poole Jr. and Michael Griffin. *Shuttle Vans: The Overlooked Transit Alternative*, Policy Study No. 176. Los Angeles: Reason Public Policy Institute, April 1994.
- Parsons Brinckerhoff Quade & Douglas, Inc. *Final Report: Sonoma County US 101 Variable Pricing Study* (for the Metropolitan Transportation Commission and Sonoma County Transportation Authority), June 6, 1998.
- San Diego State University, Department of Civil and Environmental Engineering. *I-15 Congestion Pricing Project Monitoring and Evaluation Services, Phase I Report* (prepared for San Diego Association of Governments), December 30, 1998.
- Edward C. Sullivan. *Evaluating the Impacts of the SR 91 Variable Toll Express Lane Facility, Final Report*. California Polytechnic State University, San Luis Obispo, Cal., May 1998.