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BUILDING A CASE FOR HOT LANES:
A NEW APPROACH TO REDUCING URBAN HIGHWAY CONGESTION

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Executive Summary

Increasingly, high-occupancy vehicle (HOV) lanes are being called into question. Transportation researchers find them to be of limited value in relieving congestion, and elected officials are under increasing pressure to convert these limited-access lanes into general-purpose lanes. But a number of metro areas are experimenting with a different alternative: opening up these limited-access lanes to paying customers.

The new approach is called high-occupancy/toll (HOT) lanes. As of early 1999, two such projects are in operation in California and another in Texas. Because they give motorists a choice between (1) continuing to use general-purpose lanes at no direct charge and (2) using express lanes at a specific, direct price, HOT lanes are an example of "value pricing" (charging a price only for a higher level of service).

There are at least four circumstances under which the HOT lane approach may be applicable:

- If an existing HOV-2 lane is seriously underutilized, converting it to a HOT lane makes use of this excess capacity.
- If an existing HOV-2 lane becomes congested and is set to be converted to HOV-3, experience shows that this change will lead to a large amount of excess capacity; this is also an opportunity to sell the excess, by converting to HOT.
- When an existing congested freeway is programmed for capacity expansion, the addition of a HOT lane in either direction may offer more benefits than adding either a conventional HOV lane or a general-purpose lane.
- When a new freeway is to be built, it can be built with fewer lanes if a value-pricing/HOT lane concept is employed to limit demand during peak hours.

Legal authority for such HOT-lane projects is provided at the federal level by the Value-Pricing program included by Congress in the 1998 TEA-21 legislation. State legislation may be needed, for one or more of

the following: (1) to permit conversion of existing HOV lanes to HOT lanes, (2) to permit charging a fee to use a state highway, and (3) to permit enforcement via video and electronic means.

New technology—in particular non-stop electronic toll collection using windshield-mounted transponder tags—makes HOT lanes feasible without the need for toll booths or toll plazas. HOT lanes can be separated from regular lanes simply by pavement striping and plastic pylons. Electronic and video technology can assist with enforcement.

In most cases the conversion of an existing HOV lane to a HOT lane should be more than self-supporting from the new toll revenues. In certain cases, the addition of a HOT lane, at grade, may also be self-supporting, if no major interchanges need to be rebuilt. Public-private partnerships may make such projects easier for public agencies to carry out.

Public officials' greatest concern may be the political feasibility of HOT lanes. Experience to date shows that, once in use, a HOT lane benefits both users and non-users, becoming quite popular. As long as carpools and buses continue to have good access, the lanes will continue to serve their HOV function. Some environmental groups actively support HOT lanes, realizing that value pricing—by smoothing traffic flow—reduces running emissions compared with stop-and-go driving. Experience also shows that drivers of all income levels make use of HOT lanes at those times when they really need to get somewhere on time; they are not used solely by the affluent.

Part 1

Introduction

A. HOV Lanes Under Attack

For two decades, high occupancy vehicle (HOV) lanes have been regarded as an innovative transportation-management concept offering multiple benefits. HOV lanes, it was claimed, would encourage ridesharing, raise vehicle occupancy, and thereby promote the broader objectives of reducing highway congestion, travel delays, and air pollution. But lately, this view has been increasingly questioned. The challenges are coming from three directions.

Politicians and irate road users are criticizing HOV facilities as an inefficient use of scarce road space. Few drivers, they claim, are taking advantage of carpool lanes, while thousands of solo commuters sit frustrated in stop-and-go traffic in adjacent general-purpose lanes. Evidence from around the nation tends to support their perception. The number of commuters carpooling to work declined by 19 percent during the decade of the 1980s, and average vehicle occupancy in metropolitan areas dropped from 1.17 persons/car in 1970 to 1.09 in 1990. Only 9 percent of work trips are made in multi-occupant vehicles today, compared to 16 percent in the 1980s.[1]

While certain metropolitan areas, notably Houston, Los Angeles, and Washington D.C., have maintained higher-than-average car occupancy rates, much of the rest of the nation has seen carpool rates drop substantially. Even in the cities that still enjoy significant levels of ridesharing, carpool activity consists primarily of family members with similar destinations and timing, notes transportation analyst Alan Pisarski.[2] With work schedules becoming more flexible, travel patterns growing more complex, "trip chaining" becoming more prevalent, and homes and jobs dispersing to far-flung suburban locations, fewer and fewer commuters are able to share rides and take advantage of carpool lanes.

The consequence of these trends is that many HOV facilities are operating well below their designed capacity. An HOV lane is said to be underutilized when it fails to carry at least an equal number of *people* as an adjoining general purpose or mixed-flow lane. Since a freeway lane has a capacity of approximately 1,500–1,800 vehicles per hour, an HOV lane must carry a minimum of 700–800 vehicles per hour in order to offer equivalent "person throughput," assuming an average carpool occupancy rate of 2.1–2.2 persons/vehicle. However, HOV lanes carrying as many as 1,200 vehicles per hour can be *perceived* as

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1 1995 Nationwide Personal Transportation Survey (Washington, D.C.: U.S. Department of Transportation) (preliminary data).

2 Alan Pisarski, *Commuting in America II* (Washington, D.C.: Eno Transportation Foundation, 1996).

"underutilized" when parallel unrestricted lanes are seriously congested (i.e., carrying over 2,000 vehicles per hour per lane).

How many HOV facilities in the nation fail to reach this threshold is a matter of some debate. But, as documented in the following section, the perception of "empty HOV lanes" is widespread, and opposition to them is spreading, as irate commuters stuck in regular lanes conclude that carpool lanes can be nothing else than a deliberate attempt to make life miserable for the single motorists.

HOV lanes also have come under attack from the environmental movement. Having played a major role in the push for carpools and HOV lanes three decades ago, many environmentalists have come to view HOV lanes as little more than a thinly disguised attempt to build more roads. For every car diverted into the reserved lane, they say, another car fills the vacancy, causing traffic to grow rather than decrease. Construction of HOV lanes thus only leads to more vehicle trips, higher levels of air pollution, and greater suburban sprawl. What many environmentalists once hailed as an enlightened policy, they now regard as nothing more than a ruse to accommodate more traffic.

These arguments have convinced some elected officials, notably New York's Gov. George Pataki, who canceled his own transportation department's proposal for new carpool lanes on the Cross Westchester Expressway and the Long Island Expressway in response to objections by civic and environmental groups. In the state of New York, at least, building carpool lanes is no longer deemed an acceptable approach to relieving traffic congestion.

With work schedules becoming more flexible, travel patterns more complex, "trip chaining" more prevalent, and homes and jobs dispersing to far-flung suburban locations, fewer commuters are taking advantage of carpool lanes.

Questions about HOV lane effectiveness also are being raised within the research community. Joy Dahlgren, a researcher at the Institute of Transportation Studies at the University of California, Berkeley, has argued that there are only very limited circumstances in which HOV lanes are more effective in reducing delay and emissions than general purpose lanes.[3] According to Dahlgren, the addition of an HOV lane will only be more effective when there already is severe congestion and a high proportion of HOVs in the general-purpose lanes. Dahlgren estimates that for a three-lane roadway, the proportion of HOVs must be about 20 percent of total one-way traffic if the HOV lane is to offer an advantage over an extra general-purpose lane. At the same time, the shift to HOV lanes 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 benefits of HOV lanes are limited by low utilization, but if the proportion is too high, the HOV lane provides no travel-time incentive for people to shift to HOVs. We find ourselves confronted with a paradox, says Dahlgren: the HOV lane can retain its incentive only if the general lanes remain congested—a notion that appears to mock the ostensible goal of reducing congestion through the use of HOVs.

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3 Joy Dahlgren, "Are HOV Lanes Really Better?" *Access*, no. 6, Spring 1995.

In sum, while HOV lanes provide a benefit to a small percentage of commuters who are able to carpool, their contribution to the wider objectives of reducing congestion, air pollution, and fuel consumption, has proved to be illusory.

As Carl Williams, former Deputy Secretary of the California Business, and Transportation Agency and currently a senior official of Caltrans, has argued, the time has come to reopen the public debate on HOV lanes and reexamine the orthodoxy that holds them to be an effective way to solve the congestion and air pollution problems. “We need to carefully weigh the emerging evidence and be prepared to challenge current policy if we conclude that what we have been engaged in so avidly is not producing the results we expected,” Williams has written.[4]

B. The Spreading HOV Revolt

In a number of jurisdictions that is precisely what is happening.

1. New Jersey

In November 1998, New Jersey Gov. Christine Whitman announced the elimination of two controversial HOV lanes on Routes I-287 and I-80. The governor justified her decision on the grounds that the HOV lanes failed three nationally recognized criteria for success—their ability to encourage carpooling, to reduce or at least not increase congestion, and to meet a minimum-usage threshold. (The I-80 HOV lanes met the minimum usage of 700 vehicles per hour, but failed the other two criteria). The governor’s action followed months of public protests by grassroots commuter groups and a flood of negative publicity in the local press. Following a hearing attended by many elected officials, the New Jersey congressional delegation introduced an amendment to the federal transportation appropriations bill relieving the state of New Jersey of the obligation to repay the federal government the $240 million it put up to build the lanes on the two Interstates.[5]

2. California

A sweeping provision in a bill in the California Assembly by Assemblyman Tom McClintock (AB 44, December 7, 1998) would require the California Department of Transportation (Caltrans) to redesignate all existing HOV lanes within the state as mixed-flow lanes and would prohibit construction or designation of any new HOV lanes unless a cost-benefit analysis has shown that an HOV lane is the most-efficient alternative. The bill would require the analysis results to be submitted to the Institute of Transportation Studies at the University of California, Berkeley for an independent “certification of competency.” The analysis would have to consider four alternatives: an HOV lane option, a HOT (high occupancy/toll) lane option, a mixed-flow lane option, and a “no-build” option. Only if the results of the analysis established that an HOV lane is the most-efficient alternative would Caltrans be authorized to proceed with its designation or construction.

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4 Carl B. Williams, “Are HOV Lanes Alone Effective?” *Engineering News Record,* September 23, 1996.

5 “The Growing Disenchantment with HOV Lanes,” *Innovation Briefs,* Sept./Oct. 1998.

"Carpool lanes are supposed to increase ridesharing, but the percentage of carpools has remained constant over the years, despite the proliferation of carpool lanes," commented McClintock, the bill's author.[6] "Diamond (HOV) lanes simply provide the illusion of relief to the small percentage of traffic that can use them, while artificially gridlocking the 93 percent of the traffic that cannot . . . . But diamonds don't have to be forever, as New Jersey has proven," he added.[7] The bill is awaiting committee consideration.

3. The Twin Cities, MN

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 permanently opened to regular traffic under a bill proposed by two Minnesota state legislators, Senate Minority Leader Dick Day and state Rep. Doug Reuter. Reuter said the carpool lanes were created to persuade motorists to change their commuting habits, but those habits didn't change. "What we have, is a failed experiment in behavior modification," he added.[8] During his campaign, Gov. Ventura repeatedly pledged that opening the carpool lanes to single-occupant vehicles would be one of his first actions as governor. But the measure was defeated in committee in mid-March 1999, probably killing the proposal for this session.

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4. Long Island, NY

Suffolk County Legislator Steve Levy and Nassau County Legislator Lisanne Altman, citing the recent action of New Jersey abolishing the unpopular carpool lanes on I-287 and I-80, have called on the state Department of Transportation to conduct a two-month experiment during which existing carpool lanes on the Long Island Expressway (LIE) would be open to regular traffic. "For the last two decades, there has been a politically correct mantra that HOV lanes were better off for the environment and traffic flow, but that's all now changing," Mr. Levy said.[9]

Environmental interest groups have joined in opposing the LIE carpool lanes. In a December 16, 1998 letter to Gov. Pataki, the Tri-State Transportation Campaign, an umbrella coalition of environmental advocacy groups in the New York region, called on Gov. Pataki and New York's DOT to halt plans to build new HOV lanes on the Long Island Expressway. The group said the existing HOV lanes on Long Island face an uncertain future, and that adding new ones would inevitably increase pollution, noise, and traffic. The governor, who in October 1997 canceled plans for an HOV lane on the Cross Westchester Expressway north of New York City much for the same reasons, is expected to lend a sympathetic ear to the growing chorus of opposition to the carpool lanes.

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[6] Tom McClintock, "Diamonds Take a Holiday," editorial, *Los Angeles Times*, December 14, 1998.

[7] Ibid.

[8] "Lawmakers Propose Eliminating 'Sane Lanes'," *The Minneapolis Star Tribune*, December 15, 1998.

[9] "On Long Island, More Are Speaking Out Against Expressway Carpool Lanes," *New York Times*, November 3, 1998.

5. Virginia

In Virginia, the General Assembly voted overwhelmingly in January 1999 to lift high occupancy vehicle (HOV) restrictions on the local Interstates in the Hampton Roads area. The bill had the support of all but one legislator from the affected cities of Norfolk, Virginia Beach, and Chesapeake. The state is considering asking for a congressional exemption from having to repay federal funds used to build the HOV facilities, similar to the waiver obtained by the state of New Jersey. Hampton Roads' 26 miles of HOV lanes are among the most underused in the nation according to Dwight L. Farmer, transportation director for the Hampton Roads Planning District Commission. Only about 400 cars per lane per hour use the I-64 carpool lanes, and the trend is downward, with fewer and fewer carpoolers using the HOV facility. The state of New Jersey, it will be recalled, used the criterion of 700 cars/lane/hour as the minimum usage threshold for HOV facilities.[10]

In Northern Virginia, new carpool lanes on the Dulles Toll Road, opened December 15, 1998, were attacked in their first few months. Rep. Frank R. Wolf (R-VA), in a letter to Virginia Transportation Commissioner David R. Gehr, said he has "serious reservations" about them. The business community in the booming and congested Dulles Airport corridor is also skeptical. Virginia DOT officials are wary, remembering the embarrassment six years ago when a public outcry forced them to convert a lane back to regular use only a few weeks after they had set it aside for carpoolers. Although carpool usage in the Washington region is still among the highest in the nation, ridesharing has declined from 17 percent in 1980 to 15 percent today. This trend is expected to continue because many of the commuters in the corridor are high-tech employees who keep irregular hours, use their car during the day, and get free parking at work—conditions that make it difficult to form carpools.

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10 "New Jersey Decommissions its HOV Lanes—Will This Establish a Precedent?" *Innovation Briefs*, Nov./Dec. 1998.

Part 2

The High Occupancy Toll (HOT) Lane Concept

A. Definition

With traditional HOV lanes increasingly under attack, the concept of high occupancy toll lanes (or HOT lanes, for short) is attracting growing attention. HOT lanes can best be described as new or existing high-occupancy vehicle facilities that are open to solo drivers for a fee. They are seen as accomplishing several objectives.

- First, by filling up underutilized carpool lanes they keep HOV lanes at their optimum utilization and relieve political pressure to decommission them.
- Second, by diverting some solo drivers from the adjoining general-purpose lanes, they help to reduce congestion in those lanes.
- Third, they generate revenue for transportation corridor improvements, both highway and transit.
- Finally, they provide a premium travel option to solo drivers who have a special need to reach their destination on time and are willing to pay for the privilege.

The concept, first articulated in 1993 by Gordon J. Fielding and Daniel B. Klein in a paper published by Reason Foundation,[11] has found its first real-world application in the carpool lanes on I-15 in San Diego, California.

B. I-15 HOV Lanes, San Diego, California

The San Diego HOV facility consists of 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 AM and to northbound traffic from 3 to 7 PM. The HOV facility had been operating well under capacity since it was opened to traffic in October 1988. Prompted by a desire to make better use of the existing HOV lane capacity, and to generate revenue for transit service improvements in the corridor, the San Diego Association

11 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 Foundation, November 1993).

of Governments (SANDAG), proposed the 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 first 16-month phase, which began in December 1996, solo drivers were allowed to use the HOV lanes upon purchase of a permit. The permit provided for unlimited use of the HOV lanes for a flat monthly fee. Verification and enforcement during this phase was carried out through visual inspection of a color-coded windshield sticker. In June 1997 the decals were replaced by electronic transponders, thereby facilitating collecting usage data on *ExpressPass* trips. Because the state enabling legislation required SANDAG to maintain the level of service in effect at the start of the project (LOS "C"), the number of SOVs permitted to use the HOV facility was increased gradually, and traffic was monitored carefully to ensure that the lanes remained uncongested.

In a second phase of the demonstration project, which began on March 30, 1998, the flat-rate monthly pass was replaced by a per-trip toll. Toll rates, which range from 50 cents to $4 per trip, fluctuate in real time with changing traffic volume in the HOV lanes. Ordinarily, the maximum $4 rate is charged during the peak of the rush hour, and the lowest fee is in effect when the lanes first open around six AM, and just prior to closing (9:15 AM for the morning period and 7 PM for the evening period), when traffic is light. However, if road sensors detect lighter-than-usual traffic, a lower-than-maximum toll will be charged even during the peak of the rush hour. In exceptional circumstances, when heavy congestion in the free lanes causes a sharp increase in demand in the HOT lanes, the maximum toll may increase to $8.

Electronic signs located in front of the entrance to the HOT lanes give motorists advance notice of the current toll as they approach the toll lanes. Motorists access the HOT lanes at normal highway speeds. To pay the toll, they travel through a separate lane where overhead antennas scan the customer's windshield-mounted transponder and automatically deduct the posted toll from the motorist's pre-paid account.

The intent of value pricing is not to discourage drivers from using congested facilities but to offer them the option of alternative road facilities that provide a higher level of service.

C. Value Pricing

HOT lanes are an application of a new concept called "value pricing." Value pricing has been defined 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."[12] The term was first introduced by the California Private Transportation Company (CPTC), the operator of the SR91 *Express Lanes* project—a privately built four-lane toll facility located in the median of SR 91 in Orange County, California.

While superficially sharing certain common features with road pricing (or "congestion pricing"), value pricing differs fundamentally in its underlying purpose and intent. Traditional road-pricing charges are meant

[12] "High-Occupancy/Toll Lanes and Value Pricing: A Preliminary Assessment," Report of the Institute of Transportation Engineers (ITE) Task Force on HOT Lanes, *ITE Journal*, June 1998.

to reduce demand on heavily congested roads by charging every user a fee. The intent of value pricing is not to discourage drivers from using congested facilities but to offer them—for a fee—the option of alternative road facilities that provide a higher level of service. HOT lanes are one example of value-priced facilities. HOT-lane users obtain tangible value for their money (hence, *value* pricing) in the form of faster, more predictable, and less stressful travel in free-flowing carpool lanes. Unlike traditional toll roads that require all users to pay a fee, HOT lanes offer motorists a choice. Motorists always have the option of staying in the general purpose lanes and traveling free—albeit more slowly. However, drivers who have a special need to make their trip on time and are prepared to pay a fee can enjoy a faster and more predictable trip in the adjoining uncongested carpool lanes.

Fear of being late for work, for an appointment, or for a daycare pickup are the key motivations for using the tolled facility—and these are concerns shared by all commuters, irrespective of income or occupation.

D. 91 Express Lanes, Orange Co., CA: An Application of Value Pricing

The 91 Express Lanes project is the nation's first project to implement the concept of 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).

Two toll lanes in each direction were built in the median of the existing (highly congested) eight-lane freeway. Toll rates vary with the time of day to ensure that the toll lanes remain uncongested at all times. Since the Express Lanes entered service, tolls have been raised four times in order to keep traffic flowing smoothly. The latest toll schedule, effective Jan. 31, 1999, provides eight different price levels between $0.75 and $3.50 for traveling the length of the 10-mile facility. To support California's ridesharing policy, the 91 Express Lanes initially allowed HOV-3+ vehicles to travel free. Because toll revenues were not covering debt service, as of January 1, 1998, the terms of the franchise permitted CPTC to begin charging HOV-3+ vehicles half the regular toll.

All tolls are collected electronically and only vehicles with valid transponders are permitted to enter the Express Lanes. The facility is open to all vehicles carrying transponders issued by CPTC and other toll authorities which use the California AVI (automatic vehicle identification) standard. Approximately 120,000 transponders have been issued, and about an equal number have been issued by other California toll road authorities. Enforcement is done electronically, using photographic license-recording methods as vehicles pass spotter booths located at the midpoint of the facility. Citations are issued by the California Highway Patrol (CHP). Violation notices for vehicles without transponders are sent by mail, and are handled similarly to parking violations.

The Express Lanes facility provides average time savings of 12–13 minutes, but time savings are only one of several motivations for using the Express Lanes. Other perceived benefits offered by the Express Lanes include increased reliability, greater safety, and superior predictability of arrival time. An evaluation study carried out by California Polytechnic's Prof. Edward Sullivan has found that a large majority of motorists do not use the Express Lanes regularly: only 23 percent use the facility every weekday, and a third use it less than once a week.[13] Although there is some evidence that higher-income motorists use the toll facility more often, surveys show that users of the Express Lanes are a very diverse group. Fear of being late for work, for an appointment, or for a daycare pickup are the key motivations for using the tolled facility—and these are concerns shared by all commuters, irrespective of income or occupation. The evaluation would seem to lay to rest the concern that value-priced facilities are only for the rich, as critics were wont to charge.

Value pricing benefits not only the users of the Express Lanes but also motorists in the general purpose lanes, reports Sullivan. Average peak period speeds in the free lanes have increased 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. The study also has shown that value pricing can be a powerful tool of freeway management. By metering vehicles so as to maintain free-flowing traffic at all times, variable pricing enables each tolled lane to carry as many vehicles at 65 mph as a free lane carries at 32 mph. Concludes Sullivan: "Value pricing merits consideration for further experimentation elsewhere."

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[13] Edward C. Sullivan, "Evaluating the Impacts of the SR 91 Variable Toll Express Lane Facility, Final Report," California Polytechnic State University, San Luis Obispo, CA, May 1998.

Part 3

Specific Applications of the HOT Lane Concept

HOT lanes may be justified in several types of circumstances:

- When an existing HOV-2 lane has unused capacity
- When a switch from HOV-2 to HOV-3 leaves the HOV lane with extra capacity
- To add capacity to an existing highly congested freeway
- To manage demand on a new limited-access highway

A. Converting an Existing Underused HOV Lane

An HOV lane is said to be "underperforming" or underutilized when it fails to carry at least an equal number of people as each of the adjoining general-purpose or mixed-flow lanes. Under normal conditions (level of service C or better) a freeway lane has the capacity of approximately 1,500 vehicles per hour, and an equivalent "person throughput" (i.e. 1,500 persons/hour), assuming conservatively that all vehicles carry only one person, i.e. the driver. At an average carpool occupancy rate of 2.1–2.2 persons/vehicle, an HOV lane must, therefore, carry a minimum of 680–714 vehicles per hour (usually rounded off to 700 cars/hour) in order to offer equivalent "person throughput" as each of the adjoining general purpose lanes. This was the minimum-usage threshold employed by the state of New Jersey in its evaluation that led to a decommissioning of the I-287 HOV lanes. This standard was also used by the Virginia legislature in recommending the lifting of HOV restrictions on I-64 in Hampton Roads. Any HOV lane that carries fewer than 700 vehicles per hour is a candidate for conversion to a HOT lane. The conversion of San Diego's underutilized I-15 HOV lane to a HOT lane is a good example of this type of application.

B. Managing a Switch from HOV-2 to HOV-3

When severe congestion in an HOV-2 lane (i.e. when volumes exceed 1,500–1,800 vehicles per hour per lane) necessitates raising the limit to HOV-3, the resulting switch generally leaves the lane with much unused capacity. This unused capacity can be effectively managed by permitting HOV-2 and SOV vehicles to buy space on the facility. The toll rate is set at a level of service that ensures free flow of traffic in the reserved lane. An illustration of this approach is provided below.

The I-10 (Katy) HOV Lane, Houston, Texas

The Katy HOV lane is a 13-mile, barrier-separated, reversible HOV lane located in the freeway median. The facility was opened in stages between 1984 and 1990. The vehicle-occupancy requirement for the lane has changed a number of times, stabilizing at buses, vanpools, and 2+ carpools in 1986. The 2+ occupancy requirement remained in effect until the fall of 1988. In response to high volumes occurring in the morning peak hour and the corresponding decline in travel speeds and travel time reliability, a 3+ vehicle occupancy requirement in the morning peak period was reinstated in October 1988. In the fall of 1991 the 3+ requirement was also applied to the afternoon peak hour. This created excess capacity in the HOV lanes. This led to a decision to allow 2-person carpools to use the HOV lane for a fee during the morning and afternoon peak hours when the 3+ occupancy requirement is in effect. The project, called *QuickRide*, was launched on January 26, 1998. Two-person carpools are charged $2.00 per trip for the use of the lane. The project uses AVI tags and an electronic toll-collection system.

In contrast to the HOV alternative, HOT lanes could be added at no cost to the taxpayers.

C. Adding Capacity to an Existing Freeway

One or more HOT lanes can be added to increase the capacity of an existing freeway. This approach is recommended in corridors where carpool/transit demand is insufficient to justify a dedicated high-occupancy lane. An illustration of this application is the proposed HOT lanes on US 101 in Sonoma County, California and the planned HOT lanes on the reconstructed LBJ Freeway in Dallas.

1. Proposed US 101 HOT Lane in Sonoma County, California

In 1997 the Sonoma County Transportation Authority and the Bay Area's Metropolitan Transportation Commission authorized a feasibility study to compare adding either HOV lanes or HOT lanes to the median of the congested US 101 freeway, the main north-south artery in Sonoma County. Parsons Brinckerhoff developed and analyzed the addition of a single lane in either direction, to be operated either as HOV or HOT.[14] Physically, the only difference between the two would be the addition of overhead gantries with toll-collection and enforcement equipment. For the HOT lane approach, they analyzed both flat-rate and time-variable pricing.

Overall, the feasibility study found that the HOT lane approach would offer better corridor performance than the HOV approach, because speeds in the mixed-flow lanes would be improved to a greater extent (since more vehicles would shift to the HOT lane than would shift to an HOV lane). The variable toll HOT lane was found to be best able to maintain speed levels and time savings in the restricted lane, even assuming that the carpool requirement remains at HOV-2. Most important, for this project, which involves adding new lanes at-grade, the study found that, with variable pricing, the HOT lane approach would likely cover both its

[14] Parsons Brinckerhoff Quade & Douglas, Inc., "Final Report: Sonoma County US 101 Variable Pricing Study," MTC and SCTA, June 6, 1998

capital and operating costs out of toll revenues. In other words, in contrast to the HOV alternative, HOT lanes could be added at no cost to the taxpayers.

2. Proposed Reconstruction of LBJ Freeway in Dallas

In 1997 the 23-member LBJ Executive Board, studying alternatives to cope with increasing congestion on Dallas's LBJ Freeway (I-635), recommended reconstruction of 9.5 miles of this eight-lane freeway with eight free and six HOT lanes.[15] This "locally preferred alternative" was arrived at as the conclusion of a federally required Major Investment Study. Without pricing, demand for the heavily traveled section of I-635 would require 20 lanes by 2015; pricing six lanes and putting some of them below grade would reduce the total to 14. The HOT lanes will have their own grade-separated entrance and exit ramps. Total cost of the project is estimated at $728–878 million. The implementation plan is scheduled for completion in spring 1999, with construction estimated to begin in 2002, continuing in stages through 2015.

D. Managing Demand on a New Limited-Access Highway

In the case of a newly constructed limited-access highway in a highly congested travel corridor, the entire project could be operated as a high occupancy/toll facility. Variable tolls would be used to control single-occupant vehicle (SOV) demand and thus ensure that the entire facility maintains a predesignated level of service (e.g. LOS C) at all times, even in the peak periods. This would also allow the facility to serve as a fast transitway (busway), while at the same time providing a priced option to single motorists who are in a hurry. Electronic toll collection would be used to provide tollgate-free and cashless access to the highway. An illustration of this approach is the proposed suburb-to-suburb "Intercounty Connector" in the congested Montgomery and Prince Georges, MD counties in metropolitan Washington, D.C. Without tolls, it is feared, the facility would quickly become swamped with traffic.[16]

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As of early 1999, HOT lane projects of all four types were on the drawing board, in process, or operational in some 20 locations in nine states, as shown in Table 1.

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15 Peter Samuel, "Dallas Plans 6-HOT Lanes in New 14-Lane LBJ Fwy.," *Toll Roads Newsletter*, June 1997; "First Dynamically Priced Pike Planned," *Toll Roads Newsletter*, February 1999.

16 "The Spreading Revolt Against HOV Lanes, Cont'd." *Innovation Briefs*, March/April 1999.

Table 1: Current HOT Lane Projects

State	Location	Facility	Status
AZ	Phoenix	all freeways	study
CA	Alameda Co.	I-680	study
	Contra Costa Co.	SR 4W	study
	Los Angeles Co.	SR 14	study
	Orange Co.	SR 91	operational
	Orange Co.	SR 57	study
	Riverside Co.	SR 91	study
	San Diego Co.	I-15	operational
	Sonoma Co.	SR 101	on hold
CO	Denver	I-25	legislation
FL	Miami	SR 836, 874	plans
MD	Annapolis	US 50 Bay Br.	prop. study
	Baltimore	I-95/I-895 tun.	prop. study
	Balt.-DC suburbs	I-270/I-495	prop. study
MN	Mpls./St. Paul	all freeways	study
TX	Austin	I-35	study
	Dallas	I-635/I-35E	MIS
	Houston	I-10	operational
	Houston	I-10 exp.	MIS
	Houston	I-45/US290/US59	studies
VA	Hampton Roads	I-64	approved
	VA-44	study	
WI	Milwaukee	I-94	prop. study

Part 4

Legal Authority

A. Federal Authorization

The Federal Highway Administration (FHWA) has published implementation guidance for the $51 million Value Pricing Pilot Program authorized in Section 1216(a) of TEA-21 (FR Doc. 98-26531, Oct. 2, 1998). Eligible projects include both classic congestion pricing projects, i.e. projects that use charges to “encourage drivers to use alternative times, routes, modes or trip patterns during congested periods,” and true value pricing projects, i.e. tolled facilities that offer value to toll-paying motorists in the form of a premium level of service and time savings. Also declared eligible are “innovative time-of-day parking pricing strategies . . . designed to influence trip-making behavior.” Pricing of lanes otherwise reserved for high-occupancy vehicles (i.e. HOT lanes) is explicitly authorized. However, in order to protect the integrity of HOV programs, priority will be given to “those HOT lane proposals where it is clear that an HOV lane is underutilized.”

Thus, FHWA is actively encouraging states and metropolitan planning organizations (MPOs) to propose HOT lane projects, including the conversion of underutilized HOV lanes. However, some HOV lanes (such as the one on the Katy Freeway in Houston) have been funded not by FHWA but by the Federal Transit Administration. As of early 1999, FTA appeared to be taking the position that any attempt to convert this type of HOV lane to a HOT lane would face the obstacle of the FTA demanding the repayment of all previous FTA funds spent on the project. Because of the added cost of grant payback, such a policy threatens to make proposed conversions (e.g., that proposed for the HOV lanes on I-25 in Denver) financially infeasible, unless a congressional exemption from having to repay federal funds, similar to the waiver granted to New Jersey, is provided.

B. State Pricing/Conversion Authorization

Despite the encouragement provided by FHWA, state departments of transportation may not necessarily possess the legal authority under state law either to charge fees on an existing unpriced facility or to convert HOV lanes to HOT lanes. For example, no fee may be charged for any public highway in California without specific legislative authorization. Thus, the 91 Express Lanes came about only because of a 1989 measure authorizing four pilot private toll road projects. And the HOV lane conversion on I-15 in San Diego required another specific piece of legislation. As of early 1999, general HOT lane enabling measures were pending in several states.

1. Colorado

In **Colorado**, a legislative proposal by Sen. John Andrews (Senate bill 99-88) would require the Colorado Department of Transportation to designate one or more existing HOV lanes as high occupancy/toll (HOT) lanes. By early 1999, the bill had been approved by the senate transportation committee and awaited floor action. A related proposal, to mandate construction of one or more new HOT lanes to be operated by a "private entity" under a build-operate-transfer arrangement, was struck down in the committee.

2. Georgia

In **Georgia,** House bill 45, sponsored by Rep. Bob Irvin (Fulton County), would authorize the Georgia DOT to consider opening existing HOV lanes to single-occupant vehicles and to charge drivers of such vehicles a fee. Rep. Irvin originally proposed the measure in 1998, but at that time it received little attention. In early 1999, the re-introduced measure became the subject of considerable legislative and media interest.

C. State Enforcement Issues

As noted in the next section, HOT lanes depend on the use of electronic toll collection (ETC). Efficient enforcement of ETC, in turn, depends on the legality of video enforcement techniques, under which a video recording of the license-plate number is admissible as evidence of a violation (as opposed to a patrol officer's live visual observation), and the vehicle's registered owner (which is all that can be determined from a license-plate reading) is legally the responsible party. Most states which have implemented ETC on their toll facilities have enacted such measures. States which do not currently have toll roads or bridges in operation may need to enact this kind of legislation to facilitate enforcement of toll payment.

Part 5

Technical Feasibility of HOT Lanes

A. Toll-collection Issues

In principle, three different ways of collecting the fees from paying customers are usable for HOT lanes: conventional toll booths, the use of permits (such as window placards), or electronic toll collection. In nearly all cases, practicality will rule out the first two of these. There is no room to add toll booths to congested urban freeways, and the need for cars to stop at such booths would add to congestion, create safety problems, and make the HOT lane unpopular. Moreover, the high cost of labor-intensive toll booths would also reduce the HOT lane's economic viability. Window stickers were used in the initial phase of the I-15 conversion, but a weekly or monthly sticker limits the facility to a very crude form of pricing—essentially a weekly or monthly flat rate to use the HOT lane, regardless of the number of trips, the level of congestion, or any other operational factor. This would greatly limit the facility operator's ability to manage traffic flow to maintain uncongested flow in the lane.

The breakthrough that makes HOT lanes attractive is the development of electronic toll collection (ETC) technology over the past decade. In its simplest form, this involves equipping each vehicle with a tag the size of a box of playing cards, usually mounted above the dashboard on the inside of the windshield. As the vehicle passes beneath an overhead gantry, the tag is interrogated by a low-power radio signal and sends back its hard-wired I.D. number. The ETC system's computers charge that account the amount of the toll in effect at that location for that particular time of day. Tags can be read accurately at speeds in excess of 65 mph; hence, no special toll lanes are required. Tolls can be charged at various points along the HOT lane, and payment can be based on the number of miles traveled as well as the time of day or day of week, etc. This permits tolls to be fine-tuned in response to actual congestion levels, as is done on the I-15 lanes.

Tolls can be charged on either a credit or a debit basis. With the former, a bill is created and sent to the user at, say, monthly intervals, much like a telephone bill. With the latter, the patron's account balance is debited each time a trip is taken, and the system provides a visual warning when the account balance reaches a predetermined low threshold requiring replenishment. Debit-type systems permit the establishment of anonymous accounts to protect users' privacy. As with a numbered Swiss bank account, an anonymous toll account carries only an account number and is replenished in cash. (Such accounts are offered on the Dallas North Toll Road, the 91 Express Lanes, and on Highway 407 ETR in Toronto.)

As existing U.S. toll roads and bridges convert increasingly to ETC, de-facto regional ETC standards are emerging—one in the Northeast, another in the South and Southwest, and another in the West. It is widely expected that the next generation of ETC tags will be designed to a common national standard.

B. Lane-separation Issues

In its feasibility study of adding HOT lanes to SR 101 in California's Sonoma County, Parsons Brinckerhoff assessed three alternative ways of separating the HOT lane from the regular (mixed-flow) lanes: striping, buffer, and barrier.

Most current HOV lanes are not physically separated from the regular lanes; instead, they are set off by special pavement striping. While clearly the lowest-cost approach, striping makes it temptingly easy for nonqualifying drivers to move in and out of the HOT lane at will, disrupting traffic flow and contributing to safety problems (as well as cheating the system of revenue).

The most-expensive approach is to separate the HOT lanes by some form of concrete barrier. This might take the form of permanent "Jersey barriers" or (in cases where the flow of traffic is heavily in one direction in the morning and in the opposite direction in the afternoon) by a combination of fixed and movable concrete barriers (such as those offered by Barrier Systems, Inc.). Concrete barriers eliminate random ingress/egress problems but may also limit access by police and ambulance vehicles.

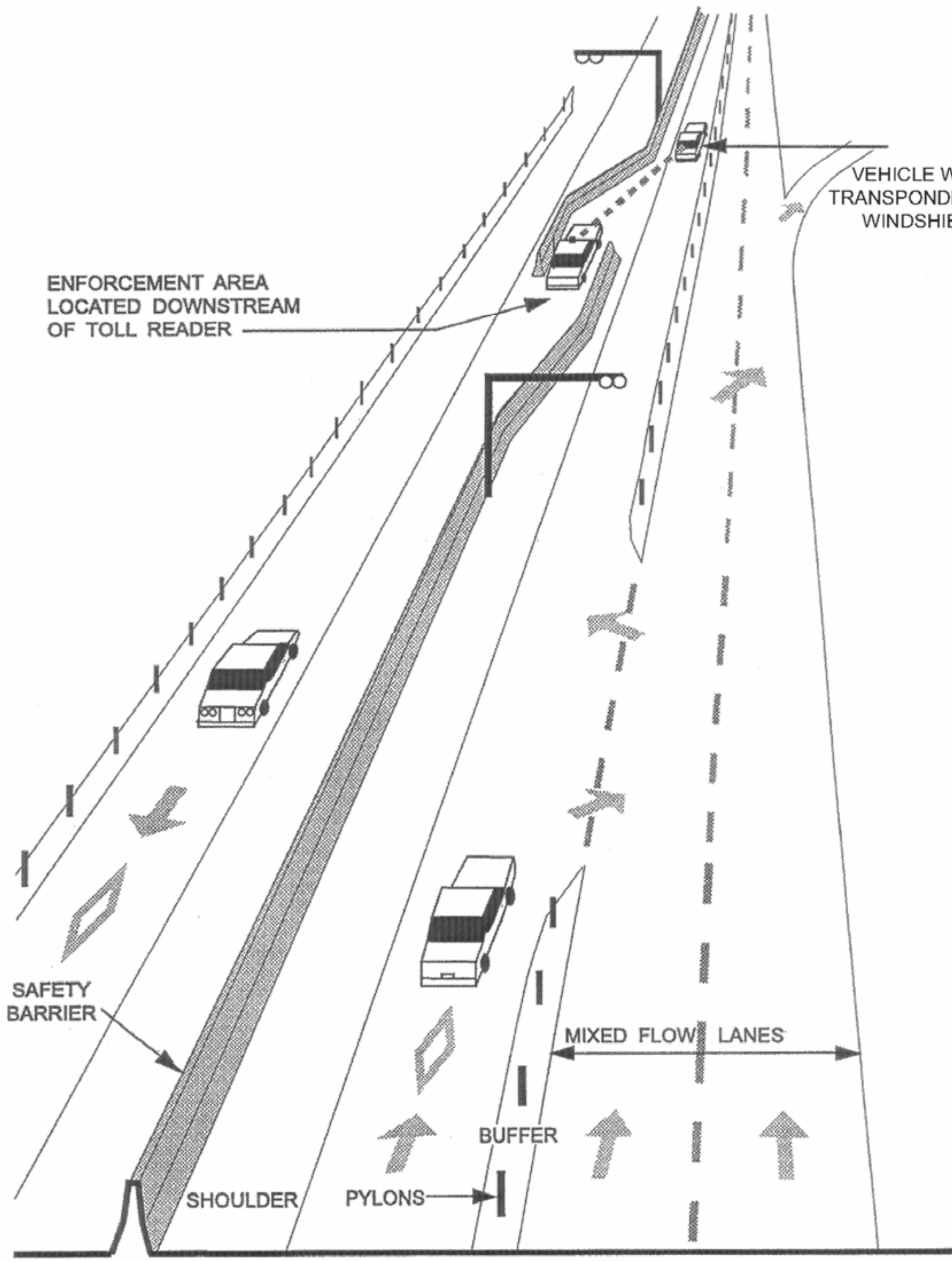
A compromise approach, as recommended by Parsons Brinckerhoff for the proposed Sonoma County HOT lane, is the use of "buffer" separation via plastic pylon channelizers. This is the approach used successfully on the 91 Express Lanes. The plastic pylons are about 20 inches tall, colored yellow or orange, and mounted permanently to the pavement within a four-foot-wide buffer area. With this approach, emergency vehicles can cross the buffer (since the plastic pylons bend when struck), but experience shows that the pylons serve as a psychological barrier to drivers tempted to cross the buffer illegally.

Figure 1 illustrates the Parsons Brinckerhoff concept of pylon-based buffer separation, showing the placement of overhead toll-reading gantries and the inclusion of enforcement areas for police vehicles, located downstream from the toll reader.

C. Enforcement Technology

To accomplish its purpose of offering reliable time savings, a HOT lane's limited access must be enforced. This means enforcing both the HOV requirement for qualifying carpools and the payment requirement for all other vehicles. Where ample space is available (as on both the SR 91 and I-15 projects), carpool and paying vehicles can be directed into separate lanes at one portion of the HOT lane, so that the HOV occupancy requirement can be visually checked by enforcement personnel. Payment from the other vehicles is checked via the ETC system, usually by automatically switching on a video camera if the ETC system fails to detect a valid account number or a positive account balance. The camera photographs the license-plate number, which—along with the date and time—becomes the basis for sending either a warning or a violation notice via the mails. Both methods are supplemented by patrol cars, which also can be sent after violators.

Figure 1: Toll Reading and Enforcement—Buffer Separated Lanes: Sonoma County/US 101 Variable Pricing Study



Source: Parsons Brinckeroff, 1998.

But on most future HOT lanes, more sophisticated methods will be needed. First, there will seldom be enough room to add additional lanes for enforcement purposes only. Second, for HOT lanes with many possible ingress and egress locations (unlike the I-15 and SR 91, each of which has no intermediate ingress or egress points), means of enforcement must be available for each and every segment. Figure 1 illustrates a workable concept including an enforcement area (capable of housing a patrol car able to move in either direction) in the median at each location where toll-collection gantries are located. When such an enforcement area was in use, the officer would receive a signal from the gantry in those cases where either no dashboard transponder is detected or some problem exists (invalid account, stolen transponder, too-low account balance). Alerted by this signal, the officer visually checks to see if the vehicle is a valid carpool, in which case no action is necessary. Otherwise, the patrol car may give chase.

D. Signage

Two types of signage are necessary for a HOT lane. The first is what is required for a conventional HOV lane—specifically, advance notice of ingress and egress points. As is the case with HOV lanes, a HOT lane is intended for relatively long commutes rather than short on-and-off-the-freeway trips. Thus, access to and from the HOT lane will be limited to selected major interchanges rather than to all freeway on-ramps and off-ramps.

The type of signage unique to HOT lanes consists of changeable message signs announcing the toll rate in effect at the time a driver must make a decision on whether or not to use the lane. Such signage is needed because the prices will vary—either in accordance with a preset toll schedule based on average congestion levels at various times of day and days of the week (as on SR 91), or more specifically in response to actual congestion levels in real time (as on I-15)—in order to limit the number of vehicles per hour to a volume consistent with smoothly flowing traffic (typically 1,500 to 1,700 vehicles per lane per hour).

For the 91 and I-15 projects, which have only a single entrance and exit, one or two changeable message signs a quarter mile in advance of the facility are sufficient. But for future HOT lanes with multiple ingress and egress points, such signs must be placed overhead before each such ingress point. The signs could either post the current charge per mile or could list several major destinations, the miles to each, and the current charge to go that distance. Future changeable message signs on approaches to HOT lanes may also include real-time information about the prevailing level of congestion and estimated time delay penalty involved in staying in the general-purpose lanes.

Part 6

Economic Feasibility

Only limited information is available thus far on the economic feasibility of HOT lanes. On the one hand, converting existing, underutilized HOV lanes to HOT lanes will almost certainly cost far less than the potential revenues, raising questions of how to make use of the surplus revenues. At the other end of the spectrum, adding new lanes that are grade-separated (especially elevated lanes, where space is very tight) is unlikely to be financially feasible—in the sense of the annual revenues generated being greater than the annualized cost of doing the project. That does not necessarily mean the project is not worthwhile—since the alternatives are almost certainly other projects that will have significant costs but will not generate any revenues. In between these extremes are a number of possible projects which will be partially or largely self-supporting, but may require some support from conventional (i.e., fuel tax) highway sources.

A. HOV-HOT Conversions

The cost of converting an existing HOV lane to a HOT lane is relatively low. The principal capital expenditures are for plastic pylons, changeable message signs, gantries, toll reading and video-enforcement equipment, and the computer hardware and software needed to complete the transactions. The pavement and striping are already there, as are the ingress/egress signs. Drivers themselves will pay for the in-vehicle tags (though the project developer/operator will have to purchase them in bulk up-front for lease or sale to motorists). Operating costs include staff to sell or lease the tags, staff to operate and maintain the ETC system, some degree of advertising/marketing to explain the HOT lane to potential users, and possibly higher enforcement costs because of the importance of credible enforcement to the revenue stream.

The I-15 conversion required just $1.85 million in capital costs (not including the transponders paid for by individual drivers) and is generating revenue at the rate of approximately $1 million per year. The capital costs were paid for by federal grant funds, as a demonstration project; thus, all project revenues are available to subsidize a new bus service in the corridor, using the HOT lane, called the Inland Breeze.

B. 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—i.e., the revenues can equal or exceed the capital and operating costs.

The 91 Express Lanes project added four new lanes for 10 miles (plus a short stretch with an additional lane in each direction for HOV enforcement) to the wide median of the Riverside Freeway at a total capital cost of $130 million. Because this project was developed by a private firm using conventional financing, it issued taxable revenue bonds at nine percent interest rate, resulting in quite high annual debt-service costs. Nevertheless, demand for congestion relief in this corridor was so strong that the company announced the project had reached breakeven before the end of its third year, in 1998. In other words, toll revenues paid by drivers choosing to use the HOT lanes rather than the adjacent regular lanes are now high enough to cover the project's annual debt service, all operating and maintenance costs (including, by the terms of the company's franchise, all highway patrol costs), with at least the beginnings of a profit to the company.[17]

The other new-capacity HOT lane for which semi-detailed figures are available is the proposed addition of HOT lanes to US 101 in Sonoma County, California. It would add a single HOT lane in each direction in the median of this freeway. The 15-mile version of this project was projected to cost $85-119 million while the 24-mile version was put at $125–177 million. The lower estimate in each case is based on less-than-standard shoulder widths. The study found that the lower-cost version (of either length) would cover both its capital and operating/maintenance costs from toll revenues, while the higher-cost version might also do so, if the higher-end revenue estimates (based on variable rather than flat-rate tolls) were achieved. Parsons Brinckerhoff summarized its study by stating: "The bottom line is that this project is financially, physically, and operationally feasible."

The I-15 conversion required just $1.85 million in capital costs (not including the transponders paid for by individual drivers) and is generating revenue at the rate of approximately $1 million per year.

Using cost estimates from both Caltrans and the Parsons Brinckerhoff US 101 study, the Reason Public Policy Institute examined a more elaborate HOT lanes project for the San Fernando Valley region of Los Angeles. First, it would acquire land to widen US 101 (the Ventura Freeway) for 13.6 miles through the Valley, providing the space to add a HOT lane in each direction as the innermost lane. Second, it would convert the existing and planned HOV lanes on I-405 (the San Diego Freeway) in the Valley and the Sepulveda Pass to HOT lanes. Finally, it would build HOT-HOT connectors above the heavily congested 101-405 interchange. The project's total estimated cost is $418 million. Estimated annual toll revenues of $22 million would support the issuance of $366 million in tax-exempt revenue bonds at 6 percent interest. Thus, this ambitious and costly project could cover 88 percent of its capital costs from toll revenues.[18]

C. Public-Private Partnerships

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[17] It should be noted that the company's overall rate of return is limited by its franchise agreement with the California Transportation Department (Caltrans). In any year in which net earnings exceed that negotiated ceiling, the excess revenues are to be either be used to retire debt earlier or be deposited into the state highway fund.

[18] Peter Gordon, James E. Moore II, Robert W. Poole, Jr., and Thomas A. Rubin, "Improving Transportation in the San Fernando Valley," Policy Study No. 249 (Los Angeles: Reason Public Policy Institute, January 1999).

The 91 Express Lanes was the first project developed under California's landmark transportation public-private partnership law, AB 680. Fifteen states now have some form of legislation of this type in place, under which the state DOT (and in some cases other levels of government) can competitively contract for the development and/or operation of transportation facilities by the private sector. The I-15 HOT lane conversion was developed by the San Diego Association of Governments (SANDAG), but the system is operated by TransCore under contract to SANDAG.

There are several advantages to such arrangements. The private sector is generally able to develop such projects using fast-track methods such as design-build, with which government agencies are typically less familiar or even prohibited from using. Companies are also generally more adept at marketing and at making full use of market pricing to deliver guaranteed time savings to their customers. Because of their bottom-line orientation, they are more likely to develop innovative ways of keeping life-cycle costs low—e.g., using a higher quality of pavement at the outset if this will lead to lower maintenance costs over the life of the project (as occurred on the 91 Express Lanes).

But early public-private partnership laws (such as AB 680) also imposed unrealistic burdens on the private-sector partner. They required 100 percent of all capital costs to come from nontax sources—even the risky up-front environmental-impact costs (which can be very hard to raise from investors because of the risk that the project will be judged unable to go forward). And they required 100 percent of operating costs to be paid for out of project revenues—even costs such as law enforcement that would normally be paid for from state funds. 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 highway public-private partnership laws—such as those in Texas and Virginia—permit the state to cover risky initial expenses and in certain cases to provide partial public funding of construction costs. They also provide ways of issuing tax-exempt toll revenue bonds for the project, either via an existing state toll agency or by the creation of a special-purpose nonprofit corporation. Until or unless Congress modifies the tax code to permit private highway developer-operators to issue tax-exempt toll revenue bonds, as Sen. John Chafee (R., RI) has proposed, state partnership laws should explicitly provide a way that tax-exempt revenue bonds can be used for public-private toll projects such as HOT lanes.[19]

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[19] For a discussion of this issue of the need for a level financial playing field, see Karen J. Hedlund, *The Case for Tax-Exempt Financing of Public-Private Partnerships* (Los Angeles: Reason Public Policy Institute, February 1998).

Part 7

Political Feasibility

Although interest in HOT lanes has been growing rapidly, by early 1999 only three such projects were actually in operation—one involving new lanes and two involving conversions of underutilized HOV lanes. How feasible will it actually be to make fairly widespread use of HOT lanes? Three principal concerns are likely to arise when HOT lanes are proposed in a metro area: undermining the HOV concept, concerns over environmentalist opposition, and concerns about equity and elitism. We will address each issue in turn.

A. Subversion of HOV Concept?

As noted in Part 1, a serious backlash against HOV lanes appears to be under way. In many metro areas, it is becoming clear that most HOV lanes are not working, in the sense that they are not increasing the extent of carpooling, and in many cases they are carrying fewer people per hour than regular lanes. Nonetheless, in cities where HOV lanes have established a significant user group, there may be significant political opposition to converting them to HOT lanes.

There are several relevant responses. First, in places where the HOV backlash is severe, opening the lanes up to a larger fraction of all vehicles may be the only way to save them from being converted to general-purpose lanes (as has happened in New Jersey and as has been proposed in pending California, Minnesota, and Virginia legislation). Second, the use of variable pricing may be the only feasible way to keep such a lane flowing smoothly when and as its popularity increases. A popular HOV-2 lane will eventually fill up to the point of serious congestion; as noted previously, raising the occupancy requirement to HOV-3 will restore uncongested flow, but only at the risk of serious backlash from those newly excluded—unless those people are permitted to buy their way back in. And should a HOT lane begin attracting so many vehicles that it begins to be congested and lose its time-saving advantage, raising the price can quickly restore uncongested conditions, as both the 91 and I-15 projects in California are demonstrating.

It is interesting to note that carpooling has actually increased on both California HOT lanes. Carpool volume on the I-15 increased by 23 percent in the AM period and 14 percent in the PM period during the first year since the conversion from HOV to HOT.[20] Carpooling has also increased over time, though more modestly, on the 91 Express Lanes.[21] Hence, HOT lanes do not appear to undermine ridesharing.

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[20] "I-15 Congestion Pricing Project Monitoring and Evaluation Services, Phase I Report," prepared for San Diego Association of Governments by San Diego State University, Department of Civil and Environmental Engineering, Dec. 30, 1998.

[21] Edward C. Sullivan, "Evaluating the Impacts of the SR 91 Variable Toll Express Lane Facility."

In metro areas where HOV lanes have not yet been introduced, policymakers should consider the option of introducing tolled express lanes (i.e., without the HOVs-go-free feature) instead of HOT lanes. The cost savings available via splitting the toll among two or three people will still provide a strong incentive for carpooling. But enforcement will be simpler and less costly without the need for the enforcement system to distinguish between paying customers and qualifying (free) carpools. One version of this approach, called ValuExpress Lanes, has been proposed by researchers at the Institute for Transportation Research and Education at North Carolina State University.[22]

Carpooling has actually increased on both California HOT lanes. Carpool volume on the I-15 increased by 23 percent in the AM period and 14 percent in the PM period during the first year since the conversion from HOV to HOT.

B. Environmental Concerns

The 1991 ISTEA legislation introduced the requirement that any highway project which adds capacity in a metro area that is a “nonattainment area” for air quality cannot be built unless it is found to be in conformity with that state’s air-quality State Implementation Plan, as required by the Clean Air Act. Thus, if a HOT lane project is proposed in such a metro area, the responsible agencies will have to demonstrate the project’s “conformity.”

Converting an existing HOV lane to a HOT lane should not pose any problem, since it does not involve adding capacity. However, the addition of new lanes configured as HOT lanes may involve the need for a finding of conformity. The analytical case may involve computer modeling to show that overall traffic flow will be improved in the corridor in question, reducing the extent of stop-and-go traffic (and hence, reducing running emissions) in the existing lanes while guaranteeing the smooth flow of traffic in the HOT lane. This kind of calculation was involved in the conformity documentation for the 91 Express Lanes, which added a total of four new lanes to the congested Riverside Freeway (SR 91).

In most cases, especially where only a single HOT lane is added in each direction, the changes in emissions due to this change will be very small. A 1995 report from the Transportation Research Board concluded that changes in emissions from even major road improvements are likely to be so small as to be unmeasurable.[23]

Different environmental organizations may be on opposite sides of the HOT lane question. Some of these groups, such as the Chesapeake Bay Foundation, argue that even allowing carpools into 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 road pricing, as a way of making auto users pay what they believe to be the full costs of driving. Most notably, the Environmental Defense Fund strongly supported the 91 Express Lanes as a step towards wider use of road

[22] Available on the Internet at http://itre.ncsu.edu/PPF/documents/RTPimprovements.pdf.

[23] 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).

pricing—even though this project involved adding four lanes to an existing freeway. EDF has also argued for the addition of HOT lanes in several counties in the San Francisco Bay Area. Other environmental groups have supported road pricing and HOT lanes in Oregon and in the New York City metro area. Some of these groups may support HOV-to-HOT conversions but not the addition of new HOT lanes. Still, it is important for policy makers to be aware of the range of views on road pricing and HOT lanes among environmental groups.

C. Equity and Elitism

Perhaps the most troubling argument raised against HOT lanes is the claim that they are elitist—lanes which the rich can use to speed past the poor who remain stuck in traffic. The favorite term of those criticizing HOT lanes on these grounds is “Lexus Lanes.” The alternative way to look at the same circumstances is that HOT lanes represent the first small step away from a one-size-fits-all highway system toward one that tries to do a better job of meeting people’s different demands for mobility. A mother racing to get to the day-care center before $1 per minute late fees kick in may well decide it is worth it to pay $2 to use a HOT lane to bypass congestion in order to save $10 in late fees. A plumber trying to fit in one last appointment in a busy day may be able to do so only by speeding past congestion, gladly paying the HOT lane’s charge. Other people would prefer to remain in the regular lanes—none of which are taken away by the HOT lane program—and continue to “pay” in the form of time rather than dollars.

Data collected from the 91 and I-15 projects bear out these descriptions. To be sure, people of higher incomes tend to be heavier users of these HOT lanes than people of lower incomes, on average. But the data show that people of all income levels choose to use the HOT lanes on certain occasions when saving time is really important.

Two other important categories of user benefit from the presence of a HOT lane on a congested freeway. Transit vehicles gain access to a faster-moving lane, giving them a competitive advantage over auto use in the regular lanes. In some cases, this time saving may be enough to make express buses or commuter-shuttle vans the mode of choice.[24] And emergency vehicles—police, fire, ambulance, tow truck—also gain a less-congested path to their destinations. This is obviously the case when a HOT lane is added to a freeway lacking any kind of limited-access lane. But it is also true, in the long-run, when an HOV lane is converted to a HOT lane. Only by making use of pricing can such a lane guarantee to remain free-flowing over its entire life.

Parsons Brinckerhoff’s Sonoma County HOT lane report summed up its conclusions on the equity of adding a HOT lane rather than an HOV lane, as follows:

- Only the users of the facility pay the tolls—which is superior to the general case of highway funding, which is filled with cross-subsidies.
- Many people benefit who do not have to pay—i.e., there are positive spinoff benefits for the adjacent general-purpose lanes as well as for the overall highway network.
- The users of the HOT lane are not exclusively the rich—as data from existing HOT lanes have made clear.
- Low-income users sometimes have a critical need to save time—and no current way to meet this need, until HOT lanes become available.

[24] 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).

- By forming carpools or using transit, users of all income classes can reduce toll costs.
- Even if there were inequities, toll revenue can be used to mitigate them—as San Diego is doing by providing express bus service in its I-15 HOT lane corridor.

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

Appendix—HOT Lanes Companies

Firm Name and Contact Information	HOT Lanes Expertise	
	Feasibility Studies	Development/Operation
Calif. Private Transportation Co. 180 N. Riverview Dr. #290 Anaheim, CA 92808 Attn: Greg Hulsizer 714-637-9191, ext. 328		✓
Daniel, Mann, Johnson & Mendenhall 3520 Wilshire Blvd. Los Angeles, CA 90010 Attn: Ray Holdsworth 213-381-3663	✓	✓
The eTrans Group, Inc. 150 Burnham Wood Lane Alpharetta, GA 30222 Attn: Daryl Fleming 770-734-9605; isiflem@aol.com	✓	✓
Peter Kiewit Sons', Inc. Kiewit Plaza Omaha, NE 68131 Attn: Gerald Pfeffer 402-943-1301; gspfeffer@kiewit.com		✓
Parsons Brinckerhoff Quade & Douglas 303 2nd Street, #700 North San Francisco, CA 94107 Attn: James Bourgart 415-243-4750; Bourgart@pbworld.com	✓	✓
TransCore 10260 Campus Point Drive San Diego, CA 92121 Attn: Hakim Al-Taanton 619-458-2554; Hakim.al-taan@cmpx.saic.com	✓	✓
Wilbur Smith Associates 135 College Street P.O. Box 9412 New Haven, CT 06534 Attn: Edward J. Regan, III 203-865-2191	✓	

About The Authors

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C. Kenneth Orski is editor and publisher of *Innovations Briefs*, a newsletter reporting on new developments and policy issues in the field of transportation. He is the chair of the Institute of Transportation Engineers Task Force on HOT Lanes and is also president of the Urban Mobility Corporation, a Washington-based transportation consulting firm which he founded in 1981. In addition to his publishing and consulting activities, Mr. Orski directs MIT's International Mobility Observatory. The project, which is sponsored by the international automobile industry through the World Economic Forum, documents and assesses global trends in transportation innovation.

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