

# Interstate 880 Value Pricing Feasibility Study

## Summary & Conclusions

### What are the objectives of the study?

The objectives of the study are to:

- Determine whether there is potential demand for light-duty (2-axle) commercial vehicles to pay a toll or fee to buy into service on the existing high-occupancy vehicle (HOV) lanes on Interstate 880. These are also known as high-occupancy toll (“HOT”) lanes.
- Determine the available HOV capacity over a time horizon of approximately 20 years
- Determine the special operational and/or enforcement issues associated with commercial vehicle buy-in to the HOV lanes
- Determine the revenues, costs, and overall financial feasibility of such a program
- Recommend one or more options for possible implementation as a pilot program

### Are there examples of value pricing projects elsewhere?

There are several applications in North America of variable pricing for the use of highway lanes based on the time of day or degree of congestion:

- *SR 91 “Express Lanes” in Orange County, California.* This is a 10-mile privately funded and managed toll facility that opened in December 1995. It consists of the four inside lanes of a freeway corridor, two in each direction, which are separated by a pyloned buffer from adjacent lanes. The remainder of the freeway is four mixed-flow lanes in each direction. The public freeway is extremely congested during peak commute hours. The SR 91 Express Lanes charge users between \$ 0.80 and \$3.75 per trip, depending upon time of day. HOVs with three or more occupants were allowed to travel for free from the opening of the facility until January 1998, when a half-price charge was instituted. This project is the first fully electronic and automated toll road with variable pricing in the U.S. Each time a vehicle drives through the electronic toll lane, electronic sensors deduct the toll amount from the driver’s account. There are no intermediate entry or exit points on the priced lanes. Two-axle commercial vehicles under 10,000 pounds are permitted.
- *I-15 HOT Lanes in San Diego, California.* In December 1996 an existing 8-mile, underutilized 2-lane reversible HOV facility was converted to high-occupancy toll (“HOT”) lanes. A limited number of drivers were offered the opportunity to purchase “Express Pass” permits for a monthly fee of \$70, which allowed a single-occupant vehicle to use the HOV lane during peak hours. The demand for permits far exceeded the number sold; the number was limited in order to maintain an acceptable level of service on the corridor. Electronic tolling and “dynamic pricing” began in 1998. Dynamic pricing means that, instead of a predetermined toll rate, the rate fluctuates according to the amount of traffic actually on the road during that particular time of day. An electronic message board displays the fare to drivers at the entrance. The average peak-period price is approximately \$3.50 per trip, though on rare occasions the price has gone as high as \$8.00, the maximum allowed. The lanes are reversible and this roadway is separated from adjacent lanes by permanent

concrete barriers, with ingress and egress only available on either end. Two-axle commercial vehicles are permitted on the HOT lanes.

- *Katy Freeway, Houston, Texas.* This is a 13-mile reversible, barrier-separated HOV lane on the Katy Freeway (Interstate 10) that allows use by two-person carpools for a fee during the most heavily congested AM and PM peak hours. Carpools of three or more continue to ride for free, and single-occupant vehicles are not eligible to use the lane. The “Quickride” lane uses windshield transponders to charge either \$2 or \$3 per trip.
- *Lee County, Florida.* The Florida Department of Transportation installed electronic toll collection on several existing toll bridges and offers a 50 percent discount for use during non-peak traffic hours.
- *Toronto Canada, 407 Express Toll Route.* Toll collection on this new 36-kilometer freeway began in 1997. The project, which was financed by a public-private partnership, charges \$0.10 per kilometer during weekday peak hours; \$0.07 per kilometer during off-peak weekday and daytime weekend; and \$0.04 per kilometer for the nighttime. Toll collection is through electronic transponders.

### **What is the Purpose and Need?**

There are three principal purposes potentially served by permitting small commercial vehicles to buy into the Interstate 880 HOV lanes:

*System capacity management:* Pricing offers another means of managing the dedicated priority lanes along I-880. Management of dedicated lanes can take the form of user restrictions, pricing and access controls. To date, user restrictions favoring HOVs provide the sole means of managing these lanes. Pricing would offer another way of enhancing management of the lanes while preserving current travel benefits enjoyed by HOVs.

From a system management perspective, it is desirable to operate close to capacity to maximize throughput, especially where there is a high demand, but still provide a safety margin so that minor reductions from free flow speeds can be maintained even with minor traffic disturbances. Generally, this condition is considered to be Level of Service D, which extends from approximately 75% to 92% of capacity. Where there is excess capacity, generally it can be allocated where roadway benefits are maximized. In the case of the I-880 proposal, small commercial vehicles would be able to experience the travel time savings now being experienced by HOVs in the lanes. These savings presumably would translate in economic benefits to the commercial users and their customers.

*Goods movement route efficiency:* The Bay Area’s largest port, the Port of Oakland, is located within the I-880 corridor. The Port generates 25% of the truck traffic on I-880 and approximately 9% of all truck traffic in the Bay Area. A high volume of goods moves to and from the Silicon Valley on the south end of the corridor. I-880 has been identified as the most critical goods movement corridor in the region and, therefore, its viability is essential to regional economic vitality.

Any improvement in system management benefits goods movement and commercial services, if it reduces congestion and delays. Permitting commercial vehicles to move into unused capacity in the HOV lanes could help in two ways: (1) those small commercial vehicles permitted into the lane, especially package delivery services and those with construction-related cargo, would

experience reduced delays, and (2) removing those commercial vehicles from the mixed-flow lanes would free up more capacity for faster movement of larger commercial vehicles.

*Increase flexibility and choices:* A value pricing program provides an opportunity to improve efficiency for a limited class of vehicles by providing a choice that is otherwise not available; the class of vehicles was determined by the terms of the grant from the Federal Highway Administration, which sought to study this option in a heavy goods movement corridor. Eligible vehicle owners would be offered the opportunity to save time, increase reliability, and reduce costs. They could choose to avail themselves of the service only when it is beneficial to do so, e.g. when the freeway is highly congested or when lateness to a destination would be especially costly. Provided that the HOV lanes do not become overloaded by an excess of buy-in vehicles, there are only “winners” from a value pricing program.

### **Is there a market?**

Unless it can be demonstrated that there is a market within the target community, there is no reason to proceed with a value pricing program. To determine if there is a market, representatives of the local community of likely users were contacted through mail, telephone interviews, and focus group meetings to determine the degree of potential interest.

Approximately 50 firms and organizations were contacted to obtain a sample of responses. These included national and local small package delivery (e.g., UPS, Federal Express, couriers), other deliveries (e.g., food, florists, medical supplies), service vehicles (e.g., telephone, plumbing), and construction vehicles. Associations contacted include the chambers of commerce, delivery service association, contractors, and labor unions.

16 entities responded fully to a questionnaire or focus group meeting invitation. The preponderance of interest clearly was found in the package delivery market. Those service companies are generally interested, and some highly enthusiastic, in subscribing to an HOV lane buy-in program. The other delivery services were only moderately interested, while the construction companies and labor unions showed little interest. The most important findings about this survey are:

- The perceived time savings per trip range from an estimated 5 to 30 minutes, with the preponderance in the 10-15 minute range.
- Fleet size does not correlate with degree of interest. Small couriers are just as likely to be interested in the service as national package delivery companies.
- Other delivery services are lukewarm about the program, because they have some flexibility in avoiding peak periods or reducing I-880 exposure by taking alternate routes.
- Most would prefer to pay a flat rate, rather than a per-use rate, because it would be simpler to understand and use.
- Estimates of willingness to pay vary from \$20 to \$120 per month, with the median around \$50 per month.
- Most believe they would use the program selectively as an option, for some vehicles in a given period but not the entire fleet. Transferability of permits between vehicles in the fleet would be preferred.
- Potential users are unlikely to travel on the HOV lanes for trips less than 5 miles long.
- Simplicity of administration in the program is very important. A flat rate permit for a period of time (monthly, quarterly, etc.) is preferred.

- There is concern expressed by many that larger commercial vehicles should not be allowed in the lanes, for safety reasons. There should be a limit on vehicle length and bulk.

In addition, a “value of time” analysis was completed, reviewing this and other findings about the value placed by commercial users on the time of their drivers, which is an indicator of willingness to pay for the time savings resulting from the buy-in program. The conclusion was that the commercial value is approximately \$18-20 per hour.

### **What alternatives are under consideration?**

Four different HOT lane alternatives were developed and considered. The two major variables distinguishing among the alternatives are the lane separation treatments and the toll collection methods. The possible lane separation treatments include:

- (1) Contiguous lanes, which is the current condition on I-880, where there is unlimited access between the HOV/HOT lanes and the adjacent mixed-flow lanes;
- (2) Buffer-separated lanes, where there is a definite barrier between the lanes, either closely spaced (no more than 50 feet apart), upright plastic pylons or a painted double yellow stripe. In this treatment, intermediate access between HOV/HOT lanes and mixed-flow lanes is restricted to only specified locations, and crossing the barrier is a traffic violation. A continuous concrete barrier was also considered, but rejected by Caltrans and others early in the process as presenting too many issues of right-of-way availability, cost, and safety.

The two toll collection methods are:

- (1) Permit toll collection. Users would purchase a permit periodically (monthly, quarterly, etc.) which permits them to use the HOV lanes. A decal would be visibly affixed to the vehicle, most likely on the front windshield or rear bumper or both, and there would be visual identification for enforcement purposes. This is similar to the current system for permitting single-occupant, zero-emission vehicles into the HOV lanes.
- (2) Electronic toll collection (ETC). Users would set up an account, obtain and affix an electronic transponder to the inside of the windshield. As the vehicle passes under an electronic reader, the toll transponder is read and the account is debited the appropriate amount. Enforcement could be done in several ways, including surveillance cameras that photograph the license plate, or a light on the reader alerting the CHP that the user does not have an active transponder.

The four conceptual alternatives considered include:

- A - Contiguous HOT lanes with Permit**
- B - Contiguous HOT lanes with ETC**
- C - Buffer-separated HOT lanes with Permit**
- D - Buffer-separated HOT lanes with ETC**

Each of the lane configuration and toll collection policy choices has identifiable benefits and limitations, as outlined below.

## Toll Collection Methods

### Permit Program (Concepts A & C)

Benefits	Limitations
Ease of implementation	Does not allow for variable pricing
Easy for public to understand	Does not charge by per trip or distance basis
Low cost solution	Does not allow for automated enforcement
	Does not provide management data
	Does not provide flexibility to manage roadway capacity

### Electronic Toll Collection (Concepts B & D)

Benefits	Limitations
Able to implement variable pricing by trip and distance	More expensive capital investment in hardware and software
Allows automated collection and enforcement	Takes longer to implement
Provides management data	More complicated enforcement; frequent false violation readings.
Could be interoperable with current and future bridge toll collection systems	

## Lane Separation Treatments

### Contiguous Lanes (Concepts A & B)

Benefits	Limitations
Low cost for roadway improvements	Difficult to monitor
Quick implementation	Difficult to enforce
Maximum flexibility for user access/egress	

### Buffer-Separated Lanes (Concepts C & D)

Benefits	Limitations
Less weaving, improved safety	Higher cost (capital and O&M)
Easy to enforce	More time to implement
	Limited flexibility for users
	Safety for maintenance workers

## **What are the physical constraints on Interstate 880?**

*Right-of-way.* Several physical constraints are evident on I-880. The most important is the constrained right-of-way. At many points along the corridor the inside and outside shoulders are below current Caltrans design standards. Dense development, especially commercial development, near the freeway characterizes much of the corridor. Thus, widening opportunities to accommodate lane separation treatments and enforcement pullout areas are limited, expensive, and disruptive to the surrounding communities.

*Interchanges.* There are currently 16 interchanges in the HOV section of I-880, and there will be 18 interchanges when the HOV lanes are extended toward Santa Clara County within the next four years. The relatively high frequency of interchanges in this highly developed corridor makes it likely that substantial numbers of HOV or HOT lane users will desire access to and egress from the HOV/HOT lanes all along the corridor. This means that restricting intermediate access becomes difficult from the standpoint of both traffic operations and public acceptance. Additionally, if freeway widening were necessary to accommodate the chosen lane separation treatment or toll collection method, the cost of widening structures at the interchanges would have to be factored into the project.

*Variable Freeway Characteristics.* Several miles to the south of the current HOV lanes there is currently a freeway section with two lanes in each direction. Also, at some interchanges, namely State Routes 238 and 92, there is inadequate ramp capacity that results in queuing onto the freeway. These conditions reduce the effectiveness of HOV lane operations at several locations in the study area during some of the hours in which they operate. The corridor predominately has three through lanes but north of SR 92 (San Mateo Bridge) there are generally four through lanes in each direction. The increased capacity of the four-lane sections reduces the benefits of the HOV lane.

## **What are the factors to consider in the assessing the electronic toll collection (ETC) system?**

*Transponder compatibility:* If electronic toll collection is selected, California state law requires that the transponders must be compatible with other transponders used on California highways, including those for the FasTrak program on Bay Area bridges and Southern California toll roads. This means that thousands of bridge users with transponders, as well as visitors from Southern California, would effectively have access to the HOV lanes, unless some kind of special regulations, protocols and equipment were developed to deny their valid use on I-880. Because of the difficulty in rationing transponders and the relatively small amount of capacity available to sell, the ETC project would be left with extremely high pricing as the only tool to control use for the limited available capacity.

*Relative costs:* ETC, compared to a permit scheme, requires high initial capital costs and somewhat higher annual operating costs. However, electronic toll collection yields higher revenues initially and much higher revenues over the long term.

*System Management:* ETC also has the capability to “manage” the system much more efficiently, by frequently changing the toll levels to respond to changing condition. It provides accurate price signals to potential users, so that the HOV lanes will neither be overutilized nor underutilized at any given time.

*Enforcement:* As distinct from ETC, the “low-tech” permit program would require the user to pay periodically (e.g., monthly, quarterly). The user would be given an identifying decal to affix prominently on a specified location on the vehicle, such as the right front windshield or left rear bumper. This system, while certainly less effective than ETC in terms of maximizing revenue and managing freeway capacity, has the advantage of being much less costly to undertake and administer. The low-tech system could be viewed as the first phase of a more elaborate program (as it was in San Diego), depending upon the success of the first phase. It also could be enforced by somewhat intensifying the California Highway Patrol’s (CHP) enforcement of conventional HOV lane restrictions, which could have the ancillary benefit of reducing HOV lane violations and therefore effectively increasing HOV lane capacity.

ETC, on the other hand, could entail much more complicated and expensive enforcement measures. This would be particularly true, if the lane separation treatments do not include a physical barrier. Easy intermediate access, whether legal (no restrictions) or illegal (double yellow stripes on the pavement to denote illegal crossing zones), means that electronic toll readers and/or surveillance cameras would have to be installed at very frequent intervals along the corridor, in order to capture all users and deter weaving in and out of the HOV lanes to evade toll-paying.

### **What does traffic analysis show?**

The traffic analysis established the answers to three primary questions:

*(1) What is the extent of the potential market for commercial buy-in of HOV lane use?* Traffic counts of both HOV lanes and were made at three locations on the corridor, namely Mowry Avenue, Industrial Parkway, and Winton Avenue, for three major categories of small commercial vehicles, as follows: (1) deliveries, (2) service vehicles, and (3) construction-related. The breakdown of these categories varies somewhat between the three locations, but in general is as follows: deliveries (45%), and service vehicles (10%); construction-related (45%). Based on the results of interviews, the estimated buy-in rate for each category is as follows: small parcel delivery (subset of deliveries), 85%; other deliveries, 50%; service vehicles, 20%; and construction-related, 5%. These percentages equate to approximately 400 users during each peak period in each direction of travel at each of the three locations.

*(2) What is the available capacity in the HOV lanes at the present time?* The capacity of an HOV lane is difficult to estimate, because circumstances vary (e.g., number of and distance between interchanges). For purposes of this project, it has been estimated at a maximum of 1,900 vehicles per hour (87% of the lane capacity for a 4-lane freeway). Because an HOV lane exists to provide travel benefits for those eligible to use it, it is important to distinguish between theoretically maximum capacity and “beneficial capacity.”

Beneficial capacity is the traffic volume above which travel time benefits drop sharply. Previous studies for individual projects have established this value at approximately 1,600-1,700 vph. The actual value depends upon HOV lane. For example, the design that provides for the HOV lane to be used as a mixed-flow lane in off-peak periods allows continuous access to and egress from the lane and standard lane dimensions are utilized has a lower beneficial capacity than a facility that has visible barrier, striped or otherwise, that limits access and egress to specified areas. The concept of beneficial capacity provided a preliminary benchmark of assessing whether any additional capacity currently exists that could confidently be made available to a new class of eligible users.

Both mixed flow and HOV volumes were measured at three locations in the corridor in both directions. From north to south, these locations were Winton Avenue, Industrial Parkway, and Mowry Avenue. The recorded numbers are slightly lower than volumes that would occur mid-way between interchanges as the locations were after an off-ramp and before an on-ramp. The highest peak hour volumes observed were at Industrial Parkway, which had 1,382 vph southbound from 5:30-6:30 am and 1,692 vph northbound from 6:00-7:00 pm. At the other two locations, the highest AM peak hour volumes for the same directions of flow were similar in magnitude; however, they were significantly lower in the PM peak. At these locations, there was a greater discrepancy between volumes in the peak and off-peak directions than at Industrial Parkway.

For planning purposes, a threshold of 1,400 vph for an HOV lane section is a reasonable figure for preliminary determination of whether or not a given location is a candidate for receiving additional vehicles is reasonable, given an estimated demand of 200 vph of "buy-in" small commercial vehicles. The 1400 vph threshold results from subtracting 200 vph from the 1600 vph beneficial capacity.

Based on hourly volumes, both the northbound and sections near Industrial Parkway would likely experience congestion during part of both the AM and PM peak hours. If the threshold were reduced even lower to 1,350 vph due to higher than expected demand from newly eligible commercial vehicles, additional sections of the corridor might risk overloading the beneficial capacity; these sections include the southbound AM area near Industrial Parkway and the northbound PM area near Mowry Avenue to the south.

In the southbound HOV lane corridor, congestion in the HOV lane is affected not only by the number of vehicles travelling in the HOV lane, but also by a bottleneck immediately north of the Mission Boulevard interchange where the HOV lane terminates. The outer through lane is dropped, and the HOV lane becomes a mixed-flow lane. As the volume exceeds the demand of the three-lane sections, queueing occurs not only for the mixed-flow lanes but also for the free-flow lanes.

These potential problem areas cast a cloud over the ability of the HOV lanes to absorb an increase in traffic of approximately 200 vph throughout the corridor. Even though adequate capacity definitely exists during most of the time during which the HOV lanes operate in both directions, the potential for congestion exists somewhere during the corridor for each direction of travel and time period when the time savings are most likely to be the highest. Given the expected major growth in peak period trips in the corridor, the question arises whether or not adequate capacity will exist several years from now. Also, it is possible that some of the commercial vehicles eligible for HOV lane "buy in" would have slower acceleration and deceleration characteristics, which could lower overall travel speeds in the lane.

(3) *What are the current benefits in travel time savings for HOV lane usage?* Travel time savings for vehicles in an HOV lane depend upon the difference in travel speeds between the HOV and mixed-flow lanes. The degree of congestion in the mixed-flow lane is not always an accurate indicator whether or not time saving benefits exist. Obviously, benefits are limited when mixed-flow vehicles are operating at free-flow speed, but they are also limited when there is similar congestion in both the HOV and mixed-flow lanes (no time savings, so less reason to use the HOV lane).

At Industrial Parkway in the northbound direction, especially during the PM peak period, equivalent congestion occurs in both the HOV and mixed-flow lanes, and each has travel



speeds of approximately 20-25. With the continuous access and egress design that exists for the I-880 HOV lanes, side friction places an upper limit of approximately 20-25 mph for the speed differential between the lanes. Weaving maneuvers can occur at any location in the HOV lane corridor and require a relatively limited differential in travel speeds, because drivers perceive it as unsafe to switch into a lane that is traveling significantly faster or slower. These maneuvers strongly influence the overall travel speed in the lane.

From numerous HOT lane projects, a rule of thumb that has emerged is that a time savings of one minute per mile is needed to attract "buy in" traffic to HOV lanes. As the I-880 HOV lane corridor is approximately 20 miles long, a time savings of at least 20 minutes would be desirable. For commercial vehicles, a somewhat smaller value of time savings might be acceptable, as their perceived value of time generally is higher than for commuters.

During the study, travel time runs over two days were conducted concurrently for vehicles in the HOV and mixed-flow lanes. A total of 7 or 8 runs throughout each peak period were made in each direction. Runs with travel time savings of at least 20 minutes occurred in both peak directions, southbound AM and northbound PM. The highest observed time savings was 32 min.37 sec. in the southbound AM peak period. This combination of time period and direction has the largest time savings, because the bottleneck at the end of the HOV lane affects mixed-flow traffic for a longer distance than HOV lane traffic.

There was a great variation in travel time savings, and the average travel time savings were significantly lower than the highest values observed. For the peak directions, the averages were slightly less than five minutes, and for the non-peak directions were approximately 2-½ minutes in each direction. Also, the travel time savings were not uniform throughout the corridor. Clearly, the HOV lanes provide some travel time savings to the eligible vehicles that currently utilize them. HOV lane usage likely is influenced by travel time savings that occur for an entire trip and not only in the I-880 corridor and by cost savings for long-distance trips. The absence of consistently high time savings along the corridor and during a portion of the peak period suggest that the potential for commercial "buy-in" may be relatively limited.

In addition, Caltrans provided its data for speed studies in both HOV and mixed-flow lanes. The travel time benefits for HOV lane vehicles depend upon the time of day and direction. For travel on the entire HOV lane in each direction, time savings in the off-peak direction were shown to be approximately 15%, or 3-5 minutes. In the peak direction, travel time savings were lowest in the first hour of HOV lane operation but had savings of at least 10 minutes during each period in each direction and in two instances had savings over 20 minutes.

The highest time savings always occurred in the last hour of HOV lane operation. Interestingly, overall travel speeds remained low (approximately 40 mph) after the end of HOV lane operation in peak directions of travel. Also, congestion was already apparent in the PM peak direction of travel (northbound) when the HOV lanes first begin operation at 3 pm. Travel time savings in the HOV lane are already at 8 minutes, with a speed difference between the HOV and mixed-flow lanes of 12-15 mph. This finding indicates that extending the HOV lane hours at the end of the morning peak and at both the beginning and end of the evening peak could benefit a substantial number of HOV lane users in the peak travel direction, when there is high demand.

### **What are revenues, costs, and financial viability?**

A financial analysis was performed to determine the financial feasibility of the proposed HOT lane project. Revenue and cost estimates were developed for both a permit system and an

ETC pricing scheme. The analysis of the ETC option assumes that only eligible small commercial vehicles would have an opportunity to buy into the HOV lane (SOVs with transponders would not be allowed to buy into the HOV lane). High and low revenue estimates were generated for each alternative that depend upon the assumed size of the target market. Revenue estimates for the ETC alternative were also generated under two carpool classification assumptions; (1) HOV2+ would be classified as carpools or (2) HOV3+ would be classified as carpools. For the permit analysis, we only consider the case where carpools would be classified as HOV2+. From these estimates, we calculate net present value ranges for each alternative.

For this analysis, we project revenue for each alternative in 2005 and 2020. Revenue (and the optimal tolls or permit price) grows substantially over this period. The growth is attributed to (1) increased congestion on the mixed flow portion of the facility, and (2) growth in users' real value of time.

*Revenues under a Permit System:* The annual revenue projection in 2005 for the permit pricing scheme ranges between \$300,000 and \$400,000. Annual revenue is expected to grow to between \$1.1 and \$1.5 million by 2020 under this alternative (in current dollar terms).

*Revenue and Tolls under an ETC System:* The revenue analysis performed on the ETC option assumes that tolls would vary by time of day, day of week, and by road segment. Peak-period tolls range between 4 and 12 cents/mile for the HOV2+ carpool alternative and between 6 and 18 cents/mile under the HOV3+ carpool alternative in 2005. Toll levels during less congested periods drop considerably due to reduced travel time savings associated with using the toll facility.

The revenue ranges associated with the ETC option range between \$0.8 to \$1.2 million and \$1.3 to \$1.8 million in 2005 under the HOV2+ and HOV3+ carpool options, respectively. Projected annual revenue is expected to grow significantly by 2020 with the ranges for the HOV2+ and HOV3+ carpool alternatives reaching \$3.2 to \$4.3 million and \$4.7 to \$6.8 million respectively.

*Cost Estimates for a Permit and ETC System:* The table shown below provides cost estimates for both the Permit and ETC systems. The permit system assumes contracting for enhanced CHP enforcement patrol and administrative costs for a simple application program for eligible vehicles and permit delivery to vehicle owners by mail. The ETC system assumes mounted electronic toll readers spaced at approximately one mile apart, surveillance cameras, changeable message signs, and a control center. Both systems assume minimal marketing costs.

Costs Estimates for Permit and ETC System

	Initial Capital Cost	Annual Operating Expense
Permit System	\$0.1 million	\$0.5 to \$0.7 million
ETC System	\$5.5 to \$7.5 million	\$1.5 to \$1.7 million

*Net Present Value of Each Alternative:* The net present value of each alternative is calculated by applying the appropriate discount rate to the estimated future net operating cash flow generated under each alternative and subtracting the up-front capital costs. For this analysis we have assumed a real discount rate of 3%. This corresponds to a 7% nominal discount rate if we assume annual inflation of 4%.

Net Present Value of Revenues and Operating and Capital Costs (2005 to 2020)

System Type	Low	High
Permit System	(\$0.3 million)	\$2.3 million
ETC System (HOV2+ Carpool)	(\$5.0 million)	\$2.2 million
ETC System (HOV3+ Carpool)	\$4.4 million	\$17.2 million

As the above table indicates, both the ETC (HOV2+ carpool) and permit scenarios could potentially have negative net present values, while the analysis for the ETC (HOV3+ carpool) indicates that the facility would have a positive net present value in both the lower and upper range estimates.

**What is the feasibility of permitting single-occupant passenger vehicles in the program?**

Because there are certain times and locations along the corridor where the current HOV lane counts approach 1600 vph, there may be relatively little excess capacity that could be “sold” to either small commercial or SOVs without reducing the benefits to existing HOV lane users. Prudent system management would dictate that the first stage of any pricing demonstration project on I-880 would involve permitting only a relatively small number of vehicles to buy into the HOV lanes. Then, the concept could be tested under actual conditions, with the potential to expand the number of permitted users later, provided that experience proves that additional vehicles do not degrade the service level on the HOV lanes.

I-880 is identified as the most heavily-used goods movement corridor in the Bay Area region, connecting the Port of Oakland with Silicon Valley and goods distribution centers to the east. The SOV buy-in option, either in addition to or instead of commercial vehicles, could compromise the original objectives of the project. It would likely reduce the interest of the business community in supporting the demonstration project, because the presence of SOVs operators who would want to buy into the HOV lanes.

A permitting program for small commercial vehicles on I-880 would involve dealing with a limited number of companies and potential users to determine who would receive permits; currently about 8% of total I-880 corridor peak-period users are in this category. Our research to date has found that the potential users most likely to be interested in the HOV lane buy-in are delivery services of various kinds (especially time-sensitive small package deliveries). While there might be more than enough interested parties in this potential market, the number of permits available vs. permit-seekers is not likely to be extraordinarily out of balance. Some kind of selection system that will not be too burdensome or controversial (by random selection, first-come-first-serve, auction, etc.) could be devised to launch the pilot project.

Opening the HOV lanes to SOV buy-in, however, is likely to be much more complicated. There are potentially many thousands, perhaps tens of thousands, of commuters and residents who would be eligible and interested in applying for a permit. Finding a way to select a small number of users from among such a large pool could be administratively difficult and politically problematic.

There are also enforcement issues under the SOV buy-in scenario, because any vehicle, not just relatively easy to identify commercial vehicles, would be a potential eligible user or a potential violator. This means that CHP officers would have to scrutinize every vehicle in the HOV lane for either the requisite number of passengers and/or a valid permit decal.

Thus, if an SOV buy-in were part of the program, electronic toll collection would be far more desirable than the permit decal. However, because physical barriers are unlikely to be acceptable as lane separation treatments, electronic toll readers would likely have to be installed at very frequent intervals. The requirement for frequent toll readers substantially increases the capital cost for the project, as compared to current projects in other parts of the country, where there is only one entrance and one exit.

Given the somewhat limited capacity available to sell on the corridor and difficulty in limiting SOV access to the HOV lanes in their existing configuration, the study team has concluded that the value of further analysis of SOV buy-in is minimal at this time. In the event a modified HOV eligibility criteria from 2-plus to 3-plus on the HOV lanes comes under serious consideration at a later date, then substantially more capacity would become available and SOV buy-in may warrant further study.

### **What choices are to be made?**

Several key choices face the policy-makers before this proposed demonstration project can proceed:

1. *Capacity.* Is there sufficient excess capacity on the corridor, currently and projected, so that a capacity can be sold to a class of single-occupant vehicles without risking degradation of HOV lane service for other HOV users?
2. *Enforcement.* Will the California Highway Patrol be able to enforce effectively the rules for a new class of eligible vehicles?
3. *Intermediate access.* What frequency of access for buy-in vehicles should be permitted? One at either end of the HOV lanes? Access at every interchange? Or unlimited access, as is the current policy?
4. *Lane separation treatment.* Should the HOV lanes be separated by a physical barrier, solid lines on the pavement, or no visible treatment?
5. *Toll collection technology.* Should the project use electronic toll collection or a permit decal system?
6. *Eligibility of vehicles.* What size and type of commercial vehicles should be eligible? If demand exceeds supply, how should users be selected?
7. *Toll collection.* How should the toll collection program be administered? Government agency (if so, which one?) or a private contractor under government contract?

### **Recommendations**

The study team consulted closely with and noted the concerns of Caltrans, the Metropolitan Transportation Commission, and the California Highway Patrol in developing recommendations. As a result, the recommendation is not to proceed at this time with a HOT lane experiment permitting small commercial vehicles to buy into the existing HOV lanes on Interstate 880. The rationale is based primarily on the answers to the first two questions above, namely Capacity and Enforcement.

*Capacity:* Current hourly volumes indicate that there is generally adequate capacity throughout the system in each travel direction during both the AM and PM peak hours for a limited number of new commercial vehicle users. However, they also indicate that in some sections, particularly in the northbound direction, the volumes are approaching the level at which travel time differences between the HOV and mixed-flow lanes are minimal. The addition of approximately 200 additional peak hour trips would possibly result in the beneficial capacity being reached for part of the peak periods in some locations.

This is not necessarily a fatal flaw for a commercial “buy in” program, but it would potentially limit the effectiveness and time savings of the HOV lanes for both existing HOV and prospective commercial users. Furthermore, because traffic volumes in the I-880 corridor have been steadily increasing, it is likely that the HOV lane traffic for 2+ vehicles will also increase. Hence, public agencies wish to retain any reserve capacity in the HOV lanes to accommodate this potential increase

*Enforcement:* The California Highway Patrol (CHP) expressed concerns about effective enforcement of the proposed eligible small commercial vehicles. Assuming no electronic toll collection or physical lane separation to channel vehicles through an electronic reader at a specific location, the CHP would have to rely upon visual identification only, by searching for a decal or placard on the vehicle. This means that the CHP officer would have to determine both whether there are two or more passengers in the vehicle and whether it displayed the proper identification for eligible vehicles, before deciding whether the vehicle is an HOV lane violator. This adds a complicating element to the split-second decision-making process already confronting the officer, who is already supposed to be enforcing the occupancy requirement in passenger vehicles.

While the CHP indicated complete willingness to work with whatever policy is adopted, they expressed a concern that this program would make their jobs more difficult. The CHP already faces a similar situation with the zero-emission vehicles, which may use the HOV lanes while displaying a placard on the left rear bumper; however, there are currently very few such vehicles on the roads, so the circumstance arises rarely.

### **Changed Conditions Could Lead to a Different Recommendation**

The changed conditions that might lead to revisiting the issue could include:

- (1) A significant reduction of traffic in the HOV lanes, for example, due to a downturn in the economy or change in commute patterns. This situation could create excess capacity that would otherwise not be used. This would have to be accompanied by a continued substantial time advantage for HOV lane users compared to general purpose lanes (e.g., if the economic downturn were so severe that all lanes become free-slow, then there would likely be no reason for commercial vehicles to pay a premium for HOV lane use).
- (2) A change in eligibility for the HOV lane from 2+ to 3+ vehicles. If this change were to occur for any reason, the possibility of severe underuse of the HOV lanes would have to be studied. In this case, the subject of HOT lane use by new classes of users, including small commercial vehicles, could be revisited.

While recommending not to proceed with the commercial vehicle HOT lane at this time, it should be noted that some positive factors for this program are also present, and these could lead to a different conclusion at some future date, if conditions change:

1. A viable market for such an experiment in this heavily commercial corridor appears to exist, but the only way to test the proposition is to make the option available.
2. At the outset, a limited program would be the most prudent way to proceed, given the concern about the amount of excess capacity and the need for assurance that HOV lane performance would not be degraded for normal HOVs.
3. The results of this experiment, which can be modified during the trial period by adjusting the number of permits up or down, will provide the basis for a possible next phase, which might include introduction of electronic toll collection, variable pricing by time of day or traffic condition, or changing the eligibility criteria for buy-in.

### **Lessons Learned**

1. Considerations for changes in HOV lane policy should be considered as a package rather than as individual elements. It became apparent during the study that changes in possible changes in HOV lane eligibility and hours of operation could significantly impact the potential for HOT lane use by small commercial vehicles. Currently, the lanes have a 2+ eligibility requirement, but it is possible that a 3+ requirement could be considered sometime in the future.
2. Because significant congestion was observed near both the beginning (PM only) and the end of the peak period operating hours for HOV, extending the operating hours could increase overall HOV lane benefits, whether or not a HOT lane concept is implemented.
3. Generally, the introduction of additional eligible vehicles into HOV lanes should be considered soon after new construction has eliminated any existing bottlenecks. Currently, the southbound direction of I-880 has a bottleneck at the end of the HOV lanes, which will be addressed with a widening project that will be completed within three years.
4. Considerations for changes in HOV lane policy should consider as much of a region's HOV lane system as possible. The study considered only a "buy in" for commercial vehicles in the existing I-880 corridor in Alameda County. The benefits for the program are likely to be greater if other parts of the regional HOV lane system could be involved.
5. The HOV lane design with continuous access and egress greatly increases the complexity of managing and enforcing HOT lane programs. A system that would charge for each HOT lane use would require a large number of transponder receiving stations. Otherwise, a permit system is the only feasible operating strategy, which can result in significantly different average costs per use. But, because a permit system does not charge per use, the ability to manage the system by controlling demand is much diminished.
6. A key issue raised by many participants, both inside the commercial vehicle community and by policy-makers, is establishing an appropriate cut-off size and weight for commercial vehicles eligible to use the HOV lanes. For example, some larger delivery

vehicles (such as UPS vans) take up significant “visual space” and likely would have more difficulty moving into and out of HOV lanes and might operate at slightly lower speeds than automobiles, which itself could reduce the capacity of the lanes.

7. The need for a political “champion” of a pricing project is underscored once again, as has been demonstrated in other projects around the country. In this case, while there was little overt opposition to the idea, neither the business community leadership nor elected officials demonstrated much enthusiasm or a sense of urgency about the proposal, even to pursue it as an easily-revoked, limited experiment. This meant that there was no driving force available to overcome skepticism, when it was expressed by public agencies involved in implementing it.