

HOW HOT ARE HOT LANES?

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There is a lot of debate on whether the HOV or carpool lanes in the state should be converted to HOT (high-occupancy toll) lanes which single-occupant vehicles (SOV) would be allowed to use by paying a toll. This idea is not new. Two frequently cited examples of successful HOT lane implementations include State Route 91 Express Lanes¹ and the I-15 FasTrak program², both in Southern California. The former is a four-lane, 10-mile toll road built in the median of California's Riverside Freeway between the Orange/Riverside County line and the Costa Mesa Freeway (State Route 55) while the latter is an eight-mile stretch of HOV lanes in the median of Interstate 15 between Kearny Mesa and Rancho Penasquitos in San Diego. And there are a host of other road pricing demonstration projects across the country with support from the Federal Highway Administration³.

HOT lanes are often proposed to achieve the following:

1. Make more effective use of HOV lanes by filling up spare or excess capacity
2. Improve traffic flow (reduce congestion) on all lanes of the freeway
3. Raise much needed revenue to help pay for transportation improvements including lane additions, interchange improvements, and better transit services.

Opponents say that converting HOV lanes to HOT lanes defeats the purpose of implementing HOV lanes in the first place – to increase carpooling and transit use, reduce vehicles on the road, improve traffic flow, and enhance air quality. Also, there is the fear that HOT lanes will turn into “Lexus Lanes” where only the rich can afford to travel solo in the fast lane.

So, the question on everybody's mind is: Will HOT lanes provide transportation and economic benefits along the congested corridors of the state without defeating the purpose of having HOV lanes? Some simple traffic analysis can help answer this question.

Consider a stretch of freeway 25 miles long with three general purpose lanes and one HOV lane (that is targeted for conversion to a HOT lane) carrying 100,000 vehicles per day in each direction. Under existing conditions, suppose 12,500 vehicles use the HOV lane while the remainder are evenly distributed across the three general purpose lanes, i.e., 29,167 vehicles per lane. The 2001 National Household Travel Survey⁴ (NHTS) data provides the hourly distribution of travel demand. The 2000 Highway Capacity Manual⁵ (HCM) published by the Transportation Research Board (TRB) provides detailed procedures to calculate travel times under various degrees of congestion. Based on these sources, the worst congestion in the general purpose lanes occurs between 5 and 6 pm when the flow rate is about 2600 vehicles per hour (vph) per lane. The capacity of a freeway lane is considerably less at about 2200 vph per lane. At this flow rate, the travel time on this 25 mile section will be about 60 min at an average speed of approximately 25 mph. The corresponding speed and travel time on the HOV lane during this same hour are 70 mph and 21 minutes respectively at a flow rate of about 900 vph. If the value

¹ <http://www.91expresslanes.com/>

² <http://www.sandag.org/>

³ http://www.ops.fhwa.dot.gov/tolling_pricing/value_pricing/index.htm

⁴ <http://nhts.ornl.gov/2001/index.shtml>

⁵ http://www.trb.org/news/blurbs_detail.asp?id=1166

of travel time savings is taken to be \$15 per hour (i.e., people are willing to pay a quarter for every minute that is shaved off their travel time), then a \$1.00 toll⁶ is worth paying as long as using the HOV (converted to HOT) lane saves the solo driver 4 minutes or more. As soon as the travel time differential between the HOT lane and the general purpose lane falls below 4 minutes, paying the toll and switching to the HOT lane is no longer worth it⁷. Based on this reasoning, after a HOV lane is converted to a HOT lane, the traffic flow between 5 and 6 pm would be redistributed such that the HOT lane carries 2100 vph and the general purpose lanes carry 2200 vph per lane. In other words, about 1200 vehicles have switched from the general purpose lane to the HOT lane and are now paying a toll. The new travel times would be 30 minutes on the HOT lane and 34 minutes on the general purpose lanes. This analysis can be repeated for all hours of the day, keeping in mind that the HOT lane would be operational during the hours of 6-9 am and 3-7 pm and would be a general purpose lane during all other hours.

Once we add up all of the numbers, here is what we find. The HOT lane conversion on this 25 mile stretch of freeway results in a total daily time savings of 6,800 vehicle-hours or about 1,700,000 vehicle-hours annually. Valued at \$15 per hour, this time savings may be viewed as being worth \$25,500,000 annually. This is equivalent to an average time savings of 4 minutes worth \$1.00 for each individual vehicle-trip on this 25 mile stretch of freeway. Meanwhile, the HOT lane itself is generating a revenue of \$2,700 per day or \$675,000 per year, probably enough to operate and maintain the high-speed electronic toll collection (ETC) systems required of HOT lanes. All of these numbers will get multiplied over depending on the total lane-miles of HOV to HOT lane conversion.

Would this potential benefit be realized at a high cost to the environment and the Valley's air quality? Probably not. An examination of the 2001 NHTS data suggests that only about 5% of the high-occupancy vehicle trips (within the HOV lane hours) are potentially motivated by the incentive to use a HOV lane. All other trips are high-occupancy vehicle trips that would have occurred anyway, regardless of the presence of a HOV lane (e.g., family members traveling together for recreation, shopping, picking up and dropping off children, etc.). In our particular example, this means that no more than an additional 300 vehicle trips would be generated over the entire day even if we assumed that all carpool arrangements motivated by the availability of the HOV lane were to dissolve. And this is not likely to happen because carpoolers would still get to use the fast lane for free.

On the other hand, does this mean that HOT lanes are the panacea for our traffic congestion woes? The analysis here suggests that, during the hour of worst congestion, travel time impacts could be substantial. Travel times on general purpose lanes would improve (on average) by about 25 minutes over a 25-mile stretch of freeway (34 min vs 60 min), although travel times on the HOT lane would actually deteriorate by about 10 minutes (30 min vs 21 min). During other hours of the day, the travel time impacts are generally more modest. With the expected growth in population and limited infrastructure expansion potential (due to funding and environmental

⁶ A \$1 toll is the lowest toll rate that is being charged in the SR91 and I-15 Express Lane programs. Higher tolls as high as \$4 for I-15 and \$8 for SR91 are charged during the hours of worst congestion.

⁷ In reality, it is likely that travelers will keep shifting to the HOT lane as long as they perceive that vehicles in the HOT lane are traveling faster than those in the general purpose lanes. Thus, the analysis presented here is likely to be a conservative estimate of the impacts of HOT lane implementation.

constraints), it is unlikely that HOT lanes will do much to change the state of traffic congestion as a whole. What they do offer is a travel option – the option to pay a premium for a reliable travel time to your destination, something that can be very valuable when you have to get to that meeting at work, catch a flight, or pick up a child from daycare before the late pick-up charges kick in.

There is no doubt that a large megapolitan region such as Maricopa County needs a multimodal transportation system where travelers have realistic options and real choices including, perhaps, HOT lanes. The package of options that defines the area's transportation system must, however, be crafted carefully. Before transportation policy is formulated through a series of Senate Bills and expensive transportation options that might depend on huge public subsidies are pursued in the state, it is critical to understand traveler behavior, preferences, and willingness-to-pay in the state. Rigorous studies of people's travel and route choices well-founded on up-to-date data can go a long way in helping plan for the future of transportation in the state. Monitoring and evaluation studies must be undertaken throughout the life of a project to ensure that intended benefits are being realized.

So, how hot are HOT lanes? Well, the forecast says that at certain times on certain congested freeway corridors in the region, they could get pretty warm...

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