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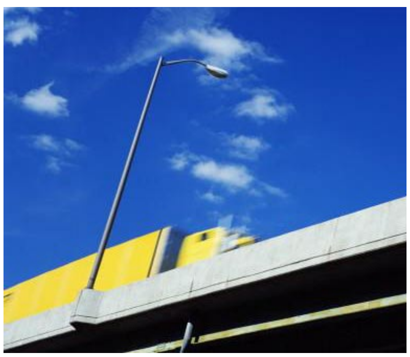





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Executive Summary

California's population is projected to reach 50 million by 2030, an increase of 16 million people. The majority of this growth will occur in the state's three major urban regions (Los Angeles, San Francisco, and San Diego). Vehicle miles traveled by individuals will increase by 30 to 50 percent in these regions, with truck traffic growing even faster, especially in greater Los Angeles. Yet California's urban freeway systems are already nearing capacity, with pervasive congestion during ever-lengthening peak periods and little planned expansion of their capacity.

The metropolitan planning organizations (MPOs) in the three largest urban regions forecast transportation spending of nearly $400 billion between now and 2030. Yet most of this money will be used to operate, maintain, and rehabilitate the existing freeways and transit systems. Only a small fraction will be spent to expand the capacity of the highway system that will continue to carry more than 90 percent of all commute trips and the vast majority of freight. Consequently, congestion will still be a major problem in 2030. And this is the *best-case* projection by the MPOs, assuming that transportation finance in California quickly returns to business-as-usual from its current dire crisis state. Any number of factors could make the outcome significantly worse.

This report suggests that business-as-usual is not sufficient, not if California is to compete with fast-growing states such as Colorado, Florida, Texas, Virginia, and others. Those states have learned two important lessons from abroad as urban regions in Europe and Australia have coped with similar pressures of growth versus limited public finances. First, they found that global capital markets are willing to invest billions of dollars in highway transportation projects, if those projects charge tolls to repay the investment. Second, they have found that long-term public-private partnerships can deliver even large-scale "mega-projects" with less

delay and less risk of cost overruns than traditional, public sector methods, such as were used on Boston's infamous Big Dig tunnel project.

To illustrate the potential of large-scale, toll-funded projects to address real transportation needs in urban California, this report includes four case studies. The first is a $2.3 billion tunnel linking Palmdale with Glendale beneath the Angeles National Forest. With value-priced tolls to keep traffic free-flowing at rush hours, it would cut 45 minutes to an hour off the time between North County and downtown Los Angeles. This would make it far more practical to develop serious airline service at the Palmdale International Airport site (the last remaining alternative to meet the region's air-service needs).

The second case study is an alternate approach to San Diego's current plan to add $2 billion worth of "managed lanes" to several major freeways. Our plan would build a more ambitious $8 billion managed lanes network, funding it largely via toll revenue bonds (unlike San Diego's current plan). For the same investment of taxpayers' dollars, San Diegans would gain a much larger system of uncongested premium lanes for both commuters and express bus service.

The third and fourth case studies are of toll truckway systems for greater Los Angeles and the East Bay region of greater San Francisco, respectively. Our Los Angeles proposal builds on recent analysis by the Southern California Association of Governments (SCAG), but proposes a longer truckway system, extending all the way from the twin ports to the California-Nevada line. By offering truckers both faster speeds (due to no congestion) and much greater payloads, the $10.4 billion truckway system would be self-supporting from toll revenues. In the Bay Area, our proposed truckway would link both the Port of Oakland and Silicon Valley with I-5, via I-580. At a cost of $9.1 billion, it, too, could be self-supporting from toll revenues.

We modeled all four studies as funded by 40-year, tax-exempt toll revenue bonds. And because of the high risks to taxpayers of cost overruns and revenue shortfalls if procured using conventional methods, we recommend that such mega-projects follow the best practices becoming standard for such projects overseas and in Texas and Virginia—to be developed under long-term public-private partnership arrangements. Well-crafted build-operate-transfer (BOT) partnerships shift construction risks and traffic/revenue risks to the private sector partners, a feature that is especially important for mega-projects such as our four case study examples.

Nearly two dozen states now have some form of transportation public-private partnership legislation, though only a few of these mirror the best practices of advanced countries in Europe and Australia. Those practices include the ability to enter into long-term partnership agreements under which the private sector can design, finance, build, and operate a transportation facility, making a return on its investment from toll revenues. Such projects could originate from either the public sector (via a request for proposals) or the private sector (via unsolicited proposals).

California's one previous attempt to engage the private sector to develop toll roads was flawed. The 1989 AB 680 private toll road law required 100 percent private financing, rather than permitting a mix of public and private support that gives both parties a stake in successful outcomes. It applied only to Caltrans, despite the subsequent devolution of significant transportation authority to regional/local levels of government. And it led to overly restrictive non-compete clauses in franchise agreements. Second-generation public-private partnership laws, like those in Texas and Virginia, are far more flexible.

For California today, we recommend that a state-of-the-art tolling and public-private partnership law be enacted. It would authorize both Caltrans and other levels of government (cities, counties, joint powers authorities, etc.) to initiate toll-funded transportation infrastructure projects, and permit them to partner with the private sector to carry out such projects, using both RFPs and procedures for dealing with unsolicited proposals. This would enable California to enter the global capital markets, as well as tap world-class expertise for modernizing its vitally important highway system.

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Part I

Why Business as Usual Will Not Suffice

"California's population grows by at least a half-million people a year, and the state is adding at least 1,000 more vehicles to its roadways every day, but California is now dead last among the states in per capita highway spending. Capitol politicians issue sympathetic noises about the plight but usually fail to do anything about it. Governors and legislators have grabbed more than $3 billion in dedicated transportation funds to balance deficit-ridden state budgets, mostly in the form of 'loans' whose repayment is uncertain. . . . Waiting for Sacramento [to fix this crisis] is an exercise in frustration."

—Dan Walters, *Sacramento Bee*, July 2, 2004

A. Dimensions of the Problem

California is projected to add 16 million more people between 2000 and 2030. Nearly 10 million of these people will be added to the state's three major metropolitan areas: greater Los Angeles (the six-county region for which transportation planning is done by the Southern California Association of Governments—SCAG), the San Francisco Bay Area (for which transportation planning is done by the nine-county Metropolitan Transportation Commission—MTC), and greater San Diego (with planning by the San Diego Association of Governments—SANDAG).

With traffic congestion already a major problem in all three areas, keeping both people and freight moving despite adding one-third more people poses an enormous challenge, especially to these three urban regions. SCAG and SANDAG have recently revised and updated their long-range transportation plans to 2030; the MTC is in the process of doing likewise. Figures from the two approved plans, and estimates from the MTC's work in progress, illustrate the magnitude of the problem facing each region (see Table 1).

As can be seen, all three areas will grow by about one-third over the coming three decades. And while all three plan massive investments in new transit capacity, if the funds to do this materialize and if the systems are as effective as projected at gaining riders, the fraction of all morning rush-hour trips made by transit in 2030 will still only be 7.4 percent in Los Angeles, 7.3 percent in the Bay Area, and 10 percent in San Diego. That means the vast majority of rush-hour trips will still be made by car. That's why vehicle miles traveled (VMT) will increase by nearly 31 percent in Los Angeles, 34.6 percent in the Bay Area, and 50.2 percent in San Diego notwithstanding huge transit system expansions. Goods movement is especially reliant on roads since the lack of rail sidings means nearly 100 percent of final product deliveries are made by truck. Truck VMT will increase more than 70 percent in Los Angeles, nearly 35 percent in the Bay Area, and 35 percent in San Diego.

The results of these trends show up in the figures regarding travel on the highway system during rush hours. Despite planned improvements in all three regions' freeways and arterials, average morning rush-hour travel speeds will be even slower in 2030 than they are today in all three. The fraction of the highway system suffering serious congestion (defined as level of service F) is expected to double in the Bay Area and San Diego and to decline only marginally in Los Angeles.

All three plans are premised on a number of assumptions about the availability of funding for both operating and maintaining the current transportation infrastructure and investing in new highway and transit capacity. In particular, the approved plans in each region assume that all existing transportation sales taxes will be re-approved by the voters when they expire in coming years. They also make rather optimistic assumptions about increases in state and federal fuel taxes, which may or may not materialize. If those events do not occur, there could be major gaps between planned expenditures and available revenues, making it impossible to achieve even the modest goals (in terms of congestion, travel speeds, and transit usage) shown in the table.

Table 1: The Transportation Infrastructure Challenge

	2000	2030	Percent change
Greater Los Angeles (SCAG)			
Population	16.5 million	22.9 million	38.6%
Vehicle miles traveled	361.5 million	472.6 million	30.7%
Truck VMT	23.9 million	40.8 million	70.7%
AM peak worktrip speed	33.3 mph	32.6 mph	-2.1%
Daily VMT @ LOS F	15.6%	14.9%	-4.5%
AM peak transit mode-share	4.8%	7.4%	54.2%
San Francisco Bay Area (MTC)			
Population	6.8 million	8.8 million	29.4%
Vehicle miles traveled	143.5 million	193.2 million	34.6%
Truck VMT*	9.5 million	12.8 million	34.6%
AM peak worktrip speed*	37.4 mph	32.4 mph	-13.4%
Daily VMT @ LOS F*	10%	20%	100%
AM peak transit mode-share*	6.9%	7.3%	5.8%
San Diego Area (SANDAG)			
Population	2.8 million	3.9 million	39.3%
Vehicle miles traveled	74.7 million	112.2 million	50.2%
Truck VMT	9.6 million	13.0 million	35.4%
AM peak worktrip speed	29 mph	28 mph	-3.4%
Daily VMT @ LOS F	3.0%	6.9%	130%
AM peak transit mode-share	5%	10%	100%

*estimates, pending further MTC analysis

Each of the three regions has produced, or is producing, a long-range transportation plan on which it bases the outcome (performance) measures shown in summary form in Table 1. In assessing the likelihood of achieving these admittedly modest goals, it is important to understand the assumptions on which each of these plans is based. Table 2 summarizes the amounts of funding involved for each of the regions. SCAG and SANDAG include a baseline number, which is an estimate of the total transportation revenue likely to be available under current law and policy, without any actions to increase them by the voters, the legislature, or

Congress. The second row in the table contains the dollar numbers on which the plans' performance numbers are actually based. The third row provides a more optimistic assumption of funding based on a more expansive set of possible projects, even though funding sources have not necessarily been identified to match these higher totals.

Table 2: Total Transportation Revenue for Each Long-Range Plan (billions)			
	SCAG	MTC	SANDAG
Baseline/Constrained	$120B	$113B	$30B
Adopted Plan	$213B	$129B	$42B
Unconstrained	$313B	---	$67B

SCAG's plan recognizes that without concerted efforts, the "baseline" might be all the funding available. Among the challenges that are reflected in this baseline number are the following:

- Reduced real (inflation-adjusted) value of gas-tax revenues;
- Potential voter non-renewal of local transportation sales taxes;
- Reduced gas-tax revenues due to growth of alternative fuels;
- Reduced sales-tax revenue due to an aging population;
- Increased operations and maintenance costs of aging infrastructure;
- Reduced state aid due to the state budget crisis;
- Limited increase in federal aid via TEA-21 reauthorization.

(These factors are problems faced by all three regions.)

Consequently, SCAG's adopted plan is based on aggressive funding strategies to add to the baseline revenues. It assumes:

- Amendment of the state constitution to permit renewal of local transportation sales taxes with 55 percent voter approval (instead of two-thirds);
- Restoration of funding from the sales tax on gasoline via Prop. 42;
- Increase in state gas-tax rate to keep pace with inflation.

These measures are projected to add some $31 billion in public sector resources over the 29-year period. In addition, the adopted plan assumes another $62 billion can be derived from user-fee revenues from public-private partnership projects (including tolls paid by users of HOT lanes and toll truckways, as well as fares paid by users of a proposed maglev system included in the adopted plan). SCAG's Unconstrained figure is based simply on $100 billion of additional desirable projects, without specifically identifying funding sources.

SANDAG has adopted a similar approach. Its baseline figure (dubbed the Revenue Constrained Scenario) assumes no increases in federal or state gas taxes or funding formulas, and no local transportation sales-tax revenue beyond the current expiration date in 2008. But it bases its plan on the Reasonably Expected

Revenue Scenario, which assumes voter extension of the one-half cent transportation sales tax through 2030, increases in state and federal gas taxes based on historical trends, and higher levels of state and federal discretionary funds. SANDAG's Unconstrained scenario identifies specific projects and does provide a list of potential additional funding sources (such as an expanded HOT lanes system, a higher sales-tax rate, and more toll projects) but does not attempt to develop a specific set of revenue sources that yield the higher total.

The MTC is adopting a more conservative approach as it goes about developing its 2030 plan. Its Constrained/Reasonably Likely number includes only existing local sales taxes through their current expiration dates. Additional monies that could become available thanks to voter extension of sales taxes and possible increases in state or federal gas taxes have been estimated at $16.3 billion, an additional sum whose allocation is being debated in a process referred to as the Big Tent. Although MTC sometimes refers to this somewhat larger possible plan as "unconstrained," it is nowhere near as speculative as the Unconstrained proposals of the other two regions. MTC's larger-dollar plan is only 14 percent larger than its baseline. By contrast, SANDAG's adopted plan requires 40 percent more revenue than baseline, and SCAG's adopted plan requires 78 percent more. If their aggressive assumptions about increased revenues do not materialize, the system performance for 2030 shown in Table 1 will not happen.

B. California's 2004 Transportation Funding Crisis

The bulk of the work on developing the SCAG and SANDAG plans was done before California plunged into its worst-ever budget crisis. There is no need to rehash the overall budget situation here. But the upshot of the overall crisis is that transportation has taken a huge hit in the process of putting the state's fiscal house in order, and it will be a long time until business-as-usual conditions prevail.

According to the Legislative Analyst's analysis of the 2004-05 budget, "since 2001-02, $2.2 billion has been diverted from the Traffic Congestion Relief Program and Proposition 42 to address the state's [general fund] budgetary shortfall. . . . the Governor's proposals would divert an additional $2 billion from transportation."[1] In the May 2004 revision of the budget proposal, the governor proposed converting the 2004-05 suspension of the Prop. 42 transfer into a loan and reviewing and revising, rather than canceling, the Traffic Congestion Relief Program. How much of the previous $2 billion this will recover for transportation (and when) remains to be seen, as the legislature grapples with transportation and the many other components of the budget.

While the slightly less draconian treatment of transportation in the May Revise is a positive sign, it does little to alter the fundamental problem that transportation infrastructure is seriously under-funded. As a special report from USC's Keston Institute put it,

> *Thus, in just the past five years, California's transportation infrastructure program – a program already determined to be under-funded based upon the statewide needs assessment – has lost billions of dollars to the budget deficit, has suspended over a billion dollars worth of "ready to go" projects . . . and, without correction, is poised to cancel billions more dollars in transportation projects needed throughout California. . . . This is not the model of success that is needed for a strong economy and good quality of life for all Californians.*[2]

C. The Need to Think Outside the Box

The state budget crisis only serves to underscore the magnitude of the transportation funding problem facing California's urban regions. As noted above, the adopted 2030 plans of SCAG and SANDAG make very optimistic assumptions about voter renewal of sales-tax measures and legislative approval of gas-tax increases. Even if these optimistic assumptions all prove correct, the performance projected in these plans is not that impressive. All three regions will invest tens of billions of dollars in mass transit, but the overwhelming majority of all trips will still take place on the roadway system. And truck trips will increase significantly more than car trips, putting even more stress on the highway system. After these huge expenditures—nearly $400 billion between now and 2030 in the three regions altogether—congestion will be little changed, and average commuting speeds will worsen slightly.

It's time to ask the question: Is this really the best we can do? The thesis of this report is that it is possible to do considerably better. One key is to realize that the huge annual cost of traffic congestion also presents a market opportunity. According to the most recent annual mobility report from the Texas Transportation Institute, in 2002 drivers in California's three largest metro areas wasted over $17 billion stuck in traffic.[3] Many of those vehicle owners would willingly pay for better mobility than that, but the present system does not offer them that opportunity. Evidence from the HOT lane projects in Orange and San Diego Counties (on SR 91 and I-15, respectively) suggests that at certain times and places, some commuters are willing to pay 50-60 cents/mile to bypass congestion. Such revenue streams can support large toll revenue bond issues that could pay for much-needed additions to the highway system.

Indeed, SCAG, SANDAG, and MTC have all included some consideration of HOT lanes and other toll-funded projects in their 2030 plans. But because these concepts are relatively new to California, the extent to which they can play a significant role in funding major infrastructure improvements has been seriously underestimated. The purpose of this report is to explore that potential—and then to suggest what California legislators need to do to turn that potential into reality.

Part 2

Learning from Abroad: Fresh Thinking from World-Class Cities

The first lesson from overseas is that there is no need to work incrementally from existing arrangements. Bold departures from past practice are often the best way to get results. The biggest innovation in overseas transportation is widespread reliance on the private sector to take responsibility for financing the construction and maintenance of major projects. The public sector remains heavily involved in the planning and permitting of projects, and usually sets the terms for investor involvement. It also supervises the construction and operations. But actual operations are a private-sector responsibility, and project financing—including the raising of toll revenues and controlling costs—is a private-sector risk.

In highways this means toll roads, since the tolls provide the revenue stream that investors need in order to raise capital. It is the private sector that is financing, building, and operating most of the major new highways in countries as diverse as Canada, Britain, Ireland, France, Spain, Italy, Greece, Hungary, Poland, China, India, Pakistan, Turkey, Indonesia, Malaysia, Israel, South Africa, Australia, Philippines, Argentina, Brazil, Chile, and Jamaica.

We have chosen some examples from Australia, Britain, Canada, and France since these countries have a lot in common with the United States in terms of economic level and political and legal culture.

A. Toronto's Highway 407 ETR

Canada's largest metro area (4.7 million population), used to rely on a single major freeway (H-401) for much of its east-west movement. That road grew incrementally, as available tax funds allowed, to the present 12-lane giant. Any further growth would be pointless because of the difficulty of enhancing the capacity of the connecting roads and interchanges. Besides, the province of Ontario had long planned a parallel route, H-407, mostly to the north serving newly developing areas as well as providing some relief for H-401. The province preserved a corridor from the 1960s onward, and began work on some of the interchanges and relocations of local roads in 1984.[4] But by 1992, all the province had was an empty right of way. The existing sources of funds were insufficient to build the new highway in any reasonable period of time. In 1993 the province decided toll financing was the only way to deliver the project efficiently. A special-purpose corporation fully owned by the province—Ontario Transportation Capital Corporation—was created. Based on the prospective toll revenues, it sold bonds to fund the design and construction of the major portions of what became known as highway 407-ETR.[5]

With funds raised in the capital markets, a first-stage 43-mile, 29-interchange project was built in a three-year period, opening in June 1997. The project was bold in technology, being the first major toll road system in the world without any cash collection. Those without transponders are recorded by camera ("video tolling"), and toll bills are mailed to them. Two years later the province was able to pay off its debt on the toll road entirely, and pocket over a billion dollars extra when it leased out the toll road for a 99-year period after seeking competitive bids from investors. The new owners of the road agreed to add lanes, build extra intermediate interchanges, and construct extensions to the east and west. The franchise deal is criticized by the present provincial government, which came to power in 2003. They say it gives them too little power to control toll rates. The contract could have been structured differently, of course, but there are trade-offs. Anyway, the much-needed highway got built. With investor additions it is now 67 miles long with 43 interchanges. It is popular with motorists, carrying over 270,000 vehicles per day on average and over 300,000 on weekdays.

The 407-ETR represented a bold move because it was a toll road built in an area without any prior experience of tolls. Also bold was the reliance on transponders and video tolling to avoid the need to build toll plazas while still allowing motorists without transponders to use the road. Finally, the privatization of the road was bold—in allowing the private sector to assume the risks and responsibilities as well as the rewards of building and operating a major intra-urban highway.

B. Great Britain's M6 Toll

New motorways have been extremely difficult to build in Britain, in part because of the common Brit's sense that his private property is inviolable and his fierce hostility to anyone proposing to affect it, but also because of the lack of dedicated funding for major roads. Each major new free road project in the United Kingdom depends on special appropriations from the central budget. The sole success story in getting a major new road built in recent years is the M6 Toll. The M6 Toll is a 27-mile, six-lane motorway that splits off from the established M6 motorway just south of Birmingham and rejoins it just north of Birmingham, providing a bypass of the free road which has turned into a congested inner-city expressway. (In its early days the M6 Toll was known as the Birmingham North Relief Road.) Opening December 9, 2003 at a project cost of about one billion U.S. dollars, it caters principally to long-distance traffic (of which there is a considerable amount since London is to the south and the major manufacturing and port cities of the Midlands of England, plus Scotland, are to the north).

In 1989 the U.K. government sought bids for the design, financing, construction, and operations of the M6 Toll in return for the investors' right to toll the road for 53 years. After the concession was awarded in 1991 there were 10 years of alternatives analysis, public meetings, and refinement of the design. Opponents challenged the road in the courts, but all were eventually defeated. Once the legal way was clear, financing and construction proceeded quickly and smoothly.

As of August 2004 traffic and revenues seem to be about on track with the business plan. The availability of the road as an alternate high-capacity route has allowed the U.K. Highways Agency to begin an extensive rebuild of the M6 (non-tolled). The U.K. Ministry for Transport has expressed satisfaction with the performance of the M6 Toll and is proposing an extension north toward Manchester. Midlands Expressway Limited, the holding company, locally managed, is jointly owned by the Macquarie Group headquartered in Sydney, Australia and Autostrade SpA, the largest Italian toll road company.

C. Paris's A86 Tunnels

By the mid-1980s Paris regional transportation authorities faced an impasse over the western quadrant of the city's second beltway, the A86. Twenty years of efforts to fashion an acceptable route through the Versailles area had come to naught. The beltway couldn't function properly without the addition of this missing link. Local roads were jammed with through traffic and there was a serious lack of north-south connectivity. Local communities blocked a largely surface design in 1975. A mostly cut-and-cover tunnel design was rejected again in 1984-86, since it was judged to do too much damage to the villages and woods of this historic area around the Palace of Versailles. In any case there was no funding for such a costly project.

In 1988 an unsolicited proposal to build the road as a tunnel deep (up to 260 feet) beneath Versailles was made by private toll operator Cofiroute. They would build a single two-deck tunnel, one deck each direction, without the need for government money, in return for the right to toll cars. Much less excavation would be required (hence lowering the cost) thanks to the double-deck design for low-height vehicles, with an overhead clearance of just two meters (6 ft., 7 in.). This allowed six traffic lanes inside a 10.4-meter (34 ft.) internal diameter tunnel. Excluding heavy trucks also allowed tight and steep ramps to be built at an important interchange with the A13, to be built underground at about halfway along the 6.5-mile length of the tunnelway.[6]

French government authorities took several years to consider the proposal. One of their objections was the exclusion of larger vehicles. Cofiroute initially couldn't see how high vehicles could be accommodated affordably. A compromise was that a second shorter, single-deck tunnel of four miles length with 4.5-meter (14 ft., 8 in.) overhead clearance would be built, with the start of construction to follow the opening of the double-deck tunnel. This all-vehicles tunnel would be built using the same tunnel-boring machine but it would have no intermediate interchange or ramps, and its southern end would be at the A13 to the west of the double-deck tunnel route. On this basis a concession agreement was granted to Cofiroute in 1994.

Construction work began November 1996 at the northern end, but was interrupted by several years of legal challenges. A new concession agreement was negotiated and work restarted in 2000. The first segment of three miles (Rueil-Malmaison to the A13 interchange) is now fully tunneled and is being fitted out for an opening in 2007 while tunneling proceeds on the 3.5-mile segment A13 to Pont Colbert at the southern end of the project. The whole 6.5-mile tunnelway filling the missing link in the A86 is due to be opened in 2009.

Because of the narrow lanes and low ceiling, the tunnelway is designed with a 70 km./hr. (43.5 mph) speed limit, which the operator says will be rigorously enforced. Patrol vehicles will remove any stopped cars. Variable toll rates—between E2.00 and E5.00 ($2.50 to $6.00)—will be used to ensure free-flow traffic conditions in the tunnelway. Travel times are expected to be about 10 minutes for the full 6.5 miles compared to about 30 to 40 minutes presently on local surface roads. No tollbooths will be used, since the tolling will be full highway-speed, open-road design with transponders plus video enforcement.

The project cost of E1,700 million (about $2 billion) is being borne by the Cofiroute group, to be recovered entirely from toll revenues. The concession term is 70 years after completion of construction.

D. Australia: Melbourne CityLink

The anti-freeway movement in Australia began earlier than in the United States and prevented most freeway construction in already developed areas. As a result, by the early 1990s Melbourne, the country's second largest metro area (population 3.6 million) had a freeway (Tullamarine Freeway) to its international airport that stopped about four miles short of the central business district. To the southeast, its principal axis of new development, another freeway (Monash Freeway) simply ended about 5 miles away from the city center and there were no high-quality connections to the downtown, the ports, the airport or to the other freeway in the west (Westgate Freeway).

CityLink was a Victoria state government-initiated project to link these three disconnected and truncated freeways with a bold new inner-urban expressway facility that makes extensive use of tunnels under residential areas and city parks and elevated structure through commercial/industrial areas. It involves 13.7 miles of six-lane motorway in an L-plan wrapping around the south and west sides of the central business district, providing new access/egress, and linking the Tulllamarine, Westgate and Monash freeways. The project has a signature bridge across the Yarra River and "gateway" to the city from the airport with tubular sound enclosures and night-lit sculptures. The Burnley Tunnel under parklands and dense residential areas is 2.1 miles long and goes to 160-ft. depth. It is claimed to be the world's longest three-lane tunnel.[7] A second tunnel, the Domain Tunnel, named for the botanical gardens it goes underneath, is one mile long and also three lanes.

The state believed motorists should pay for the facility and that construction would be most efficiently managed by a company answerable to shareholders, supervised by a special-purpose Melbourne CityLink Authority. An independent arbitrator (called the Independent Reviewer) sorted out contract issues between the state and the concessionaire.

The state sought bids for a toll concession, which was won by Transurban, a group whose funding was provided by a participating construction company, investment bank funds, and publicly subscribed equity (i.e., shares purchased on the stock exchange). Construction proceeded between May 1996 and December 2000, when all stages were open. Like Toronto's 407ETR, the Melbourne CityLink (MCL) has no cash toll collection. Motorists acquire transponders or—unlike 407ETR—they are legally obliged to make payment. Enforcement cameras handle passes and violations.

After three years of operation the system is sound, popular, and profitable. Traffic and revenues are on track with forecasts and continue to grow. In 2003 traffic grew 6 percent. MCL currently transacts 675,000 tolls on an average weekday, which is not far short of the New Jersey Turnpike volume and about half the Garden State Parkway. The facility has dramatically improved connectivity and travel times throughout the whole Melbourne metro area and improved the ambiance of surface streets.

Just about a million vehicles (about half of all vehicles in the Melbourne area) have the e-TAG brand transponders on their windshields. Another 650,000 motorists have set up video accounts for "passes" under which they register their vehicle license plate number, their address, and payment arrangements, so that when the MCL cameras register their presence on the road their account can be debited.

The MCL project is approximately a quarter of the scope of work of the Big Dig in Boston, but built at about a tenth the cost: $1.5 billion versus $15 billion. MCL did not cost taxpayers any major expense—just supervisory costs. The toll concession is 35 years, after which the facilities become the property of the state.

E. Australia: Sydney's Toll Roads and Tunnelways

Australia's biggest city, Sydney, also arrived at 1980 without a connected network of freeways. A couple of short sections of inner-city expressway were built in the 1950s on either side of the Sydney Harbor Bridge. But from about 1960 onward the accepted wisdom had been that development of heavy rail transit combined with signal optimization of surface arterials was the best answer to growing traffic, not freeways. Real estate bought for freeways was sold, and planning restrictions in old freeway corridors were lifted. The region's traffic managers developed existing arterials as "clearways" with no stopping, certainly no parking, and with restricted turns. They got very good at channeling huge traffic flows through four- and six-lane radial routes and two or three similar north-south routes connecting into truncated segments of freeways. Sydney's signal optimization software has sold worldwide. But by the 1980s this was no longer considered viable as an overall strategy. The restrictions on turns and parking devastated the economy of the commercial corridors along the arterials. And even the smartest signalized arterials reached capacity. Speeds and reliability of travel times dropped precipitously. The trip from the central business district to the airport—just 5.5 miles—could be 15 minutes or 40 minutes, occasionally an hour.

Using tax money, freeway construction was restarted on the outskirts. Then to fund the more expensive projects within the suburbs, the state of New South Wales franchised investors to build three major radials as toll roads: the M4 Western Motorway (1983 onward by stages), the M5 Southwestern Motorway (1993), and the M2 Hills Motorway going east-west through the northern suburbs (1997). But all these ended short of the inner suburbs and lacked interconnection.

The New South Wales state government then developed a series of tunneled projects to develop routes under dense urban areas where gaining surface right of way was liable to be financially ruinous, if not politically impossible anyway.

Eastern Distributor to the Airport

The first of Sydney's tunnelways is known as the Eastern Distributor (ED). Its construction was timed in order to be sure it was open for the Sydney Olympic Games in 2000. The State Roads and Traffic Authority (RTA) had to win local support in the trendy neighborhoods of renovated 19th century housing and narrow streets. It offered the prospect of putting much of the heavy traffic in a tunnel, allowing wider sidewalks, bus stops, bike lanes, curbside parking and other streetscape improvements in the neighborhoods.

The underground segment is 3.8 miles long and cost investors in Airport Motorway Limited $525 million. They get a 48-year concession. A toll of A$4 (US$3) for cars (trucks toll is A$8) is collected at the northern (central business district) end of the project in the northbound direction only, using either a transponder or cash at conventional tollbooths. Toll transactions number about 41,000 per day (60 percent by transponder, 40 percent cash); hence, traffic is about 80,000 vehicles/day. Annual growth on the ED is about 7 percent.

Cross City Tunnel

Work is presently under way on the Cross City Tunnel (CCT), an east-west corridor routed underneath the north-south Eastern Distributor not far from its city portals. The CCT is being constructed as two separate mined tubes from the western side of the downtown 1.3 miles to Kings Cross, an entertainment area east of the city. Each tunnel tube accommodates two lanes of traffic. At its deepest the tubes will be 160 feet below ground level. The tunnel will allow motorists to avoid 16 signalized intersections and save about 11 minutes travel time for a toll of A$2.50 (US $1.75) each direction, with trucks paying double that rate. Transponders will be required, no cash collected. Investors are financing the $510 million cost of the project, which is due to open in 2005.

Lane Cove Tunnel

The Lane Cove Tunnel (LCT), also under construction by toll investors, consists of twin tunnels 2.2 miles in length, the westbound one three lanes wide (to avoid a forced merge) and the eastbound tunnel two lanes wide. The tunnels, in combination with a short surface section and a new Lane Cove River bridge, will provide a high-speed, free-flow link between the M2 Hills Motorway to the west and the Gore Hill Freeway to the east with good connections to the Pacific Highway, a major north-south route. The project also involves widening the Gore Hill Freeway approach to the tunnels and an interchange with the Pacific Highway. Traffic making this trip currently is forced to use Epping Road, a signalized arterial “clearway.” Five sets of traffic signals will be eliminated and, since relieved of through traffic, Epping Road will be allowed to act as a local distributor. The concessionaire has to bear the costs of improvements to Epping Road with new bicycle and bus facilities. Reducing accessibility to cars on the old free road does help encourage them to use the toll tunnel.

The winning bidder was announced in October 2003 and tunneling began in June 2004 with seven road-headers at work. Completion is due in June 2007. The concessionaire is entitled to toll for 33 years. Tolls will probably be $A2.50 ($1.75) for cars.[8]

M4 East and F3 Newcastle Freeway to M2 Orbital Link

The state has recently selected its preferred option in another tunnel project on the main radial route due west out of Sydney. Called M4 East, it will consist of twin two-lane tunnels 2.3 miles long with a split underground at the eastern end to give motorists two route options. The major one is designed for further extensions. The report on the project foresees a need to extend the facility eight miles southeast to the Mascot (Airport)/Port Botany in the future, bypassing 65 sets of traffic signals on surface roads. The immediate project would relieve another surface “clearway,” Parramatta Road, which currently carries 86,000 vehicles per day. Travel speeds are “well below 25 km./hr.” (16mph) in peak periods and “usually low throughout the day.” Local residents complain of traffic zigzagging through residential streets to avoid the crawl on Parramatta Road—a practice known there as “rat running.” The state will call for bids to develop the project once the environmental permitting is complete.

F. Findings

Australia, Britain, Canada, and France have shown that projects conceived and developed to preliminary design stage by the public sector can be successfully put to public bid, and that investor groups will compete for the right to fund, manage, construct and operate those projects in return for a right to toll. Major metro areas there have managed to deliver mega-projects on budget and on time with private sector toll concessions. With investment money involved, local groups seem more accepting of tolls, and there seems to be more discipline to resist project creep than when they are engaged with a public entity.

Part 3

How Large-Scale Toll Projects Could Address California's Urban Transportation Needs

A. Introduction

It is one thing to cite California's transportation funding crisis and contrast it with the billions of dollars of capital investment going into large-scale tolled projects in major cities overseas. But it is quite another thing to figure out how and where such concepts could actually be applied to California's traffic-choked major metro areas. But unless the potential of such projects can be made tangible, public officials and key transportation stakeholders may be unwilling to make the changes necessary in order for such projects to be proposed, financed, and implemented in the Golden State.

Hence, the purpose of this section is to illustrate how large-scale, toll-funded projects could be developed to address specific needs in California's three major metro areas. We have defined and analyzed four such projects: two in the SCAG region, one in the Bay Area, and one in San Diego. Two involve goods movement, addressing one of the most serious deficiencies in urban transportation infrastructure. Another combines large-scale congestion-relief for motorists with bus rapid transit (BRT) service. And the fourth involves dramatically improved ground access to a major airport facility.

To assess the feasibility of funding these projects via tolls, we have adopted a simplified model for all four cases. The general principle involved is similar to that used for more than 50 years by U.S. toll agencies. If the projected traffic for a proposed toll project is large, and user willingness to pay is demonstrable, investors will purchase toll revenue bonds to pay for the up-front capital investment costs. This means that a very large project, of the multi-billion-dollar kind, can be financed and built as a single project, in a few years' elapsed time. This is very difficult to do using traditional fuel-tax funding sources, because each year's available capital investment dollars must be divided up throughout the state. This facilitates doing many small projects, but makes it difficult to amass the funds to do multi-billion-dollar-projects all at once. Instead, they tend to be funded in bits and pieces, over a decade or two, with the result that their full benefits are not realized until the end of that time period.

Our feasibility models take the estimated capital costs of a project and escalate them from 2004 dollars to starting-year dollars, using an assumed annual inflation rate of 3 percent. Toll rates are also adjusted for inflation (to keep them constant in real terms) using that same 3-percent factor over the life of the bonds. We assume 40-year tax-exempt bonds issued at a 6 percent interest rate. Actual project financing these days is typically more complex than this. The SR 125 toll road project in San Diego County, financed in 2003, used a mixture of medium-term bank debt (which will eventually be replaced with toll revenue bonds) and developer-provided equity, rather than 100 percent toll revenue bond financing. Although there are benefits to such complicated financing approaches, our simplified model is adequate for testing the basic financial feasibility of these case-study projects.

B. Case Study No. 1: The Palmdale-Glendale Tunnel

Context/Rationale

One of the most serious transportation problems facing the SCAG region is inadequate airport capacity. With the decisions to cap the growth of LAX, to not build an airport at El Toro in Orange County, and to keep severe limits on the capacity of Burbank, Long Beach, and John Wayne Airports, the only remaining options are Ontario and Palmdale. And while SCAG's Regional Transportation Plan assumes dramatic growth in Palmdale between now and 2030[9], all previous attempts to develop serious airline service there have failed. Despite significant growth in north county, the local air passenger market there is seen by airlines as too small to be viable. But significant demand from south county users is hampered by the airport's great driving distance from most population centers.

As documented in the recently completed North County Combined Highway Corridors Study[10], the growth in the northern portions of Los Angeles County is putting severe strains on the limited amount of highway capacity serving these communities. The study concluded that not only is "substantially increased vehicle capacity needed in each of the major highway corridors [I-5, SR 14, SR 138]" but also that "new north-south route options should be studied for possible feasibility."

One such possibility is a toll tunnel linking Palmdale with Glendale, deep-bored beneath the Angeles National Forest. This option was defined and evaluated, briefly, in a corridor alternatives study of SR 14 in 2000.[11] That study compared the cost and feasibility of both surface and tunnel alternatives and found that the tunnel option would cost *less*, have shallower grades thereby permitting higher speeds, and would pose significantly less land-use and environmental impacts than a surface route. Either alternative would produce significant time savings for many trips now made between north county and the L.A. Basin, the San Fernando Valley, and the San Gabriel Valley.

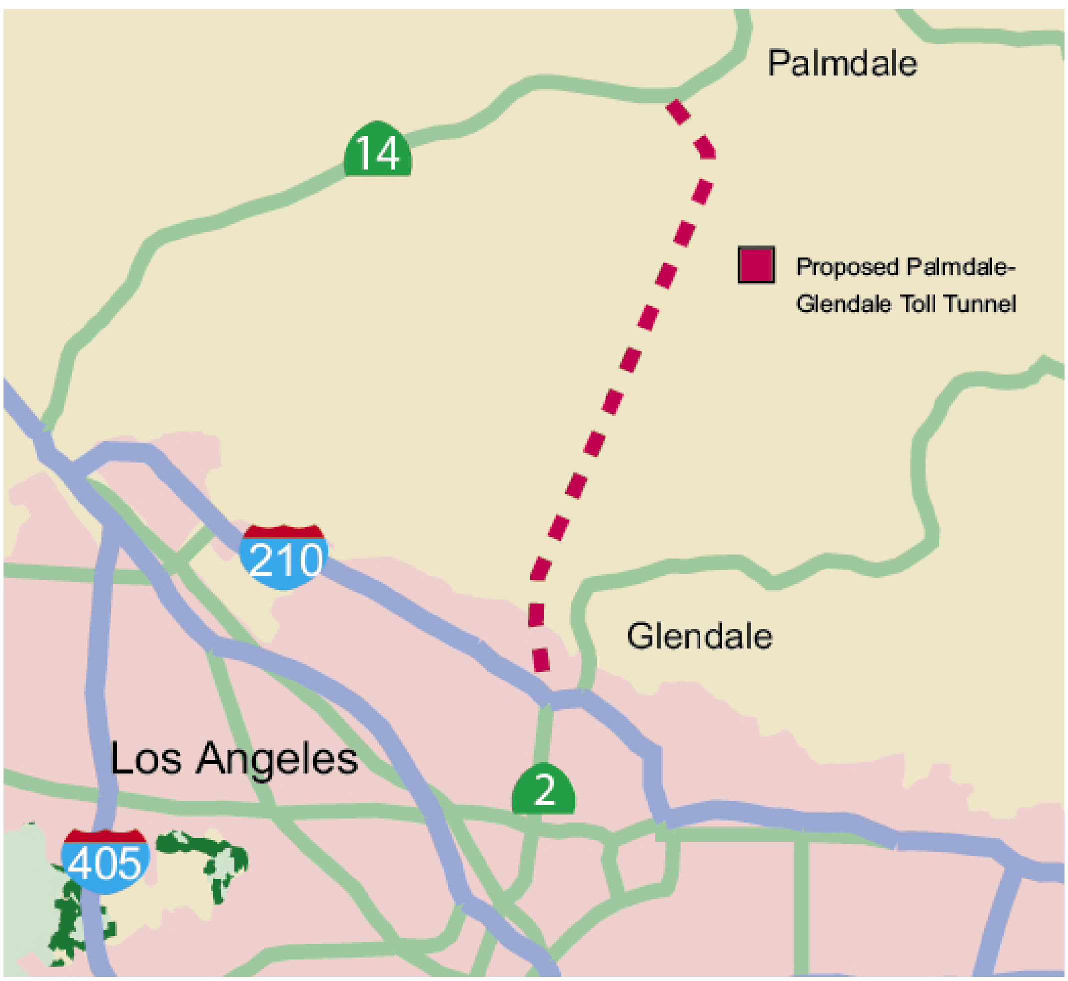
Because of the high projected cost ($1.8 billion tunnel, $2.3 billion surface) and environmental concerns, neither option has been further pursued. However, the city of Palmdale commissioned a further analysis of the tunnel option to assess its feasibility as a *tolled* route. That brief 2001 report concluded that toll revenue could pay for half the cost of the tunnel project, with the balance having to come from other sources.[12]

The 2001 tolling study, which built on the previous SR 14 analysis, omitted two important developments. First, it treated the proposed tunnel like a conventional toll road, rather than conceiving of it as a premium-service congestion-relief facility similar to HOT lanes. Second, since it was conducted prior to the regional decisions to limit the capacity of LAX and to not build the proposed El Toro airport, it neglected to consider the potential additional north-south traffic generated by serious development of Palmdale International Airport. Thus, a fresh assessment of the toll tunnel concept seems appropriate at this juncture.

Specific Concept

As defined in the 2000 study, the tunnel would extend from the SR 2/I-210 interchange northward, with interchanges at Big Tujunga Canyon and Aliso Canyon Road before terminating at an interchange with SR 14 just south of Palmdale (see Figure 1). Heading northbound, most of it would be at a grade of 3 to 4 percent. The two primary segments would be tunnels 4.7 miles and 10.8 miles long, with another five miles at-grade, for a total length of a bit less than 21 miles. The tunnel segments would consist of twin tubes created by tunnel-boring machines, with an inside diameter of 47 feet. The previous studies assumed two lanes per tube, with one tube northbound and the other southbound, but another option is discussed below.

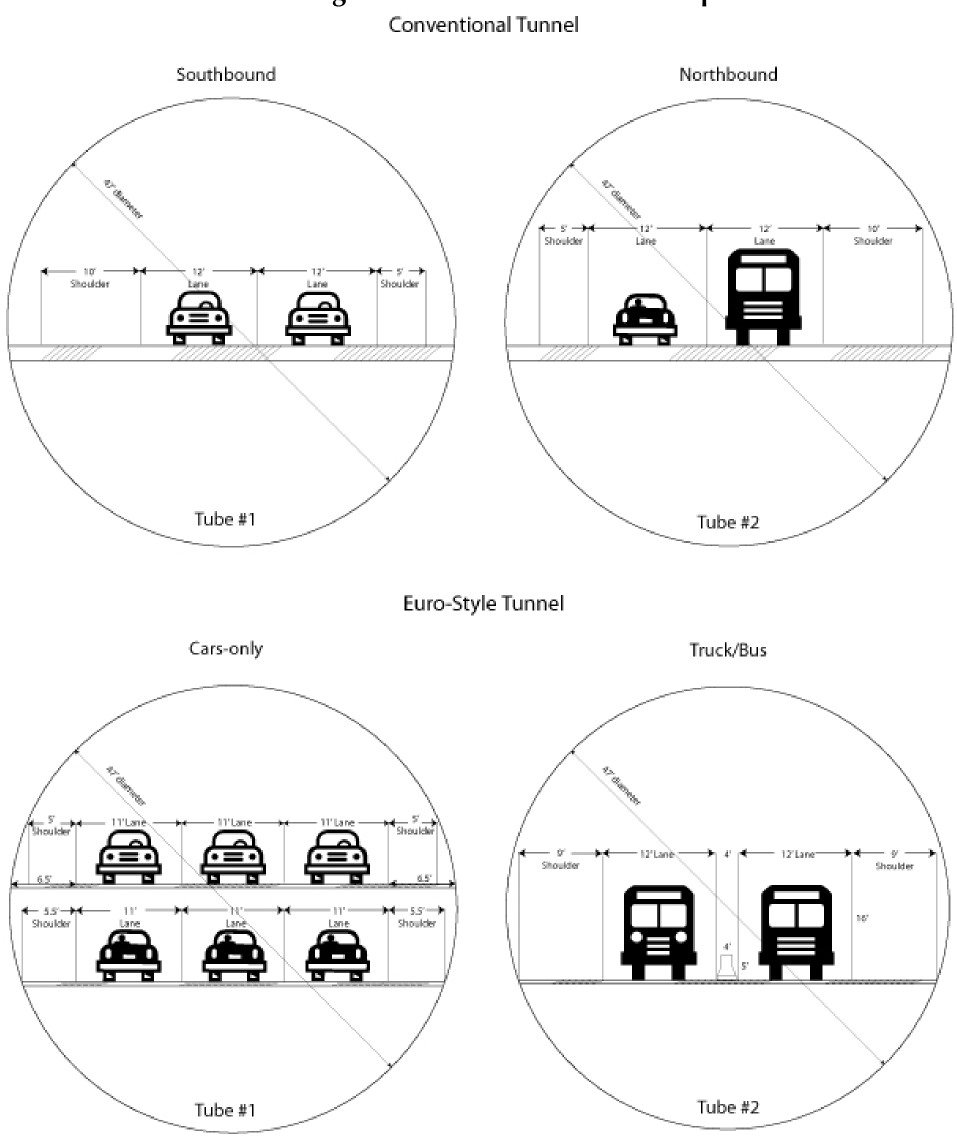
Figure 1: Proposed Palmdale Tunnel



As highway tunnels go, this would be a very large project, but hardly an unprecedented one. The world's longest is the Laerdal tunnel in Norway, completed in 2000 (15.3 miles). Second-longest is Switzerland's St. Gotthard Road Tunnel, at 10.5 miles. There are several other seven- and eight-mile-long tunnels in Europe. Such tunnels require ventilation shafts, access tunnels between the two tubes, robust fire suppression systems, emergency shelters, and special accident response/rescue systems.

Because such a project would be so costly, it is essential that its capacity be used to the maximum degree possible. As discussed in Part 2, in a comparable situation in France, the private developer of the A86 tunnels thought outside the box. It found that twin tubes that would provide space for only four (total) conventional full-size traffic lanes could be reconfigured to provide eight lanes, six in one tube for light vehicles (cars and light trucks) in a double-deck configuration and two in the other tube for heavy trucks and buses. Figure 2 compares the conventional approach, from the 2000 study, with an adaptation of the French concept to the same 47-foot inside diameter tubes.

Figure 2: Alternate Tunnel Concepts



Our initial feasibility assessment is based on using just four total lanes, and neglects truck traffic and the higher tolls that truck traffic would pay. But it should be kept in mind that for very close to the same total cost (adding only the elevated structure for the second deck in one of the tubes) the capacity of this project could be doubled. One possible approach to developing the project would be to build the six-lane (double-decked) light vehicle tunnel first (as the French are now doing), which would provide immediate congestion relief for most users as well as generating toll revenues. Once it was operating successfully and debt service was being covered, then the parallel tube could be developed and opened to truck and bus traffic at a later date.

Feasibility Assessment

The analysis of projected traffic and toll revenues is presented in the Appendix. The tunnel produces dramatic reductions in distance from many L.A. Basin locations to the Palmdale area, and even more dramatic time savings during morning and afternoon peak periods. We assume the tunnel to be value-priced, like the HOT lanes in Orange and San Diego Counties, to keep traffic moving at the speed limit even during peak periods. Our basic analysis assumes that both tunnels are built at the outset, at a 2012 capital cost of $3.07 billion. Done that way, the net present value of the toll revenues generated over the first 40 years of operation is $2.6 billion (2012 dollars), which means that toll revenues could cover 83 percent of the cost of the entire project. But if the project were done in the two-phase approach outlined above, only 60 percent as much capital costs would have to be covered from the same toll revenues in the initial years. Under that approach, the project could be fully supported by toll revenues.

C. Case Study No. 2: San Diego Managed Lanes Network

Context/Rationale

San Diego is one of the nation's pioneers with HOT lanes or, as many now prefer to call them, Managed lanes. Its conversion of the under-utilized HOV lanes on eight miles of I-15 to one version of HOT lanes was the first in the nation, and has received national and international recognition. The *Mobility 2030* plan includes the addition of similar "managed lanes" (MLs) on four freeways: I-15 (from the current eight miles to 20 miles), I-5, I-805, and SR 52.

There are two different approaches to conceiving and financing HOT or managed lanes. The first, typical of projects involving the conversion of existing HOV lanes (where little or no physical construction is involved, and hence minimal capital costs) is to fund such projects out of general transportation revenues, and to use net toll revenues (net of toll system operating costs) for transit or other purposes. This is the model SANDAG used for the initial I-15 project, and it is the model it plans to use for the other ML projects in its 30-year plan.

The other model, more typically used for ML projects requiring extensive construction of new facilities (and hence large capital investments) is to issue toll revenue bonds based on the projected toll revenues to cover as much as possible of the construction costs of the new lanes. This is the model used for Orange County's 91 Express Lanes, whose capital and operating costs are being fully covered from toll revenues. This is also the model proposed for the HOT lanes to be added to the Washington Beltway in northern Virginia, and a number of other HOT lane projects involving large capital investments.

The four ML projects in *Mobility 2030* would cost $2.06 billion in 2002 dollars. SANDAG proposes to use general transportation funds for this sum. By not having to use the resulting toll revenues for debt service on revenue bonds, the net revenues would be available (and are planned to be used) for transit subsidies in the corridors in question. Altogether, SANDAG projects $191 million in net ML revenues (through 2030) made available for transit operations thanks to this approach; the net present value of those revenues is $118 million in 2004 dollars.

This case study evaluates an alternative approach to managed lanes in San Diego, following the more conventional financing approach of issuing toll revenue bonds to cover as much as possible of the capital costs of a network of such lanes. But because there are important benefits (for both drivers and transit) from creating an interconnected network of such lanes, we have modeled a more extensive set of MLs, and have included considerably more flyover connectors at interchanges, permitting seamless connections to be made from the ML on one freeway to the ML on another.

Specific Concept

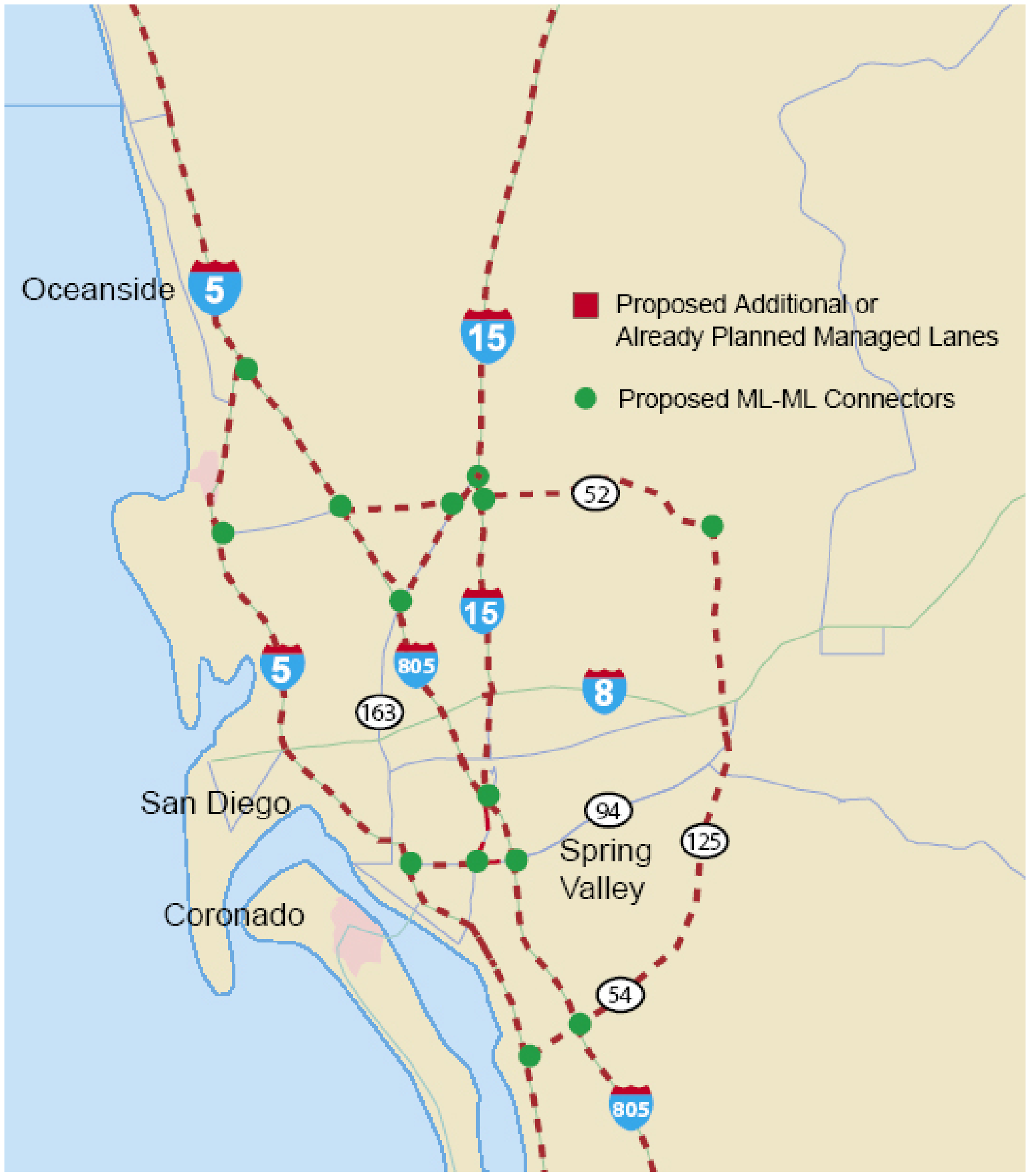
The proposed ML network for San Diego is shown in Figure 3. It incorporates the physical facilities of the four ML projects from *Mobility 2030* (shown by the solid lines) but adds additional MLs on further sections of I-15 and SR 52; and also portions of SR 54, SR 94, SR 125, and SR 163. These additions, as well as the many additional interchange connectors, are indicated by the dashed lines in Figure 3.

The addition of these new links and connectors produces a *network* of managed lanes, rather than just sets of individual facilities. This network provides much greater mobility benefits than the current ML plan, because it provides uncongested, high-speed service on a much larger portion of San Diego's core freeway system, making possible many more uncongested trips. For individual drivers, this provides a kind of "congestion insurance" for a great many routes, all seamlessly connected via the flyover connectors where the relevant freeways intersect. For bus rapid transit (BRT), this network offers the possibility of high-speed service on a much larger guaranteed free-flow network of premium-service lanes throughout the densest portions of the San Diego metro area.

Feasibility Assessment

The analysis of traffic and revenue for the ML network is presented in the Appendix. We estimate the traffic and revenue over a 40-year period, as the network is built in phases and additional links get added, generating additional toll revenues. Using what we estimate to be the market-clearing toll rate for the starting year (2010), the net present value of toll revenues is sufficient to support 63 percent of the network's $10.2 billion capital costs (in 2006 dollars). To make the project fully supportable from toll revenues would require a start-year toll that is 58 percent higher than what we used. A toll rate that high would probably deter too many potential customers, thereby not generating the needed revenue. But if further studies show that an intermediate toll rate would be feasible (e.g., if congestion adjacent to the managed lanes were greater than implicitly assumed in our model), then a somewhat greater portion than 63 percent of the capital costs could be paid for out of toll revenues, reducing the portion of network costs that would have to come from conventional sources of transportation funding.

Figure 3: Proposed San Diego Managed Lanes Network



San Diego faces a choice. SANDAG currently plans to spend $2.4 billion (2006 dollars) of transportation tax money to develop four individual ML projects, thereby improving both driving and bus travel times on those four freeways, and gaining $118 million (present value) to use to subsidize bus service. Alternatively, it could invest that same $2.4 billion (and some additional tax money) to produce a $10.2 billion ML *network*, generating $6.4 billion in toll revenues to service debt on toll revenue bonds issued to pay for the majority of the cost of building the network. The advantage of this alternative is that a much larger portion of the freeway system could offer drivers "congestion insurance"—i.e., a reliable, high-speed alternative to congested lanes. And the network benefits would mean that a much larger number of trips, both bus and car, could be made on time-saving facilities. The drawback is that no net toll revenues would be available to subsidize bus service, because those toll revenues would be needed for the next 40 years to pay off the cost of building the network.

D. Toll Truckways Case Studies

The following two case studies propose toll truckways in the heart of California's two major metro areas to handle big trucks more efficiently, more safely, and with lower tailpipe emissions. Both greater Los Angeles and the Bay Area face major challenges in handling heavy trucks. Rail, air, and barges or ships handle parts of many freight trips—generally the "wholesale" parts of transport transactions. But the pickup and delivery of most freight has to be by truck because few supermarkets, residences, offices, or even factories or warehouses have a rail siding, a dock, or an airfield alongside.

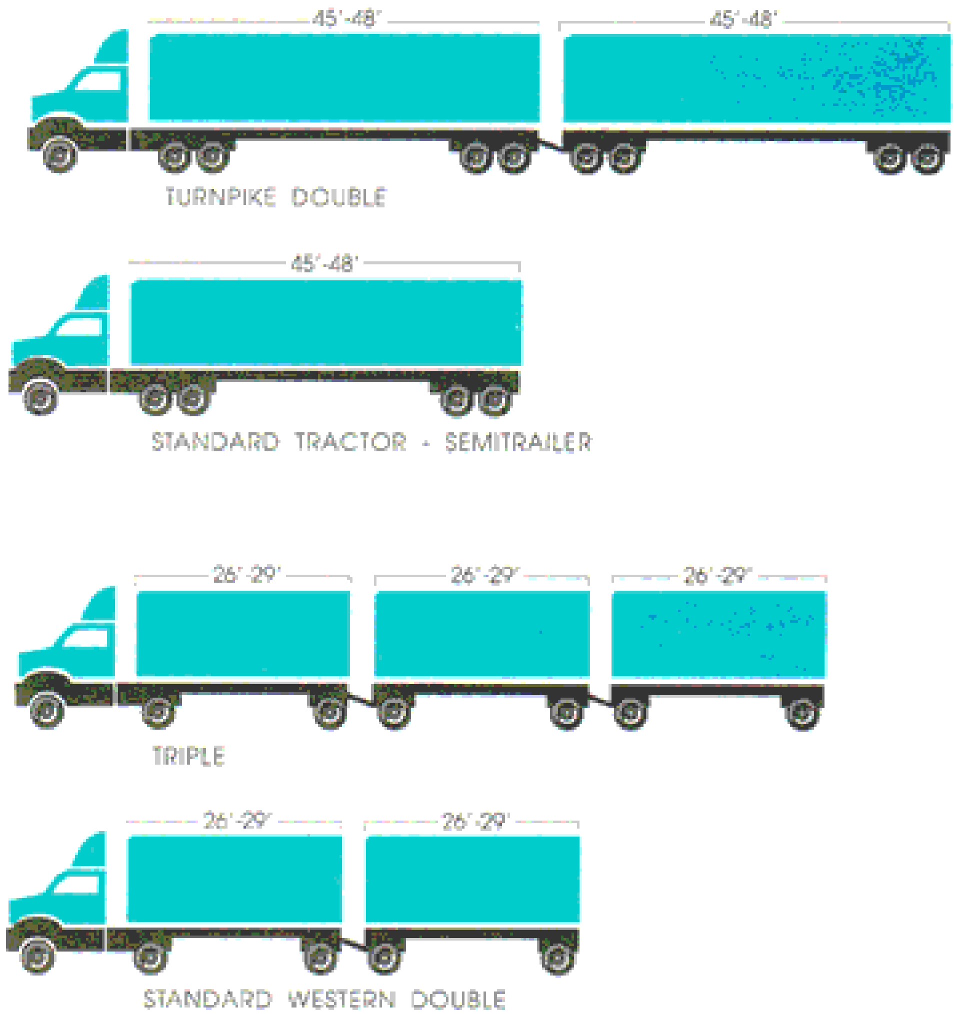
Just-in-time delivery makes truck the only feasible mode for the overwhelming proportion of freight movements. Most Americans, whether at their workplace or home, are used to being able to order goods for delivery in two or three days, if not overnight from anywhere in the country—impossible if the goods have to change modes and be gotten onto freight trains that are broken down and made up at a number of classification yards along the way. On runs over 1,000 miles long with a large enough volume for regular trains, container and trailer-on-flat-car operations are often competitive with long-distance trucking—as in Oakland or Long Beach to Chicago. But much of this freight already goes by rail, so those who hope to reduce truck traffic by substituting trains for trucks are likely to be disappointed.

Realism demands that we look at ways to make trucking operations serve our needs better. It is the intermixing of big rigs and cars that creates many of the present problems. Cargos worth a half million dollars are delayed by visiting tourists, or someone going to the supermarket, joining the traffic stream and overloading the freeway. Collisions are virtually inevitable because of the different handling characteristics of trucks and cars, and those collisions are often deadly to the car occupants. On major routes it would be desirable to separate bigger trucks from cars.

Under federal and California law, long doubles and triples (see Figure 4) are not permitted on existing highways, and that is not likely to change. The existing freeways and approach roads usually aren't designed for such big rigs and there is strong public opposition to mixing them with regular traffic. But on newly designed self-contained truckways, whereby trucks are barrier-separated from mixed traffic lanes, these longer combination vehicles (LCVs) should be welcomed. They are a key way to lower costs, reduce accident rates, and cut emissions. The lower costs and emissions arise from the economy of pulling larger loads behind the one tractor and its driver. As a result, payload represents a larger proportion of total weight moved.

By allowing two long trailers, twice the volume can be hauled by one driver and his tractor as compared with a regular tractor-semitrailer (18-wheeler). A similar configuration would involve a single tractor hauling two 40-foot containers on chassis. Likewise, with the currently permitted short-trailer doubles, the addition of a third trailer to make up a triple combination would add 50 percent to productivity. And a version of this type of rig could handle three 20-foot containers on chassis.

Figure 4: Longer Combination Vehicles Compared with Conventional Truck Rigs



So the first major productivity increase is in allowing greater volume and weight to be hauled by the one tractor in the closed environment of the truckway.

The second major source of improved productivity can arise from management of traffic flow in the truckway. By varying the toll rate by time blocks, or even dynamically according to congestion level, it is possible for the tollway operator to prevent overloading of the truckway such as would cause congestion and breakdown in flow. Once flow has broken down in any traffic lane, throughput drops precipitously—on average to about 60 percent of free-flow throughput. Then it can take hours to re-establish free flow. Toll rates can be used as a metering mechanism to discourage some truckers from traveling at the busiest time. Of course high tolls will also encourage the truckway managers, longer term, to provide extra capacity where needed. A truckway will have an hourly capacity of about 800 trucks/lane/hour so long as free flow is maintained.

With a toll truckway permitting free flow at speeds up to 75 mph (average speed of 60 mph) and operating long doubles, trucking productivity per tractor-driver could be increased as much as threefold, compared with regular tractor-semitrailers in unmanaged mixed lanes at average speeds in the 35 to 40 mph range. There would also be major benefits to reliability of delivery, freight rates, vehicle emissions, and safety. Concrete barriers would be designed to contain any errant big rigs within the truckway, virtually eliminating the possibility of heavy truck/car collisions.

Every long double operating in the toll truckway will be two fewer tractor-trailers operating in mixed traffic lanes and every two short triples in the truckway will be three less short doubles mixing in the freeway lanes, with resulting benefits of lower emissions and reduced congestion in the regular lanes.

Potential Earning Power

To estimate the potential earning power of operating on a truckway we considered present trucking rates in California metro areas. A leading online service (www.freightquote.com) provides competitive quotes from scores of carriers. The cheapest quote for about 100 miles of travel with a fully laden tractor-semitrailer within the urban areas of California works out at about $6/mile. (In New York the rates are $10/mile, but for long-distance routes, for example California to Chicago, only $1.15/mile.)

Most truckers quote on a truckload (45,000 lbs. of payload) based on about $100 to cover overhead and profit at the pickup and another $100 for the drop-off of any given trip and $3/mile on urban trips in California. So a 100-mile urban trip will be $500. A truckload trip from Long Beach to the rail yards on the south side of Los Angeles, about 25 miles, is about $300.[13] We took the $500 for a 100-mile truckload delivery as representative of the kind of freight trips most likely to be attracted to urban truckways in the extended metro areas of southern and northern California. A tractor and loaded semi-trailer can currently generate about $1,140 gross revenue per daily shift based on six hours on the road at an average speed in mixed traffic on the freeways of 38 mph, doing 228 miles.

By operating that same rig (either a tractor-semitrailer or a double short trailer combination) on a truckway where free-flow speeds are maintained, the six hours of driving will produce 360 revenue miles, a 58 percent gain. We have assumed costs remain the same since the bulk of costs are the driver's salary and benefits and the costs of the rig and insurance. Insurance costs should drop because of greater safety of operations in free-flow traffic and the closed environment with only other professional drivers. It is unclear whether fuel costs would rise because hours of engine operation would remain the same. Steady speed driving produces better per-mile fuel consumption than the erratic speeds forced on trucks by congestion, but of course daily mileage is up substantially. The benefits from extra revenue mileage are quite large. Based on the above assumptions, the trucker's surplus over variable costs for covering overhead, profit, and tolls is more than doubled by operating in the truckway as compared to present operations on congested freeways, as shown in Table 3.

Even larger benefits arise from operating longer combination vehicles (LCVs) in the truckway. Adding a third short trailer for truckway operations adds another 50 percent to payload, taking earnings per shift/day to $2,700 at present freight rates. And of course adding a second long trailer to a regular tractor-semitrailer doubles potential revenue/day to $3,600 based on the same pricing.

Table 3: Toll Truckway Productivity						
Assuming no change in freight rates	Mixed freeway	Mixed freeway	Truckway	Truckway	Truckway	Truckway
LA and Bay area rates for 45,000 pds (20t)	semi-trailer	double-shorts	semi trailer	double-short	triple-short	double-long
Payload	45,000 pds	45,000 pds	45,000 pds	45,000 pds	67,500 pds	90,000 pds
Metric tons	20t	20t	20t	20t	30t	40t
100 mile delivery - 2004 freight rates	$500	$500	$500	$500	$750	$1,000
Average speed on the road mph	38	38	60	60	60	60
Miles driven in 8hr shift (6hrs driving)	228	228	360	360	360	360
Revenue from 6hrs payload at 2004 rates	$1,140	$1,140	$1,800	$1,800	$2,700	$3,600
Variable costs per shift	$684	$684	$684	$684	$1,007	$1,165
Available for overhead, profits, tolls	$456	$456	$1,116	$1,116	$1,693	$2,435
Extra earnings from using truckway/shift/day			$660	$660	$1,237	$1,979
Drop assumption of no change in freight rates			$220	$220	$412	$660
Assume the extra productivity split 3 ways			3x$220	3x$220	3x$412	3x$660
Shipper's savings on 100 mile delivery, %			$61 12.2%	$61 12.2%	$76 15.2%	$91 18.3%
Additional for trucker for overhead & profit/day			$220 43%	$220 43%	$412 90%	$660 145%
Truck tollway - possible toll per mile			$0.61	$0.61	$1.15	$1.83

The extra equipment and load per rig obviously increase costs, but less than proportionately, because the driver/tractor costs at the front-end remain much the same. We have assumed a nearly 50 percent increase in variable costs from operating the triple short as compared with the conventional double short combination that operates on freeways now, and a 70 percent increase in variable costs for the double long trailer combination as compared to the regular long semitrailer operation. Very large surpluses of revenue over variable costs are generated as seen in the last two columns of Table 3.

Competition

In practice, competitive forces would drive freight rates down on these kinds of freight movements, passing on some of the productivity gain to shippers. And it would exert pressure on single-semi operators on the freeways to adapt their operations to twin trailer runs on the truckway. Similarly truckers running double short combinations on mixed traffic freeways would be under competitive pressure to convert their runs into triple short combinations on the truckway.

It is not possible to precisely predict how competition would reshape trucking operations. What is clear is that the improved productivity potential of operating LCVs in free flow in their own lanes is very substantial, and that this will provide major profits for truckers, and the opportunity for substantial improvements in safety and in cost savings to shippers, as well as providing a new revenue stream to help fund the facility.

For simplicity we assume that there is a three-way split of the surplus from truckway operations: a third going to shippers, a third to truckers and a third to the truckway operator in tolls. And in the lower part of Table 3 we show the order of magnitude of possible benefit to each from the different truckway operations.

For conventional rigs, the extra mileage made possible by free-flow operations on the truckway provides a potential 12 percent reduction in freight charges, adds 43 percent to the trucker surplus for overhead and profit, and supports tolls of 61c/mile on the truckway.

Quite dramatic potential benefits are shown for all three parties from the adoption of longer rigs (LCVs) in the free-flow environment of the truckway. Long doubles, for example, produce up to 18 percent reduction in freight rates, more than double present coverage for overhead and profit, and tolls of $1.83/mile.

Now for some words of caution. First, different trucking operations have different cost structures. Our numbers derive from quoted prices from the jobbers who specialize in intra-urban trucking because we think they are the ones who set prices at the margin. Large for-hire, long-distance carriers have very different cost structures, with much higher variable costs (because of driver benefits and pay per mile), and have lower fixed costs.

Second, only a portion of truck trips in the truckway corridors will be suited to operations on the truckway. The truckways will have fewer access/egress points than the freeway, so local trips will still tend to be made in the mixed lanes except in times of very severe congestion in the mixed lanes. Many loads will not be large enough to justify the longer combinations. Over time, the economic advantages of consolidating loads, operating in free flow, and running longer combinations will see ingenuity used to take advantage of cost savings for loads previously deemed “unsuitable” for the truckway.

We think that drivers of existing rigs should be able to choose whether to use the truckway or not. Truckers should only use the truckway when they perceive the benefits from using it to be greater than the toll being charged. Based on the numbers above, we think many will find it beneficial and will use the toll truckway. Obviously to operate LCVs, which are not allowed in regular lanes, truckers will have to be in the truckway. In this case they will also have to make use of make-up/break-down yards at entry and exit, picking up the extra trailer on entry to make up the triple or long double and dropping off the extra trailer on exit, so that they only operate in currently legal configurations on local streets. The exception to the use of make-up/break-down yards by the bigger rigs will be where the truckway has direct ramps in and out of a trucking-only area such as a seaport, an air cargo facility, a rail yard, or distribution center.

Eventually it should be possible for freight-intensive businesses to congregate around truckway interchanges (nodes) with their own private ramps allowing the biggest rigs access and egress without stopping at the truckway make-up/break-down yards. This use of make-up/break-down yards is an established and successful practice along a number of state turnpikes including the Ohio Turnpike, the Indiana Toll Road, the Massachusetts Turnpike, the New York State Thruway, Florida’s Turnpike, and several others where such LCVs are allowed, but prohibited off the pike.

Design Features

The truckway would have the following features:

1. Two lanes each way (2x2) of 14 ft. each;
2. Fully separated from regular lanes with concrete barriers (minimum 42” high) to contain accidents[14];
3. Its own access/egress ramps (no trucks crossing regular lanes) at interchanges;
4. Dedicated spur connections to major facilities such as ports and airports;
5. Wired for ITS services including in-cab signs, automatic lanekeeping, intelligent cruise control, dynamic dispatching, in-vehicle navigation, etc.
6. Tolls to be collected by transponder only (no on-site cash transactions);
7. Variable toll rates for management of traffic;
8. Guaranteed free-flow conditions or “your money back”;
9. Adjacent make-up/break-down yards and truck parking at key interchanges;
10. Engineered for heavier axle weights;
11. Generally located inside the existing Interstate right of way, either elevated, depressed, or with widening as determined best segment by segment or on separate alignment;
12. Walls to contain sound and provide wind protection for trucks;
13. Truck tow services provided;
14. Full monitoring by sensors and pan/tilt/zoom cameras and full-time dispatching of help.

Costs

SCAG estimated the costs in the Los Angeles area of a 2x2 lane truckway of the kind we envisage here at $27.5 million per lane-mile, or $110 million per route-mile.[15] This allows for the truckway to be built on structure with full seismic protection, and for dedicated ramps and land acquisition where that is more economical than structure. How far these costs can be financed requires consideration of the proposed corridors in northern and southern California in the case studies that follow.

Enforcement

There is understandable concern among auto clubs and highway safety groups that permitting LCVs on truck-only lanes could be the camel’s nose under the tent for legalizing LCV operations on other highways—or for less than rigorous enforcement of laws prohibiting their off-truckway use. Clearly, the credibility of a legislative decision to permit LCV-serving toll truckways depends on serious enforcement of laws prohibiting the use of LCVs on other highways. California is known nationwide for providing serious penalties ($271 fine) for violation of the restrictions on HOV lanes. At a minimum, there should be proportionally serious fines for trucking companies that violate subsequent laws on the use of LCVs only on designated truckways.

Emissions

As noted above, a gradual shift from hauling freight and containers from conventional rigs to double and triple-trailer configurations means that more freight will be hauled by fewer tractors. The Environmental Protection Agency has recognized the beneficial effects of shifts of this kind. Its recently launched SmartWay Transport Partnership intends to apply innovative strategies to increase fuel efficiency and reduce emissions in goods movement. By 2012 this initiative aims to reduce between 33 and 66 million tons of carbon dioxide (CO_2) emissions per year and up to 200,000 tons of nitrogen oxides (NOx) per year, while saving up to 150 million barrels of oil annually.

Cheryl Bynum of the SmartWay team at the EPA has specifically addressed the role of LCVs in achieving these goals:

> *If a [trucking] fleet uses longer trailers and/or multiple trailers, total ton-miles are improved for that trip, and there are fewer trips. This also provides—in addition to the fuel and GHG[greenhouse gases] savings—criteria pollutant savings. The actual environmental benefits depend upon the input the fleet enters into the FLEET Performance model, since it is specific to mileage, equipment type, mpg, and payload.*[16]

E. Case Study No. 3: Twin Ports-to-Nevada Truckway

The adjacent ports of Long Beach and Los Angeles are by far the most vital import facility in the United States. They handle a high proportion of the country's incoming manufactures from Asia, managing some 40 percent of all the containers of imported goods.

The Los Angeles area has developed an industry out of assembling, warehousing and distributing these products to destinations within California and across the country. This generates major volumes of trucking out of the ports, first north on I-710 and I-605, then east on SR 60, I-10 or I-210. The highest truck volumes are on highways immediately around El Monte just over 20 miles from the ports and east of downtown Los Angeles,[17] where the north-south routes meet the east-west routes. Four of these routes (I-605, I-210, SR-60 and I-710) are in the top seven in the country in terms of truck volumes projected for 2020.[18]

Some of this freight comes in containers, which are shipped on to destinations beyond southern California; much of this is put on railcars for destinations like Texas, Chicago, and Kansas City. But the great majority has an intermediate destination within Southern California, 10 to 80 miles from the port. These value-added destinations such as warehousing and assembly plants are widely distributed off I-10 and SR-60 in eastern Los Angeles County and off I-15 in San Bernardino and Riverside Counties. Most are totally truck-dependent.

Air cargos at Los Angeles and Ontario international airports add to truck traffic, a lot of which is also purely local to the L.A. area, but heavy in volume because of the centrality of the area immediately east of downtown Los Angeles. On some of these routes, even though very heavily trafficked by commuters and other light vehicle traffic, trucks constitute over 10 percent of the traffic stream. Considering that a tractor-semitrailer occupies about 2.5 to 3 times the road space of a light vehicle, trucks often take up 25 to 35 percent of highway capacity in these corridors. High-value shipments get caught in commuter traffic jams, and motorists complain about "walls" of trucks in the right-hand lanes blocking their entry and exit from the freeway. There are also serious safety issues involved in the intermixing of trucks and light vehicles.

SCAG has been studying truck lanes and full truckways along I-710, SR 60 and I-15. Truckways along these routes are included in SCAG's 2030 long-range transportation plan. A SCAG briefing paper[19] reports that a regional truckway system "offers a viable and self-financing way to mitigate congestion and reduce emissions in Southern California." It estimates that a toll averaging 56 cents per mile on trucks could "totally fund the development and operation" of a $16.5 billion system extending 142 miles between the seaports and Barstow on I-15. The modeling for this is based on an average of 2,466 million truck miles traveled annually, which generates toll revenues of $1,250 million per year average over 30 years.

Proposed Ports-to-Nevada Truckway System

We propose an alternate plan for this truckway. First, our proposal is that the project be considered in distinct urban and rural segments, with the break between the two being located at the I-15/I-215 interchange north of San Bernardino.

Like SCAG's truckway, our proposal would involve similar 2x2 lanes within the greater Los Angeles urban area, but that configuration would end on I-15 near the I-215 interchange north of San Bernardino. This urban truckway segment would be 73 miles long and include 292 lane-miles (see Figure 5). Based on the SCAG costing of $27.5 million per lane-mile, it would have a capital cost of $8.03 billion in 2004 dollars.

We propose that the truckway be extended (in a reduced form) all the way to the Nevada state line, so that LCVs could run continuously between the Los Angeles ports and Salt Lake City and beyond in the Rocky Mountain states. (LCVs can operate legally on Interstate routes in Nevada, Utah and 11 other western states.) From I-215 in San Bernardino north and east to the Nevada border is a rural segment of I-15 with much lower truck volumes. Our proposal is that initially the rural truckway be one lane per direction with periodic passing sections. San Bernardino to the Nevada line is 172.5 mi., and with an average of 2.2 lanes (the 0.2 there accounting for the passing sections of 2-lanes per direction), this would total 380 lane-miles. The cost of this would be much lower at approximately $5 million/lane-mi. or a total of around $1.9 billion. The FHWA's Freight Analysis Framework (FAF) projects major increases in traffic along this rural corridor, so the rural truckway needs to be designed for economical expansion to 2x2-lanes.

Make-up/break-up facilities for LCVs are an essential feature of this concept, enabling efficient long doubles and triples to operate without encroaching on other roads where they will continue to be illegal. These facilities will be provided at "nodes" which will also provide for truck parking and other truck-stop-type facilities. Over time, they should become profit centers in their own right. In the urban segment, the initial nodes would be required at East Los Angeles (I-5), El Monte (I-605), Ontario, and San Bernardino (I-15). At a nominal $100 million each, this would increase the capital cost of the urban segment to $8.43 billion in 2004 dollars. The rural segment would need only two initial nodes, at Barstow (I-40, SR 58) and Victorville (US 395, SR 18). Being in smaller towns, we cost them at $50 million each, which increases the capital cost of the rural segment to $2 billion in 2004 dollars.

California public policy should make very clear that use of the truckway is voluntary except for LCVs that are not currently allowed on California highways. These LCVs would only be allowed within the truckway and facilities directly connected to it by dedicated truckway ramps. Present tractor-semitrailers and short double combinations would have to be attracted to use the truckway by speed and service advantages worth more to truckers than the cost of tolls, or else they would be free to travel in mixed traffic lanes as they do now. There is a gridlike layout of highways between the ports and San Bernardino. Roughly similar mileages and travel times are likely on several different routings. So if truckers were required, if traveling on SR 60, to use only its toll truckway, many would divert to the parallel I-10 or I-210 instead. And if the response to that was to ban trucks from those freeways, they would then divert to parallel arterials, where their operation is perfectly legal. Better to attempt to persuade them to voluntarily use the toll truckway by making it more profitable to them, but allowing those truckers who don't find it so to continue to use existing freeway lanes.

Figure 5: Proposed Twin Ports to Nevada Truckway

Feasibility Assessment

As explained in the Appendix, we projected truck traffic in the corridors involved to increase at 3 percent per year. And we assumed that the urban portion of the truckway (ports to San Bernardino) would initially capture 10 percent of truck traffic on the adjacent freeways, growing to 50 percent by the end of a 10-year ramp-up period during which a growing fraction of trucking companies would equip for LCV operations. We assumed an average toll rate (averaged over all types of truck) of $1.00/mile (2004 dollars), escalated at our assumed inflation rate of 3 percent per year to the starting year of 2012 and adjusted annually thereafter to keep pace with the inflation rate. As shown in Table A-7, on that basis the urban truckway has a net present value of toll revenues, over the 40-year period, of $16.7 billion (2010 dollars), compared with an adjusted (2010) capital cost of $10.1 billion. This is clearly a self-supporting project, based solely on the toll revenues generated, and ought to be financeable on that basis.

For the rural segment, we assume that truckway would again start off attracting 10 percent of the much smaller truck traffic in the I-15 long-haul corridor, growing to 60 percent after 10 years and beyond, as trucking companies invested for long-distance LCV operations. Consistent with the different economics of long-haul trucking, we assumed an average (all-trucks) toll rate of 40 cents/mile (2004 dollars), which becomes 51 cents/mile by the starting year of 2012. The second sheet of Table A-7 shows that this truckway, too, looks to be self-supporting. The net present value of its net toll revenues is $5.5 billion (2010 dollars), compared with an adjusted (2010) capital cost of $2.4 billion. This truckway should be even easier to finance solely based on its expected toll revenues.

F. Case Study No. 4: Oakland-Valleys Truckway

Context/Rationale

The San Francisco Bay Area including Silicon Valley is the heart of the computer revolution and American high technology. But in addition to producing a vast amount of intellectual property, the area exports huge amounts of high-value manufactured products. This is most dramatically demonstrated by the activity at the port of Oakland. In an era in which international manufacturing is heavily concentrated in Asia, most U.S. ports import far more filled containers than they export. The Bay Area, however, is an importer of empties, and its major port at Oakland exports 800,000 filled containers compared with 500,000 imported per year. The same is true of the nearby Oakland International Airport and air freight. Outbound products from the Bay Area are valued at $171 billion annually versus $131 billion imported.[20] The Bay Area's largest originator of outbound freight is Santa Clara County, centering on San Jose. Of the outbound Bay Area freight, $48 billion/year consists of electrical and electronics equipment. Alameda County, however, has by far the largest intercounty and intracounty freight flows in the Bay Area by volume—41 percent of the total.[21]

I-880 is the major freight corridor between Alameda County and Santa Clara County. Over the past 20 years, the big growth area for warehousing and distribution has been San Joaquin County in the northern Central Valley around Tracy and Stockton. Cheap, flat land, and close proximity to several strategic freeways—I-580, I-5 and SR 99—are the major attractions of the San Joaquin Valley. The area has long housed major Pentagon logistics bases and is growing to rival the immediate East Bay in warehousing and distribution. Food processing factories in the Central Valley distribute directly to supermarkets throughout the Bay Area via I-580. Over 80 percent of the trucks on I-580 are five-axle or more tractor-semitrailers, while on I-880 shorter-distance two-axle straight trucks typically constitute 30 to 40 percent of truck traffic.

The railroads are moving major operations to hubs well outside major metro areas. For example, BNSF is building an intermodal "logistics hub" in Stockton, to serve a 250-mile radius.[22] Thus, it could serve all the Bay Area, the Sacramento area, as far north as the Oregon line, the Reno area, and as far down the Central Valley as Bakersfield. This intermodal approach by the railroad will require trucking to and from Stockton.

The recent *Regional Goods Movement Study* highlights the dominance of trucking in Bay Area freight movement. It reports that of 322 million tons and $408 billion of domestic freight moved, trucking does 80.2 percent by tonnage (versus 13.3 percent sea, 6.3 percent rail, and 0.2 percent air). By value trucking does 81.7 percent.[23] Air and trucking are expected to grow at the expense of sea and rail because of just-in-time delivery practices and weight reduction of products.

Truck routes out of the Oakland port/airport area include I-80 to the north and the Bay Bridge to San Francisco, and I-880 south; I-880 is the busiest. I-580, as the corridor linking the Central Valley to the Bay Area, is also the Bay Area's major gateway to food and raw materials and to southern California via I-5 and SR 99. It is the gateway for nearly 20 percent of Bay Area domestic trade flow, according to the *Goods Movement Study*.

There is some debate as to whether San Joaquin County will continue to gain in relative importance or whether the longer-established East Bay will stage a comeback in warehousing and distribution. But whichever grows faster—the East Bay or the Central Valley—the major connections between them and Silicon Valley seem destined to remain of crucial importance to the economy and competitiveness of the whole area.

The *Goods Movement Study* points up a growing conflict between truck traffic and automobiles.[24] This is because automobile traffic is growing fastest outside the commuter peaks and becoming much heavier through the middle of the day. The result is that the period 10:00 AM to 4:00 PM, which was once a relatively uncongested travel time for trucks, is becoming increasingly congested. The *Goods Movement Study* says: "We expect to see growing conflicts between truck traffic patterns and commuter patterns in these corridors."[25]

Specific Concept

The proposed Oakland-Valleys Toll Truckway would address the need for safe and efficient trucking in the heart of the Bay Area. It would link three key freight areas identified in the *Goods Movement Study*—the West Bay area, Silicon Valley, and the Central Valley—to one another with a trucks-only toll facility. This T-plan toll truckway would extend the length of I-880 in Alameda County from near its northern end at the Port of Oakland, terminating near the SR 237 interchange in Milpitas, just a couple of miles inside Santa Clara County. It would also have a spur from I-880 at San Lorenzo in the West Bay eastward into the Central Valley terminating at I-5 near Tracy (see Figure 6). The eastern spur would follow a short stretch of SR 238, then I-580, and I-205 to I-5. The I-880 segment is 35.4 miles long and the SR 238/I-580/I-205 spur is 45.8 miles, for a total of 81.2 miles. Common trips would be Port of Oakland to Tracy near I-5 (58 miles), Port of Oakland to Milpitas (35 miles), and Milpitas to I-5 at Tracy (69 miles).[26] The route was chosen by examining stretches of highway with present truck traffic consistently over 10,000 trucks per day based on Caltrans data for 2002.[27]

Like its southern California counterpart, this truckway would permit the use of double and triple-trailer (or container) LCVs. Hence, a crucial aspect of the truckway concept is the provision of nodes along it. Access and egress would be limited to nodes, which would consist of access and egress ramps, truck yards for parking, and make-up/breakdown space for the LCVs that would not be permitted to operate off the truckway. Nodes in the truckway would be at about six points initially along I-880 and at four points on the I-580 spur. Make-up/break-down yards at these nodes would be simple parking lots where longer combination vehicle (LCV) rigs would add a second long trailer on entering the facility, or drop off the second trailer on leaving.

The Southern California Association of Governments (SCAG) estimated the costs of a 2x2 lane truckway of the kind we envisage at $27.5 million per lane-mile.[28] The Oakland-Valleys truckway would consist of 324.8 lane-miles, which at the estimated SCAG truckway construction cost would total $8.9 billion (in 2004 dollars). SCAG's truckway cost did not include the nodes. Much of the node development could be funded by businesses operating there, but if we assume the toll truckway allows $20 million for its investment in each node, the 10 nodes would add $200 million for a total capital cost of $9.1 billion (2004 dollars).

Figure 6: Proposed Oakland-Valleys Truckway

Feasibility Analysis

In the Appendix, we analyze the financial feasibility of this truckway. Since much of its potential traffic is medium-distance, we estimate that the combined usage by short, medium, and long-haul trucking could grow to two-thirds of truck traffic in these corridors after a 10-year ramp-up period. Given the absence of plans to add significant free capacity to these corridors, and the expected doubling of severe traffic congestion in the Bay Area by 2030, we think these assumptions are reasonable. Our underlying corridor truck traffic numbers come from the federal Freight Analysis Framework.

We assumed an initial average toll, across all types of trucks, of $1.00 per mile, adjusted for annual 3 percent inflation to $1.38 by the assumed starting year of 2015. On this basis, the analysis found that the net present value of toll revenues would be $12.4 billion, compared with capital costs of $11.9 billion (both in 2013 dollars, the assumed mid-year of construction). Thus, the project appears to be a break-even proposition if financed solely based on toll revenues. In reality, some degree of financial support from state or federal funding sources would probably be required to make this project financeable.

Possible Fremont-Livermore Link

Silicon Valley-San Joaquin County traffic would be better served if the truckway system were an "A" plan with a third leg going more directly from Fremont to I-580 at Livermore, following I-680 through the Sunol

Pass and then SR 84 from Sunol past Lawrence Livermore Labs. This more direct route would save 15 miles. Therefore it would attract more traffic, though building it would add significantly to capital costs. A feasibility study would need to see if this option were cost-effective.

G. Other Large-Scale Tolled Projects

The four preceding case studies were intended to illustrate the potential of large-scale projects to improve transportation in California's largest urban areas. But they should hardly be considered to exhaust the possibilities. Indeed, with such dire needs for better transportation in this state, the hardest part of preparing this section was deciding which few projects to single out for use as case studies.

To give some idea of what else might be possible, were California to create a climate in which toll-funded investment in transportation was welcomed, here are some additional projects that would be worth exploring for financial feasibility.

Greater Los Angeles (SCAG region)

- HOT lanes on US 101 from Woodland Hills to downtown Los Angeles
- HOT lanes on I-405 from Van Nuys to LAX
- Toll tunnel to complete the missing link on I-710 beneath South Pasadena
- Toll tunnel linking I-15 in Riverside County with SR 241 in Orange County, to relieve SR 91
- Toll truckway on I-5 from I-710 to the Kern County line
- Elevated HOT lanes linking El Monte busway downtown with the Harbor Transitway

San Francisco Bay Area (MTC region)

- SR 84 bypass of I-680/I-580 interchange
- I-680/SR 84 toll truckway branch to I-580
- Regionwide network of HOT lanes to enhance planned regionwide express bus service (as proposed in the MTC's *Mobility for the Next Generation*)

San Diego Area (SANDAG region)

- Toll truckway along SR-125 and along I-15 to San Bernardino, taking Otay Mesa border truck traffic

Statewide (inter-regional)

- Toll truckway along I-5, from L.A./Kern County line to I-80 at Sacramento
- Toll truckway along I-80, from Sacramento to Nevada line

Part 4

Transportation Mega-Projects and Risk

The kinds of projects discussed in Parts 2 and 3 tend to be large, sometimes in the multi-billion-dollar range. They are of interest to urban California because (1) they could make a significant difference in urban mobility, since they are major improvements rather than minor tinkering, and (2) they are unlikely to be developed unless new sources of funding, such as toll revenue bonds, can be institutionalized.

But the perceptive observer of urban transportation may raise a legitimate concern at this point. What about the inherent risks of multi-billion-dollar projects? Isn't there a sorry track record of such projects costing far more than initially projected and attracting far fewer users than forecast? There are indeed such risks, and no recent U.S. project exemplifies them better than Boston's Central Artery/Tunnel project, which opened to traffic in 2003. In this section, we examine that project and others, drawing some important lessons about mitigating such risks.

A. Boston's Big Dig Mega-Project

Just as American military policy has to contend with the Vietnam syndrome, American infrastructure management has the Big Dig legacy to cope with. Faced with a big challenging project, elected officials and commentators often immediately say something like: "We don't want to get bogged down in the quagmire of a Big Dig."

It is a commonplace observation that the Big Dig is a paradox. As pure civil engineering this Boston project is a triumph, but as management it was a shambles. A $2.2 billion project ended up costing $14.6 billion, and its development dragged on for almost two decades. The state has been left to carry a huge debt without any revenue to service it. It is a financial disaster. And project administrators were left with near-zero public credibility and confidence.[29] A U.S. Senate report stated of the Big Dig: "These management problems exact a terrible toll on public trust and confidence… A degree of public skepticism toward our government is healthy. Rampant cynicism is not."[30]

History of the Big Dig

The concept for the Big Dig was to replace the elevated I-93 expressway through downtown Boston with a tunnel. The concept is attributed to engineer and contractor Bill Reynolds in the early 1970s.[31] Chief proponent Fred Salvucci was a planner at the Boston Redevelopment Authority and then transportation consultant to Boston Mayor Kevin White. Salvucci was appointed state secretary of transportation in 1974 by new Governor Michael Dukakis, but made no progress on the Big Dig. When Dukakis was not re-elected, Salvucci spent the next four years at MIT as an engineering professor. In that period Republican Gov. Edward J. King began planning one part of what later became the Big Dig—the third tunnel to Logan Airport now known as the Ted Williams Tunnel. Governor King's alignment for the tunnel approach through East Boston caused outrage.

Reynolds came up with the idea of combining the nascent I-93 undergrounding with an I-90 extended alignment through the entirely industrial South Boston for the third airport tunnel in 1982. He sold his idea to Salvucci, who was working transportation policy for Dukakis's re-election. Dukakis embraced the idea early in his second term in 1983 and the legislature supported the project that year at the governor's urging. At that time the cost of the whole project was put at $2.2 billion.[32]

Then, as now, the general scheme was for replacement of the elevated six-lane I-93 with an eight-lane, mainly underground, highway system for about three miles north-south, including a new bridge over the Charles River and construction of a new four-lane expressway to extend I-90 from its then-terminus downtown eastward to the airport. The project involved a big new I-90/I-93 interchange. Though only 7.5 miles in overall length, it encompassed 161 lane-miles of roadworks.[33]

U.S. House speaker Tip O'Neill became the Big Dig's most powerful proponent once the airport tunnel had been routed away from his East Boston constituency into South Boston. In Washington, D.C., O'Neill had to fight the Reagan administration; Transportation Secretary Elizabeth Dole declared the project cost was "not justified on the basis of transportation benefits to the nation." But the Big Dig was incorporated in the Surface Transportation Assistance Act of 1987. Reagan vetoed the bill, singling out its support for the Big Dig as an example of unwarranted federal spending, but his veto was overridden, winning the project federal support.

Responsibility for the project in the state was always unclear. It was at first to be under the Department of Public Works, although the Highway Department was the recipient of federal funds. At the very height of construction in 1997, nominal control was moved to the Massachusetts Turnpike Authority. But from its inception in 1985 a joint venture of Bechtel and Parsons Brinkerhoff (B/PB) demonstrated its effectiveness as project managers, working as consultants to the state on an hourly basis. The B/PB team had its own people doing design, which was also subcontracted by the team to other consultants. Despite many years of pre-construction design, the project became notorious later for bids being put out with incomplete designs and sketchy data on existing conditions. Contractors found themselves with hundreds of change orders. The project ultimately consisted of 118 prime contracts.

Salvucci, then state secretary of transportation, said that as soon as federal funding came in sight the politics got more difficult: "Special interest groups, government organizations and individual communities all wanted a piece of the well-funded actions." For example Mayor Raymond Flynn made a splash in 1990 demanding that the Bid Dig fund a rat control program to cover the whole city on the argument that road construction would displace millions of rats and cause them to invade even distant neighborhoods, if they were not put down with federal dollars.[34] Scores of buildings got money for noise control.

The airport tunnel portion was separated from the rest of the project in the early 1990s and construction began by the end of 1991. This portion alone opened in 1995, without connections, at a cost of $2 billion. On the main part of the project, the undergrounding of I-93 and the I-90 extension approach roads to the

Williams Tunnel, the big interchange and the bridge design and permitting process continued for seven expensive years from 1987 through 1994. Amid intense lobbying, new expensive features were being added constantly.

In 1987 whole project cost had been $3.2 billion. By 1991, when construction of the airport tunnel portion began, it had grown to $5.8 billion, and by 1994, when the design had firmed up enough for construction to begin on its main portions, the projected cost was $7.8 billion.

Before the spring of 2000 the Big Dig's project cost was reported as $10.8 billion. Then, in a moment of great drama under Gov. William Weld's administration, turnpike chief James Kerasiotes was accused by the governor of intentionally concealing $2 billion worth of cost overruns and destroying the trust of the feds. He was fired. The feds had discovered the fraud, though some state officials were to complain later that those on the spot had known for several years of the shoddy accounting schemes being used to keep reported costs down. Costs were now put at $13.5 billion or more.

The latest estimates are that the final cost will be $14.6 billion. Completion is expected in 2005.

Big Dig Lessons

The lessons of the Big Dig have been the subject of many discussions[35] and will be the subject of many more as we try to work our way past this national trauma. Many of the lessons are somewhat obvious:

- Work as a team;
- Set goals, benchmarks, and schedules more precisely;
- Express projected costs in construction year dollars and, where uncertain, ranges of dollars rather than single numbers;
- Carefully estimate contingencies;
- Foster cooperation between different stakeholders;
- Enlist champions to fight for these projects;
- Be honest throughout; otherwise bad news will come as a shock, losing public confidence; and
- Guard against project creep—the most insidious enemy.

Project creep is the major source of cost increases in mega-projects. The scope of the project grows as it is developed adding elements that were never anticipated. New objectives are determined to be necessary, resulting in greater complexity. More "mitigation" is held to be essential to enlist the support of groups that might oppose the project.

As Jim Sinnette of the Federal Highway Administration major projects team writes: "Big projects are sometimes perceived as opportunities for piggybacking additional projects, completing multiple projects, or producing prominent public symbols such as a signature bridge rather than opting for a less costly but less prominent design."[36] Sinnette also notes that there is an expectation that projects must be "highly responsive to constituents' needs."[37]

This is where a private sector partner with its own funds at stake is likely to be better equipped to resist expensive additions. It has a clear bottom-line orientation. Its expenditures must be related to the transportation service it is providing and for which customers will pay (via tolls.) The investors are limited in what money they can raise in the capital markets to the amount that tolls can service. They are better placed to "just say no" to demands for ancillary expenditures. "We just can't do it," they can honestly say, effectively de-politicizing the project. By contrast, the public tends to view government as some kind of bottomless pit of money. Limits on the capital that can be raised will also force the project to be administered austerely when the private sector is engaged.

Basing a project on prospective toll revenues introduces a strong constraint on capital spending that is simply absent in projects funded by several governments where the argument can always be made that by reordering priorities or borrowing more, extra money can be found. When the private sector takes on a major project and puts a financing package into the capital markets, it usually only gets one shot. After the financial closing, it has a discrete sum beyond which it cannot spend. That is a powerful discipline throughout the detailed design and construction of the project.

Melbourne's CityLink and Boston's Big Dig occurred in similar physical circumstances. Both were in awful soil conditions: Boston's in bay edge fill, Melbourne's in river and creek beds of deep muck. Both had to go to herculean lengths to maintain rail transit services and not interfere with traffic during construction. Boston's tunnels were much bigger, but Melbourne's were much deeper coping with enormous water pressures and uplift. Each had major construction problems. Each had a signature bridge. Both projects had smart, competent engineers and managers. Yet Melbourne's was built in one-third the time and one-third the cost ($27 million per lane-mile vs. $91 million).

The difference was the constraint provided by Melbourne's need to limit overall project spending to what could be supported by tolls. There was always a firm limit on the Melbourne project. There never was any limit in Boston, just a constantly growing "estimate."

B. The General Problem of Mega-Projects and Risk

Boston's Big Dig project is not an isolated case. The track record of transportation mega-projects is terrible. The costs are often seriously underestimated, and traffic is all too often overestimated. Many recent rail projects have similar, well-documented histories. It will be difficult to get public and political support for much-needed mega-projects without better-performing delivery models.

This challenge was taken up recently by Danish academic Bent Flyvbjerg and colleagues in a book called *Megaprojects and Risk* (Cambridge University Press, 2003)[38]. They document the global nature of the problem, analyze its causes, and offer useful ideas on doing better.

First, Flyvbjerg and colleagues cite studies showing that this is hardly a new problem, nor is it unique to a few countries. One of the most comprehensive studies (from Aalborg University) covers 258 highway and rail projects ($90 billion worth) in 20 countries.[39] Nearly all (90 percent) suffered cost overruns, with the *average* rail project costing 45 percent more than projected, and the *average* highway project 20 percent more. Traffic forecasts were also far from accurate, with rail projects generating an average of 39 percent less traffic than forecast (though highway projects averaged a 9 percent *under* estimate of traffic).

Flyvbjerg concludes that the "cost estimates used in public debates, media coverage, and decision-making for transport infrastructure are highly, systematically, and significantly deceptive. So are the cost-benefit analyses." Many other analysts have reached similar conclusions. Flyvbjerg goes on to explain why this comes about. First, he cites two MIT researchers' conclusion that "the incentives to produce optimistic estimates of viability are very strong and the disincentives weak." And the reason for that is a lack of accountability of the parties involved, not a lack of technical skills or insufficient data.

Another key insight is that "risk is simply disregarded in feasibility studies . . . by assuming what the World Bank calls the EGAP principle: Everything Goes According to Plan." But in mega-projects like the Big Dig, the Channel Tunnel, or the Los Angeles Red Line, things seldom go according to plan, and nobody should expect that they would.

Asking why risk is disregarded leads Flyvbjerg to question the conventional approach to project development, in which government is the project promoter and financier, and private firms are only too happy to do the best-case feasibility studies, produce the designs, and take on construction contracts fattened by numerous change orders. That is one form of "public-private partnership," but it is not one that serves the public interest. It leads directly to the kinds of results documented in the Aalburg University study.

A much better delivery model is a public-private partnership that more appropriately "allocates risks to parties who have an incentive to reduce the negative impacts." The current system puts the major risks—of cost overruns and of miserable traffic—onto the shoulders of hapless taxpayers. Not only is this inherently undesirable, but a system set up in this way "is likely to increase the total risks and costs of a project." If somebody else is picking up the tab, you don't have strong incentives to anticipate problems and costly change orders.

It would be far better to put commercial-type risks, such as construction cost risk and traffic risk, on the shoulders of sophisticated investors. But to bring that about requires true risk capital being involved in a mega-project. Indeed, one of Flyvbjerg's strongest conclusions is that the decision to proceed with such a project should be based on "the willingness of private financiers to participate in the project without a sovereign guarantee." By putting their own capital at risk, such investors will be seriously involved in monitoring how the project is done to mitigate the inherent risks. Any project for which no investor will risk capital should be seriously re-evaluated.

One recommended model is what Europeans call the long-term concession or build-operate-transfer (BOT) model, under which a private consortium, selected by a competitive process, gains a long-term ownership interest in the project, sufficiently long that they have a reasonable likelihood of making a return on the investment (and also have strong incentives to build it right in the first place, to minimize life-cycle as opposed to up-front costs). But this is not a brief for the inherent superiority of the private sector. Flyvbjerg also supports a state-owned enterprise model, provided that it, too, is financed with at least one-third genuine risk capital from private investors. The point is to create accountability and risk-management, which the conventional government-dominated model simply does not provide.

C. Shifting Risk from Taxpayers to Investors

To understand how much difference it can make to shift the model for mega-project development, consider a $2 billion urban tunnel project—perhaps the missing link in the Long Beach Freeway (I-710) through South

Pasadena. Under the conventional approach, a government agency (e.g., Caltrans or the Los Angeles County MTA) would be the project developer. It would do the preliminary design, go out to bid for detailed design, and once that design was in hand, it would go out to bid for one (or a set) of construction contractors. After the project was built, the agency would operate and maintain the project out of annual budgetary appropriations.

Let's think about the incentives involved. The design contractor will not be responsible for building or maintaining the project, so he will seek to do a straightforward job of design, meeting the required specifications but not being overly concerned about buildability or the ongoing cost of operations and maintenance. Those are not his problems. And the construction contractor will bid what he thinks the job will cost, but will know that as problems and unknowns are discovered during construction, he will be able to submit change orders which the government agency will mostly approve. To the extent that the contract provides incentives to control costs, those incentives typically focus only on initial cost to construct. That encourages the contractor to make decisions that may reduce the initial cost at the expense of higher costs to maintain the project in future years—but that's not his problem. Likewise, conventional contracts for large projects seldom provide meaningful incentives for on-time completion (or if they do, they suffer from the same problem of implicitly encouraging initial short-cuts that may carry a higher long-term cost in operations and maintenance).

Now let's think about a different model, the build-operate-transfer franchise (or concession) model used in Europe and Australia. Under this model, the responsible agency (Caltrans or LACMTA) does a preliminary design and feasibility study and then goes out to bid for a firm or consortium to design, finance, build, operate, and maintain the project for a long period of time, often 25 to 50 years. It is up to this team to cover all the costs of building, operating, and maintaining the tunnel project out of the user-fee revenues it generates (unless a portion of the initial cost will be provided by the public sector, in a transparent and publicly approved process). Consider the very different incentives involved in this model.

First, the winning team will almost certainly use the design-build method, in which a single team designs and constructs the project, thereby facilitating buildability because everyone has the same incentives, and that team bears the consequences of its actions.

Second, since the investors who finance the project (toll revenue bond buyers and possibly equity investors as well) have a very strong interest in avoiding cost overruns, the design-build team will be held accountable to a fixed price that allows for various contingencies. This exerts strong pressures to produce a buildable design and to solve problems efficiently because it's the team's own money that is at stake in cost overruns. Not surprisingly, design-build has an excellent track record of delivering large projects on-time and on-budget; recent examples include California's Alameda Corridor and Utah's rebuild of I-15 in Salt Lake City.

Third, because the investors are very concerned about toll revenues beginning to flow on time, to start making the required debt-service payments, they will typically insist on a guaranteed completion date, with significant daily financial penalties (called liquidated damages) if that date is not met. This creates a penalty for project creep, reflecting the true cost of delay.

And fourth, because the team that develops the project will also be responsible for operating and maintaining it (and turning it back to the government agency in good condition at the end of the franchise period), the team will have strong incentives to design and build the project in ways that minimize not its initial cost but its *life-cycle* cost. This is why toll roads and bridges, in general, are typically built in a more durable way.

Stronger and more durable pavement means lower maintenance expenses over time. And furthermore, the investors typically require legally enforceable bond covenants that guarantee proper maintenance of the facility over the life of the bonds, to protect the asset value of their investment.

Table 4 provides a summary of key differences between the BOT model and the traditional model.

Table 4: How Institutional Alternatives Compare

	Traditional	**Build-Operate-Transfer**
Funding source	Highway trust fund	Toll revenue bonds & equity
Procurement process	Design-Bid-Build	Design-Finance-Build-Operate-Maintain
Who pays cost overruns?	Taxpayers	Investors
Who pays for schedule slips?	Drivers	Investors
Who pays for traffic risk?	Taxpayers	Investors
Maintenance funding	Annual appropriations	Toll revenues
Maintenance incentive	Public complaints	Investors' asset value

One obvious question provoked by this discussion is: what happens, in a BOT project, if the investors guess wrong and the project ends up with significant cost overruns and/or much less usage than projected? A good example of such an outcome is the Channel Tunnel between the United Kingdom and France. Developed privately under a 55-year BOT agreement with the two governments, the Tunnel opened in 1994, several years late and 80 percent over its original budget. After six years in operation, its traffic numbers had reached only 43 percent of the original estimate for the opening year. Clearly, this must rank alongside the Big Dig as a mega-project debacle.

Yet unlike the Big Dig, where taxpayers footed the bill for enormous cost increases, the lower revenues and higher costs of the Channel Tunnel were borne entirely by the investors (mostly European banks and about a million individual shareholders). The project had to be refinanced, with the banks taking a significant "haircut". And the share price plunged to a few percent of what it had been in the project's early days. The only relief offered by the two governments was to extend the life of the franchise, so that the investors would, over a very long period of time, have some possibility of receiving an eventual return on their investment.

There are several important lessons to be drawn here. The first is that having to persuade investors to part with capital for such mega-projects will typically produce a far higher degree of scrutiny of the project's underlying feasibility than is all too often the case for conventional mega-projects. The second is that even when such scrutiny is overtaken by events and a BOT project does badly, it is investors who are at risk, rather than taxpayers. Third, despite financial difficulties, the project remains in service, meeting transportation needs. In extreme cases the original company may go bankrupt and the assets get purchased by new owners (with approval of the government agency that is a party to the BOT franchise). By purchasing the asset at a fraction of the original cost, the new owners will hope to operate it in a financially sustainable manner (much as has been happening with failed telecom companies such as Global Crossing and Iridium).

Thus, the case for using the BOT approach for transportation mega-projects is a strong one. Mega-projects are inherently risky. That does not mean they should not be done. But it does mean that public policy should allocate those risks to the parties best able to handle them. In the case of typical mega-project risks of cost overruns and insufficient traffic and revenue experience has shown that the private sector can and will take on those risks under well-drafted BOT agreements.

Part 5

Policy Issues for Large-Scale Toll-Funded Projects

A. Overseas Best Practices

The traditional U.S. approach to toll projects is to create a public entity to develop and operate the toll facility. The United States has a great variety of these, including toll authorities operated by a single state, bi-state agencies (usually in the case of toll crossings where the river forms a state boundary), bi-national agencies (with Canada or Mexico), a single county or city toll authority, or one formed of multiple counties and/or cities (a joint powers authority or JPA, such as the Transportation Corridor Agencies in Orange County). Japan, Korea and Indonesia have also followed the U.S. public authority route. For Americans, this form has the benefit of familiarity, but it has drawbacks too.

There is a danger of long-established toll authorities becoming creatures of politics. In some cases, senior officers have been appointed by political patronage, changing with the complexion of the government in office, making them less expert. Sometimes the toll authority is expected to become a kind of tax agency producing surpluses of revenue, which are then allocated to support special interests.

Toll rate-setting is also at risk of being dictated by what is popular in public agencies, rather than what makes business sense. In some older toll authorities, toll rates tend to be frozen artificially for a long run of years, and then massively raised in a crisis atmosphere. Typically such agencies have their rates stuck for eight or ten years, then raised 25 to 80 percent in one hit. This is highly disruptive to users, and the agency itself lurches from financial starvation to surfeit, then slides gradually back into financial difficulty.

Toll road operators in Europe and Australia tend to be either private-sector entities or government corporations, in both cases following more businesslike practices regarding hiring, investment decisions, and financial management. Toll rates are adjusted annually or more often, but in very small steps to which users can more readily adapt.

The major argument for having projects financed, built, and operated by investor groups is that they will be forced to operate in a businesslike manner since they are responsible to shareholders for keeping construction on budget and for then gaining a return on investment. Investors have clear-cut objectives. Unlike a public authority, the private sector partner in a long-term public-private partnership will usually be selected through some competitive process. That forces the company or consortium to look for ways to maximize revenues and minimize life-cycle costs from the beginning. So long as they have a secure legal title to their operation, they will be in a far stronger position to resist political pressures to do favors for special interests to gain popularity at election time than a public agency.

Structuring the Concession Agreement

Major infrastructure facilities usually exhibit some inherent degree of monopoly in the sense that no other facility can offer the same service. But in a highway system dominated by free public highways, toll-road project investors will normally demand some kind of protection against competition from additions of free capacity or compensation based on the negative impact such extra free capacity will have on their traffic and revenues. This is true whether the toll project developer is a public agency or an investor-owned company. Those who provide the up-front financing will have the same concern about getting repaid in either case. Since these are inherently sensitive issues, great care needs to be taken in developing provisions that will both adequately protect the providers of capital (otherwise, no capital will be provided) and protect the public interest.

When Does a Private Partner Start Work?

There are two approaches to the staging of projects. Early transition to investor responsibility requires the private sector concessionaire to develop the design, conduct public consultations, pass environmental review, and gain all needed permits. This can be very costly and time-consuming. The M6 Toll in Britain and the A86 West in Paris followed this path (as did SR 125 South in San Diego).

By contrast, a late transition will have most of the project design, public consultation, environmental studies, and permitting done by a public agency, and only when that is complete are private sector bids requested. Most of the Australian toll projects have been late-transition projects, rather fully defined and permitted before the investors get involved.

In our judgment the late transition has worked better. Early-transition projects have been very slow to proceed to construction. M6 Toll's concession was signed 11 years before construction was able to begin. A86 West took six years from concession to construction. It is unclear that private sector ownership can help speed up permitting. Developing a project concept and gaining public support is an inherently political process, and public agencies are better at that. Moreover, the project needs to fit with regional transportation plans, and the public agency will look after that better.

Once the project is firmed up and permits are in place, the risks to the private sector are reduced. This will make it easier to attract strong private sector bids. None of the Australian toll projects so far has called for any significant public sector funding. That is probably due to the public sector taking on the responsibility for permitting and presenting the private sector with what amounts to a design-build project ready to go, with a financing package tacked on. The financing package is more robust because of the strong assurance that toll revenues will flow three or four years hence. The uncertainty is far less than in cases where the private sector concessionaire is selected before permitting.

A good public-private partnership allocates tasks and risks to the party best suited to them. The private sector has a strong track record of using techniques such as design-build that provide strong incentives for on-time, on-budget completion; hence, it is willing to take on construction risks. It is also generally willing to assume the revenue risks inherent in toll projects. But the environmental review and permitting process is seen as more difficult for the private sector to quantify, and therefore seems better to assign to the public sector partner.

Unsolicited Proposals

There are strong arguments for procedures to handle unsolicited proposals from the private sector, because this opens up the process to new ideas (such as Cofiroute's innovative tunneling solution to the stalemate over completing the missing link of A86 in Paris). It encourages initiative. But unsolicited proposals do pose a challenge. The proposer has to be given some advantage as a reward for developing the initiative. At the same time it should not become a way of avoiding competition and ending up with a sole-source negotiated project. Normally in the United States there are provisions for seeking competitive bids within a set period—60 or 90 days—after an unsolicited proposal is accepted. These rules are not as clearly defined overseas, so their experience does not have much to offer the United States. In Australia the public sector agencies seem to aggressively define new projects, and private sector actors seem to confine themselves to informally making suggestions in the stages leading up to requests for proposals.

Concession Term

Concession terms for large toll projects seem to run from about 25 years to 99 years. This is analogous to the long-term franchises typically granted to investor-owned utilities in the United States. It can be politically beneficial for elected officials to be able to say that the project will become the property of the state at a date-certain. And since the net present value of earnings several decades hence is small, investors are usually willing to agree to a fixed term that coincides with or exceeds maximum long-term financing. But there is a trade-off. The longer the term for toll collection, the better the bids are likely to be.[40]

One additional feature in some agreements is a commitment by the public sector to purchase the facility at its residual value at the end of the concession term, with that value being assessed by an independent assessor. This adds value to the project and leads to better bids at the outset. It also gives the concessionaire a strong incentive to maintain and improve the facility in the final five or ten years of the concession, which may otherwise be lacking.

Toll Rate Controls

Another set of trade-offs concerns rules for setting toll rates. Clearly investors are happiest with no controls at all, and wherever variable-rate tolls are to be used as a tool to ensure smooth traffic flow, pricing freedom is essential. Since it has competition from the un-tolled M6 nearby, the M6 Toll in the United Kingdom is unfettered in its power to set toll rates (though the government has been criticized for this). The 407-ETR in Toronto also has discretion to set its toll rates without government controls, though this is being challenged in the courts by a new provincial government. The Australian toll franchises provide for tolls to be adjusted upwards on an annual basis by a formula that is part of the franchise contract documents—usually related to some national statistical index such as the Consumer Price Index, or Average Weekly Earnings. In some cases the contracts say, "whichever is greater: quarterly CPI or one percent."

In the case of A86 West, toll rate ceilings were established during the concession negotiations and are set for the first five years. After that, the company may make its case for an increase to a government adjudicator based on the trend of traffic versus capacity. Since the A86 West tunnelway is to be administered with variable pricing (like California's I-15 and 91 Express Lanes) to maintain free-flow conditions, a high volume-to-capacity ratio will be a *prima facie* case for higher tolls.[41]

We know of no overseas case in any western country where government has the arbitrary power to veto any toll increases or to unilaterally set tolls. Such direct price controls by government are generally held to have a set of undesirable consequences. Also, investors are naturally wary of elected officials seeking popularity by blocking toll increases, so the private sector would probably decline to participate with this political threat hanging over the franchise.

The 407-ETR in Toronto has an unusual toll concession. It contains a set of financial penalties for congestion developing on the toll road and discourages the concessionaire from policies that would push the growth of traffic onto parallel free arterials. It is structured to encourage the toll concessionaire to add capacity ahead of traffic growth and to discourage a high-toll, low-traffic approach. This aspect of the contract is complex, using base numbers and a mathematical formula. It is tough for laymen to understand. It was developed in considerable secrecy and only made public a couple of years after it was negotiated. It has recently become a subject of fierce political denunciations and has the government and the toll operator locked in a political war of words, plus litigation.

In our view complex contract provisions negotiated outside public view are a recipe for conflict and political trouble. The process should be straightforward and open.

B. Best Practices from Other States

Like California, many other U.S. states are experiencing rapid population growth and increasing levels of traffic congestion. Unlike California, however, many of these other states are taking concrete steps to deal with these growth-related issues. They are, for example, developing innovative finance tools, promoting the use of public-private partnerships and streamlining project delivery methods for needed transportation improvements.

For example, nearly two dozen states have enacted enabling laws for public-private partnerships in transportation, since California set the pace by enacting AB 680 in 1989 (since repealed). A list of the states with enabling laws for transportation partnerships is provided in Table 5.

Most of these statutes provide for true partnerships between public and private sectors, allocating to each the tasks that it is best at doing. Typically, the public sector partner is responsible for defining the route and the nature of the project, land acquisition, and the environmental review process, as well as preliminary design. The private sector typically handles detailed design and construction (using the design-build method), and in some types of partnerships operations and maintenance. Funding is often partly public sector and partly private sector; as noted below, Texas is willing to put state "equity" into a toll road project to cover a significant fraction of the cost, with toll financing covering the rest. Even if only half of the project cost is paid for via tolls, that still makes the state's limited transportation funds go twice as far. Financing may be done either by the state, by a specially created nonprofit corporation, or by the private concessionaire. In the latter case, under current federal tax law, only taxable toll revenue bonds may be issues (though the Senate version of the federal surface transportation reauthorization legislation would permit private partners to issue tax-exempt toll revenue bonds).

Table 5: State Transportation Public-Private Partnership Laws, 2004				
State	No limits on number of projects?	Accepts unsolicited proposals?	Have projects actually been proposed?	Are any projects in operation?
Alabama	X	X	X	X
Arizona	X	X	X	
Arkansas	X			
Colorado	X	X		
Delaware	X	X		
Florida	X	X		
Georgia	X	X	X	
Louisiana*				
Massachusetts*			X	
Minnesota	X	X	X	
Missouri	X	X	X	X
Nevada**				
New Jersey***				
North Carolina	X		X	
Oregon	X	X		
South Carolina	X		X	X
Texas	X	X	X	X
Utah****				
Virginia	X	X	X	X
Washington	X		X	
Wisconsin	X	X		

*one pilot project only

**prohibits toll roads and toll bridges

***expired 2002

****regulations never adopted

Source: Adapted from Grant Holland, *Public Works Financing*, February 2004.

Today the states of Texas and Virginia are widely recognized as being at the forefront of these efforts. It is therefore worth exploring some of the details of their respective transportation programs. In implementing its own reforms, California should consider implementing at least some of these best practices.

C. Best Practices from Texas

The Texas transportation system is the largest state-funded highway system in the nation, with over 79,000 miles of roads and highways. The state's transportation resources are concentrated in the Texas Department of Transportation (TxDOT), which is administered by the Texas Transportation Commission (TTC).

TxDOT is responsible for overseeing the acquisition, construction, maintenance and operation of the state's highways, turnpikes, toll roads, and toll bridges, as well as aviation, mass transportation, railroads and water traffic.

Historically, Texas did not borrow money to build and maintain its highways. (The only exception was a handful of urban toll roads in Dallas and Houston.) Construction of highways was financed through a "pay-as-you-go" approach, which meant that roads were not built until the necessary funding became available. The major source of such funding came from motor vehicle registration fees and taxes on motor fuels and lubricants. Over the years, however, the traditional method of financing projects became less and less workable due to the sharp increase in the state's population and increased demands on the state's highways.[42] As discussed below, the voters of Texas in 2003 passed several amendments to the state constitution to allow the TTC and TxDOT more flexibility in financing and building the state's transportation projects.Some of the highlights of the Texas model are outlined below.

Regional Mobility Authorities (RMAs)

Enacted in June 2003, H.B. 3588 is the most comprehensive and innovative piece of transportation legislation at the state level. It devolves significant authority from TxDOT to urban regions by authorizing the creation of RMAs for the purposes of designing, financing, constructing, operating, maintaining and repairing transportation projects or systems at the regional level in Texas. These projects include highway, rail, aviation, and pedestrian facilities.

RMAs have the power of eminent domain and several options for generating revenue. They may, for example, issue revenue bonds and collect tolls. A segment of the state highway system may even be converted into a toll road and transferred to an RMA by the TTC. RMAs may also purchase right of way and later lease portions of it for use by hotels, restaurants, gas stations, stores, garages, or railroad tracks. Surplus revenue from tolls is controlled by the relevant RMA, providing local officials with new revenue streams for other transportation projects in the area.

One or more counties may request the creation of an RMA; the TTC then decides whether to approve or reject this request. Once created, the TTC may, with the governor's approval, transfer highway assets to RMAs and authorize them to develop toll-funded projects both on and off the state highway system. RMAs may also lease public rights-of-way, grant easements, and issue franchises, licenses or permits to enable a private entity to construct, operate and maintain a transportation project. At the agreement's termination, the transportation project, including all related facilities, must be returned to the RMA in satisfactory condition and at no further cost.

Texas Mobility Fund

The Texas Mobility Fund is a revolving fund whose purpose is to fund more transportation projects in Texas. It is important because it provides a brand new source of dedicated revenue to supplement the traditional "pay-as-you-go" method of financing highway projects.

The Fund was created through an amendment to the state constitution to address a significant decrease in traditional sources of funding for building roadways in the state. Money in the Fund is administered by the TTC and may be used by TxDOT to finance the construction, reconstruction, acquisition, and expansion of state highways, including costs of design and right-of-way acquisition. The constitutional amendment also allows TxDOT to spend, grant, or loan state money for the acquisition, construction, maintenance, or operation of turnpikes, toll roads, and toll bridges. It further removes the requirement that money from the state highway fund used for the costs of these transportation facilities be repaid to the state highway fund.

In addition, the state constitution provides the TTC with the authority to create new RMAs outside the boundaries of existing regional authorities, controlled by local boards. These new authorities can build, operate and maintain newly created tolled projects, as well as issue bonds supported by future toll revenues. As revenues increase and surplus revenue becomes available, such local authorities can (a) reduce or remove tolls; (b) use the revenue for other transportation projects within their region; or (c) send the excess revenues to the Fund.

The state constitution also allows TxDOT to issue bonds for the accelerated construction of major highway projects when future legislatures appropriate or dedicate resources to the Fund. In 2003, the state's legislature did just that when it dedicated money sufficient to support $2.5 billion to $3 billion in bonds. Specifically, H.B. 3588 authorized certain transportation-related fees, such as motor vehicle inspection fees and driver's license fees, to be moved from the state's General Revenue Fund to the Texas Mobility Fund.

Comprehensive Development Agreements (CDAs)

Both TxDOT and RMAs are authorized to enter into public-private partnerships (PPPs), or what are known in Texas as "comprehensive development agreements." A CDA is an agreement with a private entity that, at a minimum, provides for the design and construction of a transportation project and may also provide for the financing, acquisition, maintenance or operation of such a project. For example, the project financing plan, right-of-way acquisition, maintenance and operation of a toll road may all be included in a CDA. In connection with its negotiation of a CDA, TxDOT or an RMA may also negotiate ancillary agreements for the provision of the professional and consulting services it will need.

The key benefits of the CDA approach are that such agreements:

- accelerate project delivery through concurrent design and construction activities;
- provide guarantees on cost and completion dates;
- shift some key risks to the private sector; and
- promote better life-cycle costing.

In connection with entering into these agreements, TxDOT and RMAs are required to use a competitive procurement process that provides the "best value" for the government. An RMA or TxDOT may accept unsolicited proposals for a proposed transportation project or solicit proposals pursuant to a public competitive procurement process, where the project and its location are framed by the RMA and TxDOT.

Upon receiving an unsolicited proposal from a private entity, TxDOT or the RMA must solicit competing proposals via a public request for qualifications (RFQ) and request for proposals (RFP) process. To encourage other private entities to submit competing detailed proposals, TxDOT or the RMA must pay an unsuccessful private entity that submits a response to a request for detailed proposals a stipulated amount of the final contract price for any costs incurred by such private entity in connection with the proposal's preparation. This stipulated amount must be stated in the RFP. Once this sum is paid, the relevant agency owns the exclusive rights to, and may make use of any work product contained in, the proposal, including the technologies, techniques, methods, processes and information contained in the project design. Negotiations and interviews with private entities are confidential until a CDA is finalized and signed.

In negotiating such agreements, the agency must include certain provisions related to the terms of the private entity's participation in the transportation project, which include:

- methods to determine the applicable cost, profit and project distribution between the private investor and the agency;
- reasonable methods to determine and classify toll rates or user fees;
- acceptable safety and policing standards;
- other professional, consulting, construction, operation, and maintenance standards, expenses and costs; and
- a provision authorizing the agency to purchase, under terms agreed by the parties, the interest of the private investor in a transportation project, at any point during the term of the CDA.

Bonds

Bonds permit Texas to finance projects today rather than waiting years to save up the money. There are three ways to bond projects:

- TxDOT can issue bonds backed by the Texas Mobility Fund to supplement the traditional pay-as-you-go method of financing highway projects. H.B. 3588 authorized certain transportation-related fees to be moved from the state's general revenue fund to the Texas Mobility Fund. Based on revenue projections, TxDOT can issue about $3 billion in bonds (and may not exceed $1 billion per year).
- Proposition 14, approved in September of 2003, authorized the TTC to issue bonds secured by the State Highway Fund. TxDOT can now pay for highway projects through bond sales and use future revenues to repay these obligations.
- Toll revenue bonds allow the TTC to issue bonds for a specific toll project and repay the bonds with tolls generated therefrom.

Advanced Property Acquisition

In delivering new highway projects, land acquisition is often a major obstacle. By the time the final right of way has been identified and funding is available, several years will have passed and project acquisition costs will already have increased significantly. Under H.B. 3588, the TTC may purchase an option to acquire real property for possible use in a transportation facility before a final alignment has been determined. The TTC may not, however, make an advance acquisition by condemnation. TxDOT may also offer the owner of the property needed for right of way a percentage of the toll revenue associated with a particular segment of a turnpike, rather than a single, fixed payment for the property.[43]

Toll Equity

Many highway projects that lend themselves to tolling cannot be fully funded by toll revenue bonds. But if the state provides a portion of the capital costs (investing its own equity), toll revenue bonds can still cover a majority of the project costs. Previously, monies granted by TxDOT each federal fiscal year for such toll equity could not exceed 30 percent of the obligation authority under the federal highway-aid program distributed to Texas during that fiscal year. H.B. 3588 eliminates the 30 percent cap on the use of monies in the State Highway Fund for toll equity and changes it to a hard limit of $800 million, excluding money required to be repaid. The effect of this change is to allow the TTC to contribute, at least in the short term, slightly more toll equity in the financing of turnpike projects. Toll equity could make more highway projects toll-viable, which would have the effect of freeing-up state highway funds for other highway improvements around the state. Projects would be funded in part with bond proceeds and other funds.

D. Best Practices from Virginia

Like Texas, the Commonwealth of Virginia in recent years has been working hard to promote investment in its transportation infrastructure. Virginia has the third-largest state-maintained highway system in the country, just behind North Carolina and Texas. Virginia's transportation resources are concentrated in the Virginia Department of Transportation (VDOT), which is responsible for building, maintaining and operating Virginia's roads, bridges and tunnels.[44] With over 10,200 employees, VDOT is one of the three largest state agencies in Virginia. It has an annual budget of approximately $3.4 billion or 14 percent of the total state budget; approximately 60 percent of this budget is allocated toward highway construction and approximately 37 percent is allocated for maintenance. Expenditures include funding for mass transit, airports, seaports, payments to localities for maintaining their own roads and administration costs. Funds are also allocated for debt payments on the state's toll roads and for operations, maintenance and improvement costs for these highways.

Public-Private Partnerships

The Public-Private Transportation Act of 1995, as amended, allows for public-private partnerships in the area of transportation.[45] The Act enables the state, qualifying local governments, and certain other public entities to enter into agreements with private entities to acquire, construct, improve, maintain and/or operate qualifying transportation facilities. The Act is intended to encourage public-private ventures for construction and/or operation of transportation facilities in a more efficient or cost-effective manner and to facilitate to the greatest extent possible federal pooling and funding mechanisms.[46] The Act grants public entities the authority to allow private entities to construct and/or operate qualifying transportation facilities. The Act defines "responsible public entities" to include a public entity that has the power to acquire, construct, improve, maintain and/or operate the transportation facility.[47] A private entity is required to enter into a comprehensive agreement with the responsible public entity setting forth each party's rights and obligations for a specific transportation project.

The PPTA allows both solicited and unsolicited project proposals. The major steps involved in evaluating, selecting and implementing the projects are similar for both solicited and unsolicited proposals.[48] Private entities are also encouraged to propose innovative financing methods such as the imposition of user fees or service payments. The financing arrangements for private entities may include the issuance of debt, equity, or securities or other obligations. The private entity may enter into sale and leaseback transactions. It may also secure financing with a pledge of, security interest in, or lien on all or any of the private entity's property, including all of its property interest in the qualifying transportation project. The Commonwealth Transportation Board may also award contracts for the construction of a transportation project on a design-build basis.[49]

Financing Transportation Projects

The General Assembly authorizes the issuance of bonds or notes secured and payable under Section 9 (d) of Article X of the Constitution of Virginia. Virginia's transportation authorities and districts also have the ability to issue debt as a way to dedicate more public funds for transportation without raising taxes or fees. Since 1991, almost $2 billion in bonds have been sold to supplement funds available under Virginia's traditional pay-as-you-go approach. Virginia's debt obligations escalated with the passage of the Virginia Transportation Act, which included a new credit tool, a special bond known as FRANs (federal reimbursement anticipation notes). The use of FRANs enables Virginia to pledge future payments from federal sources and dedicate a portion of the General Fund to support that debt and start a number of projects specified by the VTA. While in 1989 debt service required 1 percent of Virginia's highway construction funds, today that figure stands at 13 percent and is expected to rise to 20 percent by 2009.

Tolling

Transportation officials and elected representatives in Virginia are looking seriously at revenues collected from tolls and user fees to provide the revenue needed to build more roads. Virginia is therefore considering proposals to add toll lanes to congested freeways and even to convert existing roadways into toll roads. For example, proposals are currently underway to add toll express lanes on about one-fourth of the Washington, D.C., Beltway in the suburbs of Northern Virginia. VDOT is also working on plans to widen the entire 325 miles of I-81 with revenues collected from tolls to be used to recoup the cost for such construction, including tolls assessed electronically for large trucks. Funds collected from tolls and user fees deposited into the Transportation Trust Fund must be held in a separate sub-account designated as the "Toll Facilities Revolving Account."

E. Summary of State Innovations

In delivering transportation projects to its growing population, California has fallen behind other states such as Texas and Virginia. Catching up will require California to look carefully at its best practices used to develop innovative finance tools, promote the use of public-private partnerships and streamline project delivery methods for needed transportation improvements. A comparison of the financing tools being used in these three states is provided in Table 6.

Table 6: Key Features of State Transportation Programs

Relevant issue:	California	Texas	Virginia
What is the annual budget of the state DOT?	$8.1 billion ($225/capita)	$5.4 billion ($245/capita)	$3.4 billion ($486/capita)
What state transportation revenue sources are dedicated to the state DOT?	Tax on motor vehicle fuels, other than alternative fuels (alcohol, electricity, etc.), unless the governor declares an economic emergency (which recently occurred). Sales tax on gasoline subject to Prop 42 dedicated to transportation.	Sources include motor fuel tax and vehicle registration fees. See also discussion below of innovative use of tolling revenue and the Texas Mobility Fund.	Sources include motor fuel taxes; vehicle title fees; license tag fees; and one-half cent of the general sales tax. New revenue sources were created by the Virginia Transportation Act of 2000 and include bond sales based on expected federal revenue (i.e., GARVEES), a more efficient method for collecting motor fuel taxes, and a portion of the existing tax on insurance premiums.
Is the state DOT authorized to issue revenue bonds?	No.	Texas Mobility Fund allows the TTC to issue approximately $3 billion in bonds to finance the acquisition of right of way, design, construction, maintenance, reconstruction, and expansion of state highways. Also authorized to use toll revenues to repay these bonds. These funding sources are constitutionally protected.	No, but nonprofit 63-20 corporations sanctioned by the state may issue tax-exempt toll revenue bonds.
Is the state DOT authorized to create local toll road authorities to help finance projects?	No enabling legislation (but a one-time law created the Transportation Corridor Agencies in Orange Co.).	Yes at county or regional level.	Yes.
Is design/build authorized as a method of project delivery?	No. However design sequencing has been authorized on a pilot program basis.	Yes.	Yes.
Does the state DOT have the ability to form public-private partnerships?	No. AB 680 pilot program law was repealed in 2002.	Yes. Called Comprehensive Development Agreements.	Yes, under Public-Private Transportation Act of 1995.
Is the state DOT able to review unsolicited proposals?	No. Public contracting rules do not permit this.	Yes.	Yes.
Does the state DOT have Grant Anticipation Revenue Vehicle ("GARVEE") bonding authority?	Yes.	No.	Yes.
What other innovative finance tools are available to the state DOT?	None.	Using toll equity, TxDOT can combine highway funds with other sources to finance toll roads.	Nonprofit 63-20 corporations, used so far for two public-private toll road projects.

Part 6

Potential Legal and Policy Changes

Given California's projected growth to 50 million people by 2030, it is becoming increasingly difficult for state and local governmental agencies to maintain—let alone improve—the state's aging infrastructure, including its highways and bridges. Periodically, the legislature focuses on this problem and attempts to identify new funding sources by, for example, encouraging the private sector to shoulder some of the responsibility. In addition, it considers expanding the use of innovative project delivery tools such as design-build. Some of these previous efforts are examined below. In sum, it is fair to say that California took an ambitious (if flawed) first step with AB 680 back in 1989 but then fell well behind other fast-growing states, such as Texas and Virginia, in subsequent years.

In 2004, Governor Schwarzenegger reenergized interest in discussing transportation issues through his California Performance Review (discussed below). California also is having its own Big Dig scandal involving Caltrans' rebuilding of the San Francisco-Oakland Bay Bridge. The multi-billion dollar cost overruns associated with this project are likely to further increase calls for the state to reform its transportation project delivery system and increase the number of financing tools that are available to fund these efforts.

A. The Pioneering but Flawed First Step: AB 680 Private Toll Roads

In 1989, Assembly Bill 680 authorized Caltrans to enter into agreements with private entities for the development, construction and operation of four demonstration transportation projects at private sector expense and without the use of state funds. Four projects were selected from among a number of proposals submitted to Caltrans. Only two of the four projects ultimately went forward; the other two failed due to a lack of financial and community support.

Of the two that went forward under this legislation, the SR 91 Express Lanes project in Orange County is the only one in operation; the San Diego SR 125 South toll road is now under construction and is expected to open to traffic in 2006.

Below is an overview of these two projects:

- **SR 91 Express Lanes.** This four-lane, 10-mile toll road is located southeast of Los Angeles in the existing center median of SR 91, the existing nontoll public highway connecting three of the fastest-growing counties in the United States: Riverside, San Bernardino and Orange counties.[50] It was privately financed at a cost of $135 million, and it opened in December 1995.[51] Originally, it was owned and operated by California Private Transportation Company, L.P., a joint venture of Kiewit Pacific, Granite Construction, and Cofiroute. In late 2002 the Orange County Transportation Authority bought it for $207.5 million. Cofiroute continues to operate this toll project pursuant to a management contract. The project itself was unique and innovative in several respects. It was the first U.S. toll road to be privately financed in more than 75 years.[52] It was also the first toll road in the United States to use variable congestion pricing.[53] Finally, SR 91 was the world's first fully automated toll road, utilizing electronic transponders to collect tolls.[54]

- **SR 125 South Toll Road.** This 9.5-mile, four-lane toll road is located in San Diego County. The development of SR 125 South has been part of California's planned freeway system since 1959, and part of SANDAG's Regional Transportation Plan, which lays out the region's priority projects through 2030. It is intended to reduce traffic congestion on I-5 and I-805 and increase capacity for future travel between the United States and Mexico. With an estimated cost of $722 million, it is being financed and developed as a public-private partnership under a franchise agreement between Caltrans and California Transportation Ventures, an affiliate of Macquarie Infrastructure.[55] Construction began in September 2003, and the project is expected to be open to the public by fall 2006. The project is being financed by private debt and equity supplemented by a loan under the U.S. Department of Transportation's TIFIA program.

But despite the success (in transportation terms) of the two AB 680 projects, political controversy surrounding aspects of the 91 Express Lanes led to this project's purchase by Orange County and the repeal of AB 680 in late 2002. The reasons for the political failure of California's initial public-private partnership measure are worth exploring.

Some Riverside County public officials (both Republican and Democrat) opposed the 91 Express Lanes project from the start. Riverside County had adopted a local transportation sales tax many years before Orange County did, and used some of those funds to build HOV lanes on SR-91 up to the county line. Lacking such a sales tax in 1990, Orange County officials welcomed the private firm's proposal to provide the express lanes on their side of the county line. But the requirement to pay a toll (or get a third person into the carpool) in order to stay in the faster lane caused resentment. Riverside officials engaged in litigation against the Express Lanes at various stages of the project's history.

The biggest controversy concerned enforcement of the non-compete zone for this project. Nearly all new toll road projects, in order to sell bonds to investors, must offer some degree of protection from unlimited tax-funded competition from competing free highways. But the very stringent clause in the Express Lanes franchise agreement precluded Caltrans from adding any new capacity in the corridor (except minor safety improvements) until traffic in the corridor reached much higher levels, far in the future.

In 2002 Sen. Rod Pacheco (R., Riverside) got a bill passed to outlaw non-compete zones, but Governor Davis was persuaded to veto the bill, on grounds that even if applied only prospectively, it might preclude use of toll roads to meet some of California's future transportation needs. But continued concerns about the inability to add general-purpose lanes to SR 91 led to subsequent legislation for the Orange County Transportation Authority to purchase, at fair market value, the 91 Express Lanes. That transaction was completed at the end of 2002, and the lanes are now owned by OCTA but continue to make use of the value-pricing toll philosophy in order to keep traffic flowing smoothly on the Express Lanes. They are also still operated by Cofiroute, under contract to OCTA.

Because of the negative reaction to the controversy over non-compete clauses, the legislation authorizing OCTA to purchase the Express Lanes also repealed (rather than reform) AB 680. Hence, California has been left with no enabling legislation for creating new toll roads or toll lanes, converting HOV lanes to HOT lanes, or making use of other forms of public-private partnerships for toll projects.

B. Incomplete Second Step: Fee-Generating Infrastructure Under AB 2660

In the mid-1990s, the legislature acknowledged that local governmental agencies such as cities and counties were unable to make necessary improvements to their "deteriorating" infrastructure facilities due to a lack of public funding.[56] It also acknowledged that they must identify new funding sources such as private sector investment capital to make these improvements, and that the failure to do so would reduce the increasing population's "quality of life."[57]

In 1996, the legislature's response to dealing with this funding problem was AB 2660. This piece of legislation was innovative for several reasons. First, it gave local governmental agencies the authority to allow private contractors and developers to design, construct, lease, operate, maintain, and finance their fee-generating infrastructure facilities. These facilities include, for example, water supply, treatment and distribution, airports, commuter and light rail, and highways and bridges.[58] In addition to leasing these facilities, the governmental agency in its discretion may also decide to transfer ownership of them to the private sector for up to 35 years.[59]

A second innovative aspect of AB 2660 is that it gives the governmental agency the ability to impose user fees and service charges on those persons benefiting from or using such infrastructure facilities. The revenues from these user fees are then dedicated exclusively to payment of the private entity's direct and indirect capital and administrative costs associated with the project and a "negotiated reasonable return on investment to the private entity."[60] The statute is silent on what is reasonable, leaving that financing issue for individual public-private partnership agreements to address.

Lastly, rather than waiting for the public sector to act, AB 2660 enables the private sector to submit unsolicited proposals for individual projects or those that are part of a larger project.[61] The responsible governmental authority then decides whether or not it is interested in further discussing the private sector's proposal. If it is, then it may avoid the typical public procurement process—which relies on competitive bidding—and instead use a special bidding process that focuses on "demonstrated competence and qualifications" and that ensures the facility will be operated at "fair and reasonable prices" to the users of the infrastructure facility.[62]

Despite the foregoing, there has been only mixed interest in and use of AB 2660 for eligible fee-generating infrastructure projects in California. The statute to date has been used most successfully to develop water and wastewater facilities, including projects in Arvin, Fillmore, Lathrop, Palm Springs, and Rialto.

In the transportation sector, however, AB 2660 has not been a useful tool because one of its provisions prohibits its use on projects involving toll roads on state highways which are otherwise state-financed.[63] State-financed projects include transit, but these types of projects generally do not make enough money even to cover their operating costs, so it is unlikely that the private sector would have much interest in financing them anyway (absent a special situation such as the Las Vegas monorail). In addition, if a road or bridge is not part of the state highway system, it is unlikely to have traffic high enough that it would lend itself to toll finance. Recall, for example, that both of the AB 680 privately financed toll road projects (SR 91 and 125) are part of the state highway system. To make AB 2660 a truly effective tool, the legislature would therefore have to eliminate these prohibitions.

C. The Keston Report on Transportation Funding and Finance

In early 2004, the new Secretary of the Business, Transportation and Housing Agency, Sunne Wright McPeak, encouraged local transportation experts to help her brainstorm what steps should be taken to improve the delivery and financing of public infrastructure projects in California. The University of Southern California's Keston Infrastructure Institute responded to this request by convening a panel of transportation finance experts, who came up with a series of specific recommendations in a March 17, 2004 report entitled "Initiatives in Transportation Funding & Finance."

In particular, the Keston report cited Texas as a good example of how one state has created a comprehensive set of new tools to fund major mobility improvements and improve the efficiency of the delivery of such projects. These tools, including that state's expanded use of tolling and public-private partnerships, were discussed previously in this policy study in Part 5, Sections B and C.

Some highlights of the Texas model singled out by the Keston report include:

- Tolling, to accelerate and help finance a significant portion of new construction;
- Bonding authority, now available to the Texas Transportation Commission;
- The Texas Mobility Fund, a revolving loan fund for transportation; and
- Regional Mobility Authorities, enabling local governments to engage in large-scale transportation projects, using tolling and toll revenue bonds.

As the Keston report makes clear, transportation reform should be one of California's top priorities given the gap between its limited funding sources and huge investment needs and the negative impact of congestion on the state's economy. The new Schwarzenegger administration seems to agree with this conclusion, as evidenced by its establishment of the California Performance Review.

D. California Performance Review (CPR)

On February 10, 2004, Governor Schwarzenegger created the CPR.[64] Interestingly, Billy Hamilton, one of the CPR's co-executive directors, is from Texas, where he is responsible for tax administration, statewide financial management, revenue forecasting, and treasury operations. As indicated above, Texas is considered to be a model of transportation infrastructure reform in the United States.

The CPR's purpose was to make recommendations on how all sectors of state government could best be reorganized. The emphasis was on streamlining processes and procedures, reducing the size of government, improving customer service and implementing technological advances that would facilitate more productive relationships between agencies, state and local government and California residents. To achieve this objective, the CPR focused on seven substantive governmental functions, including infrastructure, and seven cross-cutting topics, including government procurement.

On August 3, 2004, the CPR released a 2,500-page report on this reform effort containing more than 1,200 recommendations. Among its findings, the report concluded that there are four major problems with the existing infrastructure delivery system in California, all of which are due to a lack of coordination:

- California lacks an integrated infrastructure policy.
- Infrastructure projects are not centrally managed or coordinated.
- Necessary infrastructure investment lacks stable funding.
- Multiple agencies involved in infrastructure make it difficult to complete projects.

The CPR recommended the creation of a single Infrastructure Department, one of whose operating decisions would be responsible for transportation. Other highlights included:

- Shift to paying for highways by charging per mile driven (the principle underlying tolling);
- Give the Bay Area's Metropolitan Transportation Commission the power to set and adjust tolls based on congestion levels;
- Create networks of toll lanes in urban areas statewide;
- Revamp the procurement process on new transportation projects, allowing help from private engineering firms and flexibility from current rules that permit contract awards only to the lowest-cost (rather than best-value) bid.

The CPR is currently holding a series of public hearings to obtain public input on its report. Once these hearings are completed, the CPR Commission will deliver all testimony to the governor without any recommendations for action. The governor will next decide what testimony to include and what parts of the proposal should be advanced. The Little Hoover Commission would then receive any government reorganization recommendations and, if approved by that entity, the plan would go to the legislature for an up or down vote. Remaining issues would be handled through executive orders, legislation, or a combination of both. The governor is not expected to introduce legislation or submit a reorganization plan to the Little Hoover Commission until early 2005.

E. Recent Legislative Efforts

California's 2003-04 legislative session ended in August 2004. A number of bills were put forth during this session containing some of the kind of reforms discussed above to improve the delivery and financing of public infrastructure projects in California. Several of the most interesting of these legislative proposals and their current status are summarized here.

AB 2032. This bill, by Sen. John Dutra, permits some expansion of the extent of HOT lanes in California. It was passed and signed by the governor. This bill authorizes SANDAG, the Sunol Smart Carpool Lane Joint Powers Authority, the Santa Clara Valley Transportation Authority, and the Alameda County Congestion Management Agency to undertake HOT lane programs beyond the existing eight-mile I-15 project in San Diego. The bill requires the net toll revenue generated by each program after payment of direct expenses to be allocated to the construction of additional HOV facilities and the improvement of transit services pursuant to an expenditure plan adopted by the sponsoring agency. The bill authorizes the operation of the program by each agency for a period not to exceed four years after the agency first collects revenues for any of the authorized corridors. Local transportation sales tax revenues could be used to partially fund these programs.

SB 1210. Sen. Tom Torlakson introduced this bill to give state and local public agencies broad authority to use design-build and design-build-operate-maintain procurements for transportation projects. But it was amended to eliminate these innovative methods and to instead continue the design-sequencing pilot project authorized previously, beyond its January 1, 2005 expiration date. (Design-sequencing is a method of public contracting that enables the sequencing of design activities to permit each construction phase to commence when design for that phase is complete, instead of requiring design for the entire project to be completed before commencing construction.) This bill established a phase 2 of this pilot project that would be in effect until January 1, 2010. The governor recently signed it into law.

AB 1609. This bill, by Assemblyman Todd Spitzer, would have authorized a public entity to use the alternative design-build-operate delivery system for public works improvements when the public entity anticipated that use of the design-build-operate delivery system was beneficial. The bill would also have required the public entity, among other things, to establish a competitive prequalification procedure for design-build-operate entities. It died in committee.

In sum, while there were several transportation reform bills introduced in this legislative session, they fell short of the kind of sweeping reform discussed in this policy study. And even most of the modest bills that were introduced died. The one exception was the AB 2032 HOT lanes demonstration project.

F. Suggested Future Reform Measures

As this study has attempted to demonstrate, California does not currently have the policy tools needed to finance and develop large-scale improvements to its highway system, on which we will continue to rely for more than 90 percent of passenger transportation and the large majority of all goods movement over the next 30 years. A growing number of other fast-growing states (as well as urban areas in Australia, Britain, Canada, France, and others) have developed effective means of tapping the private capital markets and drawing on the project-delivery skills of the private sector, to make major improvements to their transportation systems. California needs to do likewise.

The political failure of AB 680 should not suffice to dismiss the demonstrated success of more sophisticated public-private partnership measures in other states and other countries. Billions of dollars of private capital are going into toll-funded projects in these other locales, thanks to well-crafted enabling legislation. Unlike the very narrowly drafted AB 680, a second-generation enabling law for California would differ in at least the following particulars:

1. It would permit the relevant agencies to develop projects in either of two ways: by issuing requests for proposals (RFPs) and by receiving unsolicited proposals from the private sector.
2. It would apply not just to Caltrans but to other levels of government, including cities, counties, congestion management agencies, and joint powers authorities.

3. It would permit tolls to be charged for such projects without any further action by the legislature (i.e., it would be general enabling legislation for tolling in the context of such projects).
4. It would provide for a variety of partnering agreements between the private and public sectors, ranging from simple design-build through design-build-operate-maintain to full-fledged long-term concessions or franchises, on the Australian/European model.
5. It would permit a mix of public and private funding, as in Texas and Virginia, rather than specifying 100 percent private capital, as did AB 680.
6. It would allow for non-compete provisions defined in functional terms, accepting all projects in the approved MPO's long-range transportation plan and providing for compensation to the franchise-holder only for impacts of other competing capacity additions.

What would be the best vehicle for achieving these goals?

1. A simple first step would be to allow all state and local governmental entities to have the option of using the design-build project delivery method for transportation infrastructure projects. While there is an extra up-front cost associated with this type of procurement, it does provide on-time delivery and on-budget price guarantees, and helps to avoid the type of multi-billion dollar cost overruns associated with, for example, Caltrans' rebuilding of the San Francisco-Oakland Bay Bridge.
2. One approach to the broader issue would be to start with the now-repealed AB 680 private toll road law and turn it into a modern public-private partnership law more like those in Texas and Virginia. But because AB 680 has negative political connotations in some quarters, this approach may carry unnecessary political baggage; it could be characterized by opponents as going back to a flawed model.
3. A simpler approach, which would achieve most of the above goals, would be to amend the already existing AB 2660 law, which empowers local agencies to make use of public-private partnerships. The principal reforms needed would eliminate those prohibitions which prevent its use on projects involving toll roads on state highways or which are otherwise state-financed. Its scope should also be expanded to enable Caltrans (or its successor) to use the innovative financing and procurement provisions of AB 2660, in addition to local agencies.
4. Another approach, championed for several years by SCAG, would permit the creation of new regional governmental authorities (joint powers agencies) for the purpose of developing user-fee-supported transportation improvements in a specific geographic location, such as the six-county SCAG region or the nine-county Bay Area of San Francisco. Such authorities would be granted the power to impose user fees, incur debt secured by the pledge of revenues, and enter into public-private partnership agreements. Such authorities would be empowered to receive or solicit proposals and enter into franchise agreements for the design, construction, operation, maintenance and finance of projects that would enhance the movement of passengers or freight. The Transportation Corridor Agencies in Orange County were created by special legislation in 1986. But instead of forcing local officials to go to the legislature each time such an entity is needed, the legislature should pass general enabling legislation authorizing the creation of such joint powers authorities wherever and whenever they are needed.

Part 7

Summary and Conclusions

California is at a crossroads regarding the future of its highway system. The massive growth projected between now and 2030 in both driving and truck movements threatens to paralyze our highways, especially in the major urban regions. Yet the current highway funding system is under such severe stress that it can barely maintain the existing highway assets, let alone develop the kinds of major new projects needed to cope with the growth that is on the way.

We have seen that other fast-growing states, and world-class urban regions such as Paris, Sydney, and Toronto, have addressed the urban highway infrastructure challenge in creative new ways. They have found that the global capital markets are ready, willing, and able to invest billions of dollars into urban toll roads and tunnels so as to relieve congestion, improve connectivity, and make trips more reliable. They have also found that carefully designed long-term public-private partnerships can get such projects built sooner, and with less of a tendency toward cost overruns, than conventional highway procurement methods. Such mechanisms actually shift many of the risks of mega-projects from taxpayers to investors, who can better afford to take such risks.

California was an early pioneer in public-private partnerships for toll roads, with its innovative 1989 pilot program, AB 680. Although that measure made possible two important additions to our urban highway system, its flaws led to its repeal by the legislature in 2002. Unfortunately, it was not replaced with a more modern measure, leaving California without the tools to attract global capital and world-class project delivery expertise to our highway system. Consequently, that capital and expertise are going to states like Texas and Virginia (as well as other countries) whose laws welcome the role the private sector can play in addressing the need for major highway investments.

California has a lot going for it, if it can just get the policy climate right. It already has an interoperable statewide electronic tolling system, FasTrak. The state is home to many of the leading global companies that design and develop large-scale infrastructure (including AECOM, Bechtel, Granite Construction, Jacobs Engineering, etc.). International toll owner-operators such as Cofiroute (91 Express Lanes) and Macquarie (SR 125 South) are already active in the state. The $17 billion annual cost of congestion in its three largest urban areas is a powerful signal of the potential economic gains to be had from meaningful congestion relief. And although tolling is still of modest dimensions in California, agencies such as Alameda Corridor Transportation Agency, Bay Area Toll Authority, Orange County Transportation Authority, and the Transportation Corridor Agencies have a proven track record with billion-dollar revenue bond deals. Moreover, the federal government has provided credit support for ACTA, TCA, and the SR 125 South project and stands willing to offer support for future projects.

Given both the ongoing transportation finance crisis and the need to cope with major growth over the next 25 years, California urgently needs state-of-the-art enabling legislation to mobilize private capital and private sector project delivery expertise. This need has been acknowledged by the Governor's California Performance Review, USC's Keston Institute, and others. Such a measure should permit the use of tolling wherever it is needed to finance major highway improvements in California. And it should empower both Caltrans and other levels of government to carry out such projects, either by themselves or in partnerships with the private sector.

Appendix

Toll Project Case Study Details

The Palmdale-Glendale Tunnel

Cost Estimate

For purposes of the initial feasibility assessment, we began with the figures for the toll tunnel project from the 2001 study. That study took as given the design and cost of the 2000 (non-toll) tunnel and added costs of right-of-way acquisition for interchanges, utility relocation, toll collection equipment, and engineering administration, all updated to 2001 dollars. That total was $2.26 billion. Our assumption is that the project would be financed in 2012, based on a cost in 2012 dollars, so we adjusted the previous figure for 3 percent annual inflation to arrive at a capital cost of $3.07 billion in 2012 (the assumed mid-point of a six-year construction period). The tunnel would open and begin collecting toll revenues in 2015.

Traffic and Revenue Estimate

The key to the potential viability of the tunnel is the distance and time savings it would offer. Table A-1 shows the reduction in highway miles for three representative destinations from Palmdale: Pasadena, Burbank, and downtown Los Angeles. Such trips would be from 27 percent to 44 percent shorter in distance.

Table A-1: Trip Distance Comparison, SR 14 vs Tunnel (miles)

Palmdale to	Pasadena	Burbank	Downtown L.A.
Distance via SR 14	62.1	52.7	61.3
Distance via tunnel	34.6	38.3	40.5
Difference	27.5 (44%)	14.4 (27%)	20.8 (34%)

While the shorter distance is important to travelers, perhaps even more important would be the large savings in *travel time* during peak periods. In Table A-2 we work out comparative travel times during the AM peak in 2020, using data from the 2000 study for travel times on SR 14 under either the "no-build" alternative or under the alternative that adds HOT lanes to SR 14. For other freeways, we use the average AM peak speed for 2020 of 32.8 mph. And for the tunnel we use 60 mph. To get from Palmdale to the beginning of the tunnel requires using SR 14, so we must analyze two tunnel cases as well, with and without the HOT lanes on SR 14. Table A-2 presents the results.

Table A-2: 2020 AM Peak Trip Time Savings, SR 14 vs. Tunnel (minutes)			
Time via SR 14 (no-HOT lanes)	Pasadena	Burbank	Downtown L.A.
Palmdale to I-5	69	69	69
I-5 to destination	40.2	23.4	39
Total	109.2	92.4	108
Time via SR-14 (with HOT lanes)			
Palmdale to I-5	59.4	59.4	59.4
I-5 to destination	40.2	23.4	39
Total	99.6	83.1	98.4
Time via tunnel/SR-14 (no HOT lanes)			
SR-14 to tunnel	13.2	13.2	13.2
Tunnel	21	21	21
I-210 to destination	11.4	18	22.2
Total	45.6	52.2	56.4
Time via tunnel/SR-14 (with HOT lanes)			
SR-14 to tunnel	10.8	10.8	10.8
Tunnel	21	21	21
I-210 to destination	11.4	18	22.2
Total	43.2	49.8	54
Tunnel savings over SR14/no HOT	63.6	40.2	51.6
Tunnel savings over SR14/with HOT	56.4	33.3	44.4.

These are very significant time savings, mostly between 45 minutes and one hour during the morning rush hour. How much might some travelers pay to obtain these savings? The best available data come from the 91 Express Lanes in Orange County, which offer two lanes in each direction of 65 mph performance during rush hour, though only over a 10-mile stretch. At the busiest rush hours during the week (on Thursday and Friday afternoons), commuters pay as much as 62.5 cents/mile in order to save what measurements reveal to be about 15 minutes (but which is perceived to be more than that, partly because of the reliability of the speedy trip). A weighted average of the peak-direction tolls paid during all peak hours on the 91 Express Lanes in April 2004 (6-8 AM and 3-7 PM) is 40 cents/mile.

The projected toll tunnel traffic in the 2001 study is heavily directional in the AM peak but about evenly split during the PM peak. Thus, if peak-direction rates were charged southbound during the AM peak (assumed to be three hours) and in both directions during the PM peak (assumed to be four hours), then 88 percent of all peak-period traffic would be paying peak-direction tolls. Thus, the average toll charged during peak periods on the tunnel would be 88 percent of the peak-direction rate. Using the Orange County peak-direction figure of 40 cents/mile, our overall average peak-period toll for the tunnel would be 35.2 cents/mile as of 2004.

As a cross-check on the reasonableness of such a toll rate, the peak-direction toll of 40 cents/mile, over a 21-mile facility, would be $8.40. Referring back to Table A-2, we found AM peak time savings of between .50 and 1.06 hours. The U.S. Department of Transportation recommends using $21.20/hour as the value of time for business purposes and $10.60 for non-business purposes.[65] Since AM peak travel represents a mix of the two, a 50/50 mix yields an average value of time of $15.90 in 2000 dollars. Thus, saving 0.50 hours should be worth 7.95 and saving 1.06 hours worth $16.85. Clearly, a toll of $8.00-$9.00 would be in the right ballpark.

Value pricing uses market pricing to keep the toll rate high enough to ensure that the number of vehicles/lane/hour remains low enough to ensure uncongested, free-flow traffic. As a proxy for this, our analysis used the 91 Express Lanes' overall average peak-period toll of 35.2 cents/mile (in 2004) as the starting point, and adjusted it annually for the assumed 3 percent inflation rate. We also assumed that the time-sensitive travelers choosing the toll tunnel would be as many as projected in the 2001 toll tunnel analysis (though that study was not based on value-pricing principles, and did not base its rates on actual time savings, nor did it adjust the toll rate annually; hence, it sorely underestimated toll revenue).

Table A-3 shows our 40-year projection of traffic and revenue, based on the foregoing assumptions. Since the main revenue producer is peak periods, we focus on that traffic initially, in the second data column. To this we add the results of a separate analysis of projected daily and peak-period cars traveling to and from Palmdale International Airport from downtown Los Angeles and other centers for which the tunnel provides the fastest route. Our Palmdale Airport projection is based on achieving the SCAG long-range transportation plan's 2030 target of 12.8 million annual passengers (MAP) for Palmdale, though we assume serious airline operations there only getting under way by 2015 (the tunnel's opening year) when we project 1.1 MAP. (Note: airport traffic is only 1.3 percent of peak-period trips in 2020, 14 percent in 2030, and 20 percent in 2040.)

Adding the general (non-airport) peak traffic and the airport peak traffic gives us the daily total peak-period traffic, which is multiplied by the average peak-period toll in effect each year to yield daily toll revenue from the peak periods. Experience with the 91 Express Lanes is that non-peak revenues (weekdays at other hours, plus weekends and holidays) equal about 29 percent of peak revenues, and on that basis we estimate off-peak annual revenues. Finally, that gives us total annual revenues for each of the 30 years.

Financial Feasibility

A simple way of making an initial assessment of a project's financial feasibility is to estimate its long-term return on investment. One way of doing this is to compare the net present value of the project's revenues (net of operating costs) to its initial capital cost. This is done in the last three columns of Table A-3. First, we approximate operating and maintenance costs at 15 percent of each year's revenue; thus, the "net revenue" for each year is 85 percent of the gross revenue. Next, we discount each year's net revenue to the year the project was financed, 2012, using a 6 percent discount rate. The sum of these figures is the project's total net present value, which is found to be $2.6 billion. That equals 83 percent of its 2012 capital cost. What this means is that the project would nearly cover its capital costs out of the toll revenues generated.

However, as noted in Part 3, if the innovative French double-deck concept were used, the project could be built and financed in two phases. Only a single (double-decked) tube would be built initially, and we estimate the cost to be 60 percent of the total (due to many fixed costs applying to both phases, as well as the additional cost of the second-deck structure). It would open in 2015 with four of its six lanes in use initially (which would be enough to handle the projected travel until 2033). The second tube would be financed and built to open in 2030. By that point, revenues would have grown sufficiently large to better cover the larger capital cost of both tubes. The net present value (NPV) of this two-phase project would be greater than the capital cost, meaning that the entire project could be funded by toll revenues.

Table A-3: Palmdale Tunnel Traffic and Revenue

Year	Weekday ADT	Peak ADT	Airport Peak ADT	Total Peak ADT	Avg. Peak Toll	Peak Rev/Day	Peak Rev/Year	Off-peak Rev	Annual Rev	Net Rev.	NPV factor	NPV, 2012
2015	43,567	27,447	521	27,968	0.487	$286,031	$71,507,721	$20,737,239	$92,244,960	$78,408,216	0.8396	$65,831,538
2016	44,438	27,996	757	28,753	0.502	$303,113	$75,778,373	$21,975,728	$97,754,102	$83,090,986	0.7921	$65,816,370
2017	45,327	28,556	994	29,550	0.517	$320,824	$80,206,115	$23,259,773	$103,465,888	$87,946,005	0.7473	$65,722,049
2018	46,233	29,127	1,278	30,405	0.532	$339,682	$84,920,578	$24,626,968	$109,547,546	$93,115,414	0.705	$65,646,367
2019	47,157	29,709	1,562	31,271	0.548	$359,866	$89,966,408	$26,090,258	$116,056,666	$98,648,166	0.6651	$65,610,896
2020	48,100	30,303	1,894	32,197	0.565	$382,017	$95,504,351	$27,696,262	$123,200,613	$104,720,521	0.6274	$65,701,655
2021	49,062	30,909	2,225	33,134	0.582	$404,964	$101,241,120	$29,359,925	$130,601,045	$111,010,888	0.5919	$65,707,345
2022	50,043	31,527	2,604	34,131	0.599	$429,335	$107,333,745	$31,126,786	$138,460,531	$117,691,452	0.5584	$65,718,907
2023	51,044	32,158	2,983	35,141	0.617	$455,318	$113,829,577	$33,010,577	$146,840,155	$124,814,131	0.5268	$65,752,084
2024	52,065	32,801	3,361	36,162	0.636	$482,979	$120,744,751	$35,015,978	$155,760,729	$132,396,620	0.497	$65,801,120
2025	53,106	33,457	3,787	37,244	0.655	$512,288	$128,072,048	$37,140,894	$165,212,943	$140,431,001	0.4688	$65,834,053
2026	54,168	34,126	4,213	38,339	0.674	$542,648	$135,661,985	$39,341,976	$175,003,961	$148,753,367	0.4423	$65,793,614
2027	55,252	34,809	4,640	39,449	0.695	$575,755	$143,938,663	$41,742,212	$185,680,875	$157,828,744	0.4173	$65,861,935
2028	56,357	35,505	5,113	40,618	0.716	$610,731	$152,682,724	$44,277,990	$196,960,714	$167,416,607	0.3936	$65,895,176
2029	57,484	36,215	5,586	41,801	0.737	$646,953	$161,738,210	$46,904,081	$208,642,291	$177,345,947	0.3714	$65,866,285
2030	58,634	36,939	6,060	42,999	0.759	$685,368	$171,341,939	$49,689,162	$221,031,101	$187,876,436	0.3503	$65,813,116
2031	59,806	37,678	6,581	44,259	0.782	$726,818	$181,704,421	$52,694,282	$234,398,703	$199,238,898	0.3305	$65,848,456
2031	61,002	38,431	7,101	45,532	0.805	$769,723	$192,430,714	$55,804,907	$248,235,621	$211,000,278	0.3118	$65,789,887
2033	62,222	39,200	7,622	46,822	0.83	$816,105	$204,026,255	$59,167,614	$263,193,869	$223,714,789	0.2942	$65,816,891
2034	63,467	39,984	8,143	48,127	0.854	$863,113	$215,778,346	$62,575,720	$278,354,066	$236,600,956	0.2775	$65,656,765
2035	64,736	40,784	8,664	49,448	0.88	$913,793	$228,448,282	$66,250,002	$294,698,283	$250,493,541	0.2618	$65,579,209
2036	66,031	41,600	9,232	50,832	0.906	$967,121	$241,780,172	$70,116,250	$311,896,422	$265,111,959	0.247	$65,482,654
2037	67,352	42,432	9,800	52,232	0.934	$1,024,474	$256,118,435	$74,274,346	$330,392,781	$280,833,864	0.233	$65,434,290
2038	68,699	43,280	10,368	53,648	0.962	$1,083,804	$270,951,093	$78,575,817	$349,526,910	$297,097,873	0.2198	$65,302,113
2039	70,073	44,146	10,936	55,082	0.99	$1,145,155	$286,288,643	$83,023,706	$369,312,350	$313,915,497	0.2074	$65,106,074
2040	71,474	45,029	11,504	56,533	1.02	$1,210,929	$302,732,180	$87,792,332	$390,524,512	$331,945,835	0.1956	$64,928,605
2041	72,904	45,930	12,120	58,050	1.05	$1,279,992	$319,997,979	$92,799,414	$412,797,393	$350,877,784	0.1846	$64,772,039
2042	74,362	46,848	12,735	59,583	1.08	$1,351,344	$337,835,950	$97,972,426	$435,808,376	$370,437,119	0.1741	$64,493,102
2043	75,849	47,785	13,351	61,136	1.12	$1,437,916	$359,478,916	$104,248,886	$463,727,801	$394,168,631	0.1653	$65,156,075
2044	77,366	48,741	13,966	62,707	1.15	$1,514,364	$378,590,977	$109,791,383	$488,382,360	$415,125,006	0.1565	$64,967,063
2045	78,913	49,715	14,581	64,296	1.184	$1,598,660	$399,665,117	$115,902,884	$515,568,001	$438,232,801	0.1477	$64,726,985
2046	80,491	50,709	15,244	65,953	1.22	$1,689,724	$422,431,079	$122,505,013	$544,936,091	$463,195,678	0.1389	$64,337,880
2047	82,101	51,724	15,907	67,631	1.257	$1,785,246	$446,311,435	$129,430,316	$575,741,751	$489,380,489	0.1301	$63,668,402
2048	83,743	52,758	16,617	69,375	1.294	$1,885,199	$471,299,674	$136,676,905	$607,976,579	$516,780,092	0.1235	$63,822,341
2049	85,418	53,813	17,375	71,188	1.333	$1,992,775	$498,193,800	$144,476,202	$642,670,003	$546,269,502	0.1169	$63,858,905
2050	87,126	54,889	18,180	73,069	1.373	$2,106,809	$526,702,358	$152,743,684	$679,446,042	$577,529,136	0.1104	$63,759,217
2051	88,868	55,987	18,984	74,971	1.414	$2,226,184	$556,546,031	$161,398,349	$717,944,380	$610,252,723	0.1038	$63,344,233
2052	90,645	57,106	19,836	76,942	1.457	$2,354,205	$588,551,271	$170,679,869	$759,231,139	$645,346,468	0.0972	$62,727,677
2053	92,458	58,249	20,736	78,985	1.5	$2,488,013	$622,003,253	$180,380,943	$802,384,196	$682,026,566	0.0923	$62,951,052
2054	94,307	59,413	21,683	81,096	1.546	$2,632,876	$658,219,012	$190,883,513	$849,102,525	$721,737,146	0.0874	$63,079,827
												$2,602,982,250
												83% of 2012 cost

This phased approach would mean that large vehicles (trucks and buses) could not take advantage of this shorter route between North and South County until 2030. But that would appear to be a small price to pay for obtaining this hugely beneficial project funded entirely by toll revenues.

San Diego Managed Lanes Network

Cost Estimate

The complete ML network is detailed in Table A-4. All project elements are taken from Appendix A of SANDAG's *Mobility 2030* and the cost figures are the year 2002 estimates from that document. For analysis purposes, the proposed network is envisioned as being implemented in four phases, to occur between now and 2025 The total cost of these four phases is $8.07 billion (2002 dollars)—four times as much as the set of MLs included in SANDAG's baseline (Reasonably Expected Revenue) plan. The $6 billion difference may be summarized as follows:

- $3.3 billion for MLs that are included in the baseline SANDAG plan as HOV lanes, but which would now be built as revenue-generating MLs instead;
- $200 million for MLs on SR125 that are in SANDAG's "unconstrained" plan but not in the baseline plan;
- $2.5 billion for interchange connectors that are in the "unconstrained" plan but not in the baseline plan

It should be noted that the MLs in SANDAG's baseline plan are nearly all four-lane facilities (two MLs in each direction, except for I-15 with a movable barrier allowing different lane configurations at different times of day and a reversible two-lane ML on SR 52). Our proposed expanded network includes some two-lane facilities, which would be built either as two-lane reversible or as one lane in each direction, depending on traffic flow patterns in each case. While two lanes per direction are preferable to a single ML per direction, the Federal Highway Administration's handbook on HOT lanes[66] considers single lane per direction HOT lanes as acceptable. Northern California's first such project, on I-680's Sunol Grade, is being done in this configuration, as are several other projects around the country.

Traffic and Revenue Estimate

The operating concept proposed for this ML network differs from that planned by SANDAG. It is drawn from Reason's previous policy paper on HOT Networks.[67] Its underlying rationale is that the cost of adding a network of new managed lanes and flyover connectors is so large that this scarce and valuable capacity should not be given away, except to super-high-occupancy vehicles—i.e., buses and vanpools. All lower-occupancy vehicles, including two-person carpools, should pay a market-based value price to use this premium service. It is this significantly different operating concept that makes possible the much higher revenue-generating ability of our network, which is what makes it possible to finance a major portion of the $8 billion cost from toll revenue bonds.

Table A-4: Components of Proposed San Diego Managed Lanes Network

Route	Link	Route miles	Existing HOV	HOV In-mi	New MLs	ML In-mi	Cost(M)	Plan Status
I-15	SR94 to SR163	9.7	0	0	2	19.4	$200	RER
	SR163 to SR56	6.9	2	13.8	2	13.8	$200	RER
	SR56 to Centre	8.5	0	0	4	34	$340	RER
	Centre to SR78	3.7	0	0	4	14.8	$120	RER
Totals, Phase 1				13.8		82	$860	RER
I-5	SR905 to SR54	6.3	0	0	2	12.6	$130	RER
	SR54 to I-8	10.5	0	0	2	21	$900	RER
	I-8 to I-805	9.7	0	0	4	38.8	$440	RER
	I-805 to SR56	2.3	1	2	4	9.2	$30	RER
	SR56 to Leucadia	9.8	1	4	4	39.2	$353	RER
	Leucadia to Vandegrift	11.1	0	0	4	44.4	$370	RER
SR52	I-805 to I-15	3.6	0	0	2	7.2	$70	RER
	I-15 to SR125	6.9	0	0	2	13.8	$170	RER
SR94	I-5 to I-15	1.9	0	0	2	3.8	$72	RER
	I-15/SR94 connector						$150	RER
	I-15/SR52 connector						$150	UNC
	I-5/SR94 connector						$300	UNC
	I-5/SR52 connector						$300	UNC
Totals, Phase 2				6		190	$3,435	
I-805	SR905 to SR54	7.5	0	0	4	30	$300	RER
	SR54 to I-8	7.9	2	6	4	31.6	$450	RER
	Mission V. Viaduct	0	0	0	4	0	$250	RER
	I-8 to I-5	11.1	0	0	4	44.4	$380	RER
	I-805/SR52 connector						$150	RER
	I-805/SR94 connector						$450	UNC
	I-15/I-805 connector						$150	UNC
	I-5/I-805 connector						$180	RER
Totals, Phase 3				6		106	$2,310	
SR54	I-5 to SR125	6.9	0	0	2	13.8	$110	RER
SR125	San Miguel to SR54	2.4	0	0	2	4.8	$70	UNC
	SR54 to SR94	3.9	0	0	2	7.8	$57	UNC
	SR94 to Grossmont	2.5	0	0	2	5	$53	UNC
	Grossmont to SR52	1.2	0	0	2	2.4	$24	UNC
SR163	I-805 to I-15	4.6	0	0	2	9.2	$100	UNC
	I-5/SR54 connector						$300	UNC
	I-15/SR163 connector						$150	UNC
	SR52/SR163 connector						$150	UNC
	I-805/SR54 connector						$150	UNC
	I-805/SR163 connector						$150	UNC
	SR52/SR125 connector						$150	UNC
Totals, Phase 4				0		43	$1,464	
Grand Totals				25.8		421	$8,069	

For HOT or managed lanes operated so as to maximize revenues, a pre-defined amount of capacity is set aside for designated super-HOVs, with the balance available for sale at market prices, using the kind of real-time pricing pioneered on SANDAG's I-15 project. With demand for uncongested peak-period driving generally exceeding supply on the freeways where MLs would be located, the challenge is to set the toll high enough that it will limit peak-period usage to an amount consistent with high-speed, free-flow conditions. We assume a maximum of 1,600 paying vehicles/lane/hour in the peak direction during peak hours on these lanes, and 1,100 paying vehicles/lane/hour in the non-peak direction, for an average (both directions) of 1,350 vehicles/lane/hour during the peak hours. We further assume there to be six hours per weekday of peak conditions during which these assumptions (and high toll rates) would apply, with much lower traffic and tolls at all other hours (non-peak weekday hours and weekends/holidays).

Analysis of actual I-15 data for March 2002 shows that the average toll during the AM peak was $1.625 and during the PM peak was $3.14 (in 2002 dollars). This gives a weighted average peak-period, peak-direction toll of $2.42. Assuming that the toll charged in the non-peak direction (during peak hours) is one-half that charged in the peak direction, the overall average peak-period toll for a two-way I-15 facility would be $1.81. Since the I-15 facility is eight miles long, this is an average peak-period toll rate of $.226/mile in 2002. We assume this to be generally reflective of supply/demand conditions for congestion relief in the San Diego area.

For estimating revenues from the proposed network, we assume that this average peak-period rate must be adjusted each year for inflation, to keep it the same in real terms. Thus, using an assumed 3 percent annual inflation rate, the toll in the initial year of Phase 1 operation (2010) would be $.287/mi. (It should be noted, again, that actual tolls would vary in real time, as do tolls on the current I-15 facility; this figure is merely the average across all ML lanes in the network during the six peak hours each weekday.)

Table A-5 then provides the basic data on travel and toll rates as the network is built and put into operation between now and 2025. The table shows the daily peak-period revenue collected each weekday and converts that to annual peak-period revenue. Then, based on the 91 Express Lanes' experience that total off-peak revenue equals about 29 percent of peak-period revenue, annual off-peak revenue is estimated and added to the former to produce total annual revenue for each year.

Financial Feasibility

The next step is to estimate the financial feasibility of the network, by calculating the net present value of the revenue generated (net of operating costs) in comparison with the capital invested in building the network, on a financially consistent basis. As can be seen in Table A-5's final columns, the NPV of the net toll revenues is $6.4 billion, compared with a 2010 capital cost of $10.2 billion. Thus, the project covers just over 63 percent of its costs out of toll revenues.

An alternative calculation was carried out, to see what starting (2010) toll rate would be needed to make the project 100 percent supported by toll revenues. A starting average peak-period toll rate of 45.4 cents/mile (instead of 28.7 cents/mi.) would be needed to accomplish this. Assuming that such toll rates were not feasible to charge (because it would not attract enough paying customers), then the project would have to be built using a combination of existing transportation funding sources (state and federal gas tax monies, local transportation sales tax monies) to cover the balance. In 2010 dollars, that would require $3.75 billion, rather than the $2.39 billion (in 2010 dollars) that SANDAG currently plans to spend on a much more limited set of managed lanes.

Table A-5: San Diego Managed Lanes Traffic and Revenue

		Lane-Miles		Avg Peak Toll	Peak Rev/Day	Annual Peak Rev.	Annual Off-peak	Annual Gross Revenue	Net Revenue	NPV 2010
1	2010	95.8		**$0.287**	222,706	55.68	16.15	**71.82**	$64.64	$64.64
2	2011	95.8	-	$0.296	229,387	57.35	16.63	**73.98**	$66.58	$62.81
3	2012	95.8	-	$0.304	236,269	59.07	17.13	**76.20**	$68.58	$61.03
4	2013	95.8	-	$0.314	243,357	60.84	17.64	**78.48**	$70.63	$59.31
5	2014	95.8	-	$0.323	250,658	62.66	18.17	**80.84**	$72.75	$57.63
6	2015	291.8	*196*	$0.333	786,391	196.60	57.01	**253.61**	$228.25	$170.56
7	2016	291.8	-	$0.343	809,982	202.50	58.72	**261.22**	$235.10	$165.73
8	2017	291.8	-	$0.353	834,282	208.57	60.49	**269.06**	$242.15	$161.04
9	2018	291.8	-	$0.364	859,310	214.83	62.30	**277.13**	$249.41	$156.49
10	2019	291.8	-	$0.374	885,090	221.27	64.17	**285.44**	$256.90	$152.06
11	2020	403.8	*112*	$0.386	1,261,553	315.39	91.46	**406.85**	$366.17	$204.47
12	2021	403.8	-	$0.397	1,299,400	324.85	94.21	**419.06**	$377.15	$198.68
13	2022	403.8	-	$0.409	1,338,382	334.60	97.03	**431.63**	$388.47	$193.06
14	2023	403.8	-	$0.421	1,378,533	344.63	99.94	**444.58**	$400.12	$187.59
15	2024	403.8	-	$0.434	1,419,889	354.97	102.94	**457.91**	$412.12	$182.28
16	2025	446.8	*43*	$0.447	1,618,223	404.56	117.32	**521.88**	$469.69	$195.98
17	2026	446.8	-	$0.461	1,666,770	416.69	120.84	**537.53**	$483.78	$190.44
18	2027	446.8	-	$0.474	1,716,773	429.19	124.47	**553.66**	$498.29	$185.05
19	2028	446.8	-	$0.489	1,768,276	442.07	128.20	**570.27**	$513.24	$179.81
20	2029	446.8	-	$0.503	1,821,325	455.33	132.05	**587.38**	$528.64	$174.72
21	2030	446.8	-	$0.518	1,875,964	468.99	136.01	**605.00**	$544.50	$169.78
22	2031	446.8	-	$0.534	1,932,243	483.06	140.09	**623.15**	$560.83	$164.97
23	2032	446.8	-	$0.550	1,990,211	497.55	144.29	**641.84**	$577.66	$160.30
24	2033	446.8	-	$0.566	2,049,917	512.48	148.62	**661.10**	$594.99	$155.77
25	2034	446.8	-	$0.583	2,111,414	527.85	153.08	**680.93**	$612.84	$151.36
26	2035	446.8	-	$0.601	2,174,757	543.69	157.67	**701.36**	$631.22	$147.07
27	2036	446.8	-	$0.619	2,240,000	560.00	162.40	**722.40**	$650.16	$142.91
28	2037	446.8	-	$0.638	2,307,199	576.80	167.27	**744.07**	$669.66	$138.87
29	2038	446.8	-	$0.657	2,376,415	594.10	172.29	**766.39**	$689.75	$134.94
30	2039	446.8	-	$0.676	2,447,708	611.93	177.46	**789.39**	$710.45	$131.12
31	2040	446.8	-	$0.697	2,521,139	630.28	182.78	**813.07**	$731.76	$127.41
32	2041	446.8	-	$0.718	2,596,773	649.19	188.27	**837.46**	$753.71	$123.80
33	2042	446.8	-	$0.739	2,674,677	668.67	193.91	**862.58**	$776.32	$120.30
34	2043	446.8	-	$0.761	2,754,917	688.73	199.73	**888.46**	$799.61	$116.89
35	2044	446.8	-	$0.784	2,837,564	709.39	205.72	**915.11**	$823.60	$113.58
36	2045	446.8	-	$0.808	2,922,691	730.67	211.90	**942.57**	$848.31	$110.37
37	2046	446.8	-	$0.832	3,010,372	752.59	218.25	**970.84**	$873.76	$107.25
38	2047	446.8	-	$0.857	3,100,683	775.17	224.80	**999.97**	$899.97	$104.21
39	2048	446.8	-	$0.882	3,193,704	798.43	231.54	**1,029.97**	$926.97	$101.26
40	2049	446.8	-	$0.909	3,289,515	822.38	238.49	**1,060.87**	$954.78	$98.40
41	2050	446.8	-	$0.936	3,388,200	847.05	245.64	**1,092.69**	$983.43	$95.61
42	2051	446.8	-	$0.964	3,489,846	872.46	253.01	**1,125.48**	$1,012.93	$92.90
43	2052	446.8	-	$0.993	3,594,542	898.64	260.60	**1,159.24**	$1,043.32	$90.28
44	2053	446.8	-	$1.023	3,702,378	925.59	268.42	**1,194.02**	$1,074.62	$87.72
45	2054	446.8	-	$1.054	3,813,449	953.36	276.48	**1,229.84**	$1,106.85	$85.24
46	2055	446.8	-	$1.085	3,927,853	981.96	284.77	**1,266.73**	$1,140.06	$82.83
47	2056	446.8	-	$1.118	4,045,688	1,011.42	293.31	**1,304.73**	$1,174.26	$80.48
48	2057	446.8	-	$1.151	4,167,059	1,041.76	302.11	**1,343.88**	$1,209.49	$78.20
49	2058	446.8	-	$1.186	4,292,071	1,073.02	311.18	**1,384.19**	$1,245.77	$75.99
50	2059	446.8	-	$1.222	4,420,833	1,105.21	320.51	**1,425.72**	$1,283.15	$73.84
								$35,441.57	**$31,897.41**	**$6,467.02**
										63.27%

This sum would be reduced if a starting toll somewhat higher than 28.7 cents proved to be feasible.

Comparison with SANDAG's Current Plan

SANDAG's baseline (Reasonably Expected Revenue) plan would use $2.39 billion (2010 dollars) of transportation tax money to create 318 lane-miles of managed lanes, none of them interconnected via flyover connectors into a seamless network. Our proposal would use up to $3.75 billion (2010 dollars) of transportation tax money, along with toll revenue bonds paid for by users' tolls, to create a $10.2 billion (2010 dollars), 447 lane-mile network, interconnected via 12 flyover connectors.

SANDAG has chosen its approach (instead of funding the project with toll revenue bonds) in order to have toll revenues available to use for transit operations (rather than for paying debt service on bonds). Figures provided by SANDAG estimate those net toll revenues for each of the three decades in its Reasonably Expected Revenue Plan, as shown in Table A-6. However, those out-year revenues have not been put on a comparable-dollar basis via a net-present-value calculation, so they can be added together. When this is done, discounting SANDAG's each-decade toll revenues to 2004 value, the total is a 2004 NPV of only $118 million. While certainly not trivial, this is a very modest sum in the context of the overall $42 billion Reasonably Expected Revenue Plan. And it contrasts dramatically with the $6.4 billion NPV of toll revenues from our revenue-bond financed network.

Table A-6: SANDAG Net ML Toll Revenues

Period	2002-2010	2011-2020	2021-2030
Net Toll Revenues	$13.7 million	$62.4 million	$115.2 million
Midpoint of period	2006	2016	2026
NPV, 2004	$12.2 million	$31.0 million	$75.2 million

Thus, the trade-off for San Diego is whether to follow its currently planned approach, which produces some modest transit subsidies from toll revenues, while building $2.39 billion worth of managed lanes—or to use toll revenue bonding to build an interconnected $10.2 billion managed lanes network. The former would generate modest operating subsidies to assist with express bus operations on the unconnected set of managed lanes. The alternative proposed here would produce a larger, interconnected network of managed lanes on which region-wide express bus service could operate at no charge, but without itself providing operating subsidies for that service. This is a choice that should be debated by transportation policy makers and the public in San Diego.

L.A. Ports to Nevada Truckway

Traffic Projections

There are a number of varying estimates of likely growth in truck traffic. A 2001 study for SCAG of truck lanes on SR-60[68] estimated that truck traffic would grow about 2.4 fold by 2020. The federal Freight Analysis Framework puts the increase in truck traffic on I-15 by 2020 at a 2.2 fold increase overall, but a lower increase (about 1.8 fold) for the four-lane section up to the Nevada state line. The SCAG report on the Los Angeles ports to Barstow truckway assumed a 2.6 percent annual increase in truck traffic over the period of the project (29.2 percent per decade.)[69] Freight in total is forecast to grow faster than this, so the 2.6 percent annual increase must depend on an assumed major mode shift from trucking to rail.

This scenario seems to come from a "freight management case study" by the Los Angeles County Metropolitan Transportation Authority (LACMTA). It refers to forecasts of a rise in rail's share of the tonnage of southern California freight from 22 percent to 37 percent by 2020.[70] That would require a compound rate of growth of rail freight of 5.5 percent a year. Such a shift to rail seems to be wishful thinking because of the paucity of origins and destinations served by rail and the proportion of truck trips being made within the metro area for which there are no relevant rail lines. The MTA report provides no reasoning as to why rail should be expected to make such outsize gains in market share from trucking. All the economic and social trends are against rail—just-in-time deliveries favoring trucking's door-to-door service, lighter higher-value products being better suited to truck, the road orientation of most distribution centers and big box stores, and the proliferation of truck loading docks versus the steady disappearance of branch rail lines and sidings. Shifts to rail away from truck were previously predicted as a result of construction of the multi-billion dollar Alameda Corridor rail project, but these shifts have not occurred.

A conservative assumption for trucking is that it won't gain further mode share against rail, and that the two modes will grow at about the same pace. That would produce a trend growth in truck traffic of 3.0 percent per year in southern California rather than the 2.6 percent numbers suggested by the MTA (and used in SCAG's truckway study). The 3.0 percent per year growth number is also more in line with the trucking volumes suggested by the federal FAF projections. The 2.6 percent MTA number produces a 29.3 percent growth per decade in truck cargo volume while the 3 percent number produces 35 percent per decade.

Some forecasts are probably too high to form the basis for prudent investments. The same MTA freight report which suggests trucking will only grow at a compound 2.6 percent suggests that containers handled in the ports of Long Beach and Los Angeles will grow from 9.5 million in 2000 to the range 30 to 36 million by 2020 and calls these numbers "probably conservative."[71] These numbers represent a compound annual growth rate of 5 to 6 percent. Something has got to give. The ports cannot be growing traffic at 5 to 6 percent while the principal highways serving the port have freight traffic growing at only 2.6 percent. More likely the port container numbers are an exaggeration, and both will grow somewhere between 3 and 4.5 percent compound. On that basis our 3 percent number could be dubbed "conservative."

Revenue Projections

Given the kinds of savings possible from operating trucks on truckways versus the unmanaged mixed lanes of freeways, it seems reasonable to posit that our proposed truckway might over time attract half the trucks in the urban segment at an average of about $1.00/mile (in 2004 dollars). This is a lower proportion than modeled (below) for the Bay Area truckway. That is because truck volumes vary more along the corridor between the L.A. ports and San Bernardino than on the Oakland to Milpitas and Tracy routes, indicating a higher fraction of local traffic in southern California. The biggest gains from truckway use will accrue to the medium-distance trips (defined as more than 20 miles).[72] Ports to the rail yards and intermodal centers will make LCVs attractive so long as they are catered for at trip ends with direct ramps from the truckway into the yards themselves, and they will make sense for a lot of trips between the ports and thousands of distribution centers in eastern Los Angeles County and San Bernardino and Riverside Counties. And they will be extremely attractive for truckers operating directly from the ports area or elsewhere along the truckway into Las Vegas and other points east. But about half the traffic moving along I-710 and SR 60 terminates locally.

On the rural segment along I-15, congestion will be less of an issue over most of the road than on the urban segment, and we assume that capacity in the free lanes will be expanded more or less to maintain present conditions.[73] Still a much larger proportion of trips beyond San Bernardino are interstate long-distance trips for which the economies of operating LCVs will make the truckway attractive. We assume that on opening in 2012, 10 percent of trucks will use the rural truckway but that by 2022 after a 10-year ramp-up period (and fleet upgrades by trucking companies), 60 percent will use it at an average toll of 40c/mile (in 2004 dollars). And we assume that same proportion will be maintained from 2022 onward.

In our financial modeling, we have assumed an annual inflation rate of 3 percent over the entire 40-year analysis period. We have escalated 2004 capital costs by this 3 percent per year to the mid-point of construction in 2010 to obtain the project cost of $10.1 billion in 2010 dollars on which financing is based.

Table A-7 presents the results. The urban segment generates net revenues (after operating and maintenance costs) of $16.7 billion, in 2010 dollars. Compared with a capital cost of $10.1 billion, the project is clearly viable as toll-funded. The rural segment appears viable, as well, with a net present value of revenues at $5.5 billion versus a project cost of $2.4 billion, both in 2010 dollars. On this first-cut basis, a toll truckway project from the LA ports to the Nevada line is clearly profitable and should be financeable. It could be developed either by investors, as a for-profit venture under a long-term BOT concession, or by a government joint powers authority, as a nonprofit toll enterprise.

Oakland-Valleys Truckway

Traffic and Revenues

To estimate the potential earning power of this truckway, we looked at traffic volumes and forecasts for trucks for 2020. The most convenient database, the federal Freight Analysis Framework (FAF)[74], has the base year 1998 and projections for 2020. The data for I-880 and I-580 are broadly consistent with Caltrans counts, which are less conveniently collated and not projected into the future. We produced 2005 numbers based on scaling between 1998 data and the 2020 projections, assuming steady annual average growth.

We looked for end points on the truckway where truck volumes fall away. Originally we had in mind continuing the I-880 truckway into the heart of Santa Clara County and Silicon Valley to I-280 in San Jose. But the truck volumes drop off drastically beyond the SR 237 junction in Milpitas and further as you go south. It seems truck traffic between the East Bay and Silicon Valley disperses over many routes at the southern end of the Bay, so we foreshortened the truckway there, placing the terminus only just inside Santa Clara County. Truck volumes on the two branches are remarkably similar, in part an artifact of our deliberately choosing end points at given traffic volumes, but also due to real constancy of the data over long stretches of roadway. These are corridors with a large proportion of medium-distance truck traffic.

Table A-7: Los Angeles Ports to Nevada Truckway[75]									
1	2	3	4	5	6	7	8	9	10
	TMT (m)	% in Tway	TMT Tway (m)	Toll rate/mi	Toll rev $m	Gross rev $m	Net rev $m	NPV discount factor	NPV $m
				URBAN					
2012	919	0.10	92	$1.27	117	122	104	0.884	92
2013	946	0.15	145	$1.31	189	198	169	0.831	149
2014	975	0.20	198	$1.34	266	279	237	0.781	197
2015	1004	0.25	250	$1.38	347	364	309	0.734	242
2016	1034	0.29	303	$1.43	432	454	386	0.690	283
2017	1065	0.33	356	$1.47	523	549	467	0.649	322
2018	1097	0.37	409	$1.51	618	649	552	0.610	358
2019	1130	0.41	462	$1.56	719	755	642	0.573	391
2020	1168	0.44	514	$1.60	826	867	737	0.539	422
2021	1203	0.47	567	$1.65	938	985	837	0.507	451
2022	1239	0.50	620	$1.70	1,056	1,108	942	0.476	477
2023	1276	0.50	638	$1.75	1,119	1,175	999	0.448	476
2024	1315	0.50	657	$1.81	1,187	1,247	1,060	0.421	474
2025	1354	0.50	677	$1.86	1,260	1,323	1,124	0.395	473
2026	1395	0.50	697	$1.92	1,336	1,403	1,193	0.372	472
2027	1436	0.50	718	$1.97	1,418	1,489	1,265	0.349	470
2028	1480	0.50	740	$2.03	1,504	1,579	1,342	0.328	469
2029	1524	0.50	762	$2.09	1,596	1,676	1,424	0.309	468
2030	1570	0.50	785	$2.16	1,693	1,778	1,511	0.290	467
2031	1617	0.50	808	$2.22	1,796	1,886	1,603	0.273	465
2032	1665	0.50	833	$2.29	1,905	2,001	1,701	0.256	464
2033	1715	0.50	858	$2.36	2,021	2,122	1,804	0.241	463
2034	1767	0.50	883	$2.43	2,145	2,252	1,914	0.227	461
2035	1820	0.50	910	$2.50	2,275	2,389	2,031	0.213	460
2036	1874	0.50	937	$2.58	2,414	2,534	2,154	0.200	459
2037	1931	0.50	965	$2.65	2,561	2,689	2,285	0.188	458
2038	1988	0.50	994	$2.73	2,717	2,852	2,425	0.177	456
2039	2048	0.50	1024	$2.81	2,882	3,026	2,572	0.166	455
2040	2110	0.50	1055	$2.90	3,058	3,210	2,729	0.156	454
2041	2173	0.50	1087	$2.99	3,244	3,406	2,895	0.147	453
2042	2238	0.50	1119	$3.08	3,442	3,614	3,072	0.138	451
2043	2305	0.50	1153	$3.17	3,651	3,834	3,259	0.130	450
2044	2374	0.50	1187	$3.26	3,874	4,067	3,457	0.122	449
2045	2446	0.50	1223	$3.36	4,109	4,315	3,668	0.115	448
2046	2519	0.50	1260	$3.46	4,360	4,578	3,891	0.108	446
2047	2595	0.50	1297	$3.57	4,625	4,856	4,128	0.101	445
2048	2673	0.50	1336	$3.67	4,907	5,152	4,379	0.095	444
2049	2753	0.50	1376	$3.78	5,206	5,466	4,646	0.090	443
2050	2835	0.50	1418	$3.90	5,523	5,799	4,929	0.084	442
2051	2920	0.50	1460	$4.01	5,859	6,152	5,229	0.079	440
									16,660

Table A-7: Los Angeles Ports to Nevada Truckway[75]									
1	2	3	4	5	6	7	8	9	10
	TMT (m)	% in Tway	TMT Tway (m)	Toll rate/mi	Toll rev $m	Gross rev $m	Net rev $m	NPV discount factor	NPV $m
					RURAL				
2012	680	0.10	68	0.51	34	36	31	0.884	27
2013	700	0.17	116	0.52	61	64	54	0.831	45
2014	721	0.23	164	0.54	88	93	79	0.781	61
2015	743	0.29	212	0.55	117	123	105	0.734	77
2016	765	0.34	260	0.57	148	156	132	0.690	91
2017	788	0.39	308	0.59	181	190	161	0.649	105
2018	812	0.44	356	0.61	215	226	192	0.610	117
2019	836	0.48	404	0.62	252	264	225	0.573	129
2020	861	0.52	452	0.64	290	305	259	0.539	140
2021	887	0.56	500	0.66	331	347	295	0.507	149
2022	914	0.60	548	0.68	373	392	333	0.476	159
2023	941	0.60	565	0.70	396	416	354	0.448	158
2024	970	0.60	582	0.72	420	441	375	0.421	158
2025	999	0.60	599	0.74	446	468	398	0.395	157
2026	1029	0.60	617	0.77	473	497	422	0.372	157
2027	1059	0.60	636	0.79	502	527	448	0.349	157
2028	1091	0.60	655	0.81	532	559	475	0.328	156
2029	1124	0.60	674	0.84	565	593	504	0.309	156
2030	1158	0.60	695	0.86	599	629	535	0.290	155
2031	1192	0.60	715	0.89	636	667	567	0.273	155
2032	1228	0.60	737	0.92	674	708	602	0.256	154
2033	1265	0.60	759	0.94	715	751	639	0.241	154
2034	1303	0.60	782	0.97	759	797	677	0.227	154
2035	1342	0.60	805	1.00	805	846	719	0.213	153
2036	1382	0.60	829	1.03	854	897	762	0.200	153
2037	1424	0.60	854	1.06	906	952	809	0.188	152
2038	1466	0.60	880	1.09	962	1010	858	0.177	152
2039	1510	0.60	906	1.13	1020	1071	910	0.166	151
2040	1556	0.60	933	1.16	1082	1136	966	0.156	151
2041	1602	0.60	961	1.19	1148	1206	1025	0.147	151
2042	1651	0.60	990	1.23	1218	1279	1087	0.138	150
2043	1700	0.60	1020	1.27	1292	1357	1153	0.130	150
2044	1751	0.60	1051	1.30	1371	1439	1224	0.122	149
2045	1804	0.60	1082	1.34	1454	1527	1298	0.115	149
2046	1858	0.60	1115	1.38	1543	1620	1377	0.108	149
2047	1913	0.60	1148	1.43	1637	1719	1461	0.101	148
2048	1971	0.60	1182	1.47	1737	1823	1550	0.095	148
2049	2030	0.60	1218	1.51	1842	1934	1644	0.090	147
2050	2091	0.60	1255	1.56	1955	2052	1744	0.084	147
2051	2154	0.60	1292	1.60	2074	2177	1851	0.079	146
									5516

Next is the question of what is a reasonable estimate of the proportion of traffic that will use the truckway. Given evidence of large proportions of the traffic being medium-distance in these two corridors, we think two-thirds of the trucks might eventually use the truckway as opposed to mixing it with cars in the free lanes. Obviously the proportion will be very much lower in the early years. It will take time for businesses to find ways to take advantage of the truckway, and the truckway will take time to develop physical facilities around the nodes and to develop specialized services. In the early years conditions in the free lanes will tend to improve a little as truck traffic shifts to the truckway, limiting its growth.

Medium and longer-term toll road forecasts are often more accurate than early-year forecasts. Public policy issues are involved here. How much extra free capacity will be provided? The viability of the truckway will depend in large part on the differential speed advantage it provides as compared with the free lanes. Our assumption is that only enough free capacity will be added to maintain present conditions in the face of increasing traffic, so that a 60 mph versus 38 mph differential is roughly maintained. This seems broadly consistent with the MTC’s 30-year planning, which envisions no major capacity additions to I-880 or I-580.

Overall, we estimated that 25 percent of truck miles traveled in the early years would be on the truckway rising to two-thirds after 10 years. An average starting toll rate of $1.00/mile in 2004 dollars would capture about a third of the benefits to pay for the truckway, leaving a substantial portion for shippers and truckers. As with the L.A. truckway, the model assumes that toll rates are adjusted annually for inflation, to keep them the same in real terms over the 40-year period.

Capital cost is escalated from $9.1 billion in 2004 dollars to the midpoint year of construction, 2013, for a cost of $11.9 billion. The results are shown in Table A-8. The net present value of net revenues, in 2013 dollars, is $12.4 billion, as compared with the investment cost of $11.9 billion. Once again, this truckway appears to be at least a break-even proposition, based on its toll revenues, though it is not as robust as its southern California counterpart. It may be viable as a self-financing enterprise, though in this case credit support or partial state investment may be necessary to produce a financeable project.

Table A-8: Oakland-Valleys Truckway[76]									
1	2	3	4	5	6	7	8	9	10
	TMT (M)	% in Tway	Tway TMT (M)	Toll/mile $	Toll rev $M	Gross rev $M	Net rev $M	Discount factor	NPV $M
2015	717	0.25	179	1.38	248	261	221	0.884	196
2016	735	0.29	215	1.43	306	321	273	0.831	227
2017	753	0.33	252	1.47	370	388	330	0.781	258
2018	772	0.38	290	1.51	439	461	392	0.734	288
2019	792	0.42	331	1.56	516	541	460	0.690	318
2020	812	0.46	373	1.60	599	629	535	0.649	347
2021	832	0.50	418	1.65	690	725	616	0.610	376
2022	853	0.54	464	1.70	790	829	705	0.573	404
2023	874	0.59	512	1.75	898	943	802	0.539	432
2024	896	0.63	563	1.81	1017	1067	907	0.507	460
2025	919	0.67	616	1.86	1145	1202	1022	0.476	487
2026	942	0.67	631	1.92	1209	1269	1079	0.448	483
2027	965	0.67	647	1.97	1277	1340	1139	0.421	479
2028	990	0.67	663	2.03	1348	1415	1203	0.395	476
2029	1014	0.67	680	2.09	1423	1494	1270	0.372	472
2030	1040	0.67	697	2.16	1503	1578	1341	0.349	469
2031	1066	0.67	714	2.22	1587	1666	1416	0.328	465
2032	1093	0.67	732	2.29	1675	1759	1495	0.309	462
2033	1120	0.67	751	2.36	1769	1857	1579	0.290	458
2034	1148	0.67	769	2.43	1868	1961	1667	0.273	455
2035	1177	0.67	789	2.50	1972	2070	1760	0.256	451
2036	1207	0.67	809	2.58	2082	2186	1858	0.241	448
2037	1237	0.67	829	2.65	2198	2308	1962	0.227	445
2038	1268	0.67	850	2.73	2321	2437	2072	0.213	441
2039	1300	0.67	871	2.81	2451	2573	2187	0.200	438
2040	1333	0.67	893	2.90	2588	2717	2309	0.188	435
2041	1366	0.67	915	2.99	2732	2869	2438	0.177	431
2042	1400	0.67	938	3.07	2885	3029	2575	0.166	428
2043	1435	0.67	962	3.17	3046	3198	2718	0.156	425
2044	1471	0.67	986	3.26	3216	3377	2870	0.147	422
2045	1508	0.67	1011	3.36	3396	3565	3031	0.138	419
2046	1546	0.67	1036	3.46	3585	3764	3200	0.130	415
2047	1585	0.67	1062	3.56	3785	3975	3378	0.122	412
2048	1625	0.67	1089	3.67	3997	4197	3567	0.115	409
2049	1666	0.67	1116	3.78	4220	4431	3766	0.108	406
2050	1707	0.67	1144	3.90	4456	4679	3977	0.101	403
2051	1750	0.67	1173	4.01	4705	4940	4199	0.095	400
2052	1794	0.67	1202	4.13	4967	5216	4433	0.090	397
2053	1839	0.67	1232	4.26	5245	5507	4681	0.084	394
2054	1885	0.67	1263	4.38	5538	5815	4942	0.079	391
									12373

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Robert W. Poole, Jr., and Peter Samuel, *Corridors for Toll Truckways: Suggested Locations for Pilot Projects*, Policy Study No. 316, February 2004.

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[2] *Initiatives in Transportation Funding & Finance: Report and Recommendations to Sunne Wright McPeak* (Los Angeles: Keston Institute for Infrastructure, University of Southern California, March 17, 2004).

[3] David Schrank and Tim Lomax, *The 2004 Urban Mobility Report* (College Station, Texas: Texas Transportation Institute, September 2004).

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[5] ETR is Express Toll Route.

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[7] Information on Melbourne CityLink comes from the company Web sites and from some 12 reports by one of the authors in *Toll Roads Newsletter* 1996 to 2002.

[8] See www.lanecovetunnelproject.com.au.

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[15] Southern California Association of Governments, "User-supported Regional Truckways in Southern California," briefing paper, January 5, 2004, page 3.

[16] Cheryl Bynum email to the authors, January 22, 2004. For further details about the SmartWay program, go to http://epa.gov/smartway.

[17] Freight Analysis Framework, Federal Highway Administration, database at http://www.ops.fhwa.dot.gov/freight/freight_analysis/faf/index.htm. This is a major database and takes quite an investment of time and familiarity with database management to extract information.

[18] The others are the Atlanta Perimeter belt route I-285, the New Jersey Turnpike, and I-93 in Boston, Massachusetts. I-880 in the Bay Area—considered elsewhere in this study—is eighth.

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[21] *Ibid.*

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[25] *Ibid.*, page ES-2.

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[27] Traffic and Vehicle Data Systems, State of California Business, Transportation and Housing Agency Department of Transportation, in cooperation with the U.S. Department of Transportation Federal Highway Administration, "2002 Annual Average Daily Truck Traffic on the California State Highway System," February 2004.

[28] Southern California Association of Governments, "User-supported Regional Truckways in Southern California." page 3.

[29] Bostonians took to calling the project "the Big Pig."

[30] "Government at the Brink", report by committee headed by Senator Fred Thompson cited by J. Richard Kapka FHWA in *Public Roads*, July/August 2004, p3.

[31] Dan McNichol and Andy Ryan, *The Big Dig* (New York: Silver Lining Books, 2000), page 35.

[32] Federal Highway Administration, "Federal Task Force on the Boston Central Artery/Tunnel Project: Review of Oversight and Costs," undated, no page numbers, at www.fhwa.dot.gov/reports/tunnel.htm.

[33] The physical aspects of the project are nicely described on the official Web site www.bigdig.org.

[34] McNichol and Ryan, *The Big Dig*, p. 43.

[35] For example the July/August 2004 issue of the FHWA journal *Public Roads* is devoted to ten articles on mega-projects, many of which dwell on the Big Dig.

[36] Jim Sinnette, "Accounting for Megaproject Dollars" *Public Roads*, July/August 2004, Vol 68, No. 1, p. 41.

[37] Ibid, p. 44.

[38] Bent Flyvbjerg, Nils Bruzelius, and Werner Rothengatter, *Megaprojects and Risk* (Cambridge, UK: Cambridge University Press, 2003).

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[40] This was recognized recently by Virginia Transportation Commissioner Phil Shucet who said he was prepared to entertain perpetual ownership of toll lanes in the Virginia portion of the Capital Beltway by Fluor Corp if this eliminates the need for state financial support for the project.

[41] E-mail in reply to question from Laurenceau Fabienne, Cofiroute, September 1, 2004 at infoa86@cofiroute.fr.

[42] The state's highways are increasingly overloaded by heavy truck traffic from NAFTA-related activities. Approximately 80 percent of NAFTA truck traffic crosses the U.S./Mexico border in Texas.

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[43] Texas Transportation Code § 361.136.

[44] VDOT works closely with the Virginia Department of Rail and Public Transportation ("VDRPT") and the Northern Virginia Transportation Authority ("NVTA"). The VDRPT is responsible for administering Virginia's rail, public transportation and ridesharing as a means of transporting people and freight. (Va. Code Ann. § 33.1-391.1 et seq.) The NVTA was created in 2002 to address the transportation needs of Northern Virginia, which has approximately 26 percent of the state's population, gets 25percent of the General Assembly votes, and generates approximately 36 percent of the state's sales tax revenue. (Va. Code Ann. § 15.2-4840)

[45] Ibid. at § 56-556.

[46] Ibid. at § 56-558. Public-private partnerships have been used in Virginia to cut the cost of maintaining roads. Virginia granted a performance-based, fixed-price contract to a private party (VMS Inc.) for the maintenance of 251 miles of interstate. The project is estimated to save Virginia between $16 million and $23 million over the life of the contract.

[47] Ibid. at § 56-557.

[48] VDOT has developed PPTA Guidelines for its PPP law, known as the "Public-Private Transportation Act of 1995," which can be found at the following link: http://www.virginiadot.org/business/ppta-default.asp

[49] The CTB may annually award five design-build contracts valued at no more than $20 million, provided that no more than five of these are in force at the same time. (Va. Code Ann. § 33.1-12(2)(b))

[50] Michael C. Loulakis, ed., "Design- Build for the Public Sector," at Section 6.05[E], 2003, p. 205.

[51] Presentation by Jim Kenan, Treasurer/Director of Finance and Administration, Orange County Transportation Authority, given on Feb. 19, 2004.

[52] Loulakis, "Design Build for the Public Sector," at Section 6.05[E], p. 205.

[53] U.S. General Accounting Office, "Private Sector Sponsorship of and Investment in Major Projects Has Been Limited," GAO-04-419, March 2004, at p. 41.

[54] Ibid,, at 42.

[55] Ibid,. at 46.

[56] "See California Government Code section 5956 (also known as AB 2660), which can be found at the following link: http://www.leginfo.ca.gov/cgi-bin/displaycode?section=gov&group=05001-06 000&file=5956-5956.10

[57] Ibid.

[58] Ibid, at section 5956.4.

[59] Ibid, at section 5956.6(a).

[60] Ibid at section 5956.6(b)(4).

[61] Ibid at section 5956.6

[62] Ibid.

[63] Ibid at section 5956.10(a) and (d).

[64] Created by executive order under the authority of Government Code section 12080.1.

[65] U.S. Department of Transportation, "Revised Departmental Guidance: Valuation of Travel Time in Economic Analysis," available online at http://ostpxweb.dot.gov.

[66] Benjamin Perez and Gian-Claudia Sciara, *A Guide for HOT Lane Development* (Washington, D.C.: Federal Highway Administration, Publication No. FHWA-OP-03-009, 2003).

[67] Robert W. Poole, Jr. and C. Kenneth Orski, *HOT Networks: A New Plan for Congestion Relief and Better Transit,* Policy Study No. 305 (Los Angeles: Reason Foundation, February 2003).

[68] Kaku Associates, Inc., et. al, "SR-60 Truck Lane Feasibility Study Final Report" Kaku Associates, Inc., et.al., November 2000.

[69] Southern California Association of Governments, “User-supported Regional Truckways in Southern California,” p. 6.

[70] Metropolitan Transportation Authority, “Southern California Freight Management Case Study,” (Los Angeles: LACMTA, January 2002) p. 6.

[71] Ibid, p. 8.

[72] "Toll Truckways: A New Path Toward Safer and More Efficient Freight Transportation," by Peter Samuel, Robert W. Poole, Jr., and Jose Holguin-Veras, June 6 2002 suggested net benefits at 14 miles and substantial benefits over 20 miles.

[73] The FAF calculates the four-lane sections of I-15 as having VCRs ranging between 1.00 and 1.35 in 2020 with speeds degraded below free flow ranging between 8 mph and 23 mph.

[74] Produced by the Federal Highway Administration, the Freight Analysis Framework (FAF) “integrates data from a variety of sources to estimate commodity flows and related freight transportation activity among states, regions, and major international gateways.” See: http://www.ops.fhwa.dot.gov/freight/freight_analysis/faf/index.htm.

[75] Col 2: TMT is truck miles traveled in the corridor (million yearly)

Col 3: Truckway starts with 10% of corridor AADT growing to 60% after ten years and staying at that proportion thereafter.

Col 4: truck miles traveled in the truckway (million yearly)

Col 5: 40c/mile toll rate chosen for 2004 is escalated by 3% inflation rate to 2012 and beyond.

Col 7: toll revenue plus 5 percent for estimate of net income from concessions.

Col 8: Net revenue is gross revenues less 15 percent for covering operations and maintenance

Col 10: Net present value of net revenue is obtained by applying a discount index of 0.94^n to each year from 2010.

Ratio of net present value (NPV) of net revenue NPV to capital cost = 2.31

Capital cost escalated to 2010, the mid year of construction 2388

[76] Col 2: Truck Miles Traveled is escalated at th 2.51% rate implicit in the Freight Analysis Framework projections

Col 5: Toll rate of $1.00/mile in 2004$s was escalated by assumed inflation rate of 3%/year to $1.38 in 2015 continuing to track inflation through the project

Col 7: Gross revenue includes 5 percent of toll revenues to include possible net concessions income

Col 8: Net revenue allows 15% of gross revenue for operating costs and maintenance.

Col 10: Net present value (NPV) of net revenue discounted at 6 percent per year to 2012.

Capital cost 11915.2

Ratio NPV net profit to capital cost= 1.03844