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TASK A-1: Motivations Behind Electronic Road Pricing. What is the Driving Force Behind the Worldwide Rise in Tolling? A Review of Innovative Road Pricing from Across the Globe

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TASK A-1: Motivations Behind Electronic Road Pricing

What is the Driving Force Behind the Worldwide Rise in Tolling?

A Review of Innovative Road Pricing from Across the Globe

California PATH Project—Task Order 6330

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ABSTRACT

The report identifies the motivations behind and objectives of specific road pricing initiatives, and to explore why such policies are becoming an increasingly popular approach to transportation finance and management. Over the past 15 years, electronic road pricing projects have appeared in a variety of forms across the globe – from the Interstate 15 High-occupancy toll (HOT) Lanes in San Diego County, to the congestion cordon pricing scheme in central London, to the German weight-distance truck toll system, to the Oregon mileage-based user fees pilot program. While the stated objectives of these projects are typically straightforward, the underlying motivations behind the turn to electronic road pricing are nuanced and varied. Accordingly, this report explores the forces behind this gathering shift in transportation policy toward electronic pricing through a series of case studies from around the globe. The information was gathered primarily through a detailed review of primary, secondary, and, when available, tertiary source documents.

In each of the case studies examined for this report, we find that the status quo – that is the old system of transportation planning and finance – is in crisis. Whether the problem is insufficient revenue or choking congestion, transportation planners and policymakers around the world are struggling to keep pace with the rise in motor vehicle traffic, and the problems that such growth engenders. As with many other policy areas, technology is facilitating the development of innovative approaches to facilitating the transition from theory to reality. With respect to transportation planning and finance, we conclude that we are at a unique juncture, as the full range of possibilities for the potential of road pricing is only now being fully realized.

Keywords: road pricing, HOT Lanes, congestion pricing, electronic pricing

EXECUTIVE SUMMARY

INTRODUCTION

Over the past 15 years, electronic road pricing projects have appeared in a variety of forms across the globe – from the Interstate 15 High-occupancy toll (HOT) Lanes in San Diego County, to the congestion cordon pricing scheme in central London, to the German weight-distance truck toll system, to the Oregon mileage-based user fees pilot program. While the stated objectives of these projects are typically straightforward, the underlying motivations behind the turn to electronic road pricing are nuanced and complex. Accordingly, this report explores the forces behind this gathering shift in transportation policy toward electronic pricing through a series of case studies from around the globe. These case studies are then followed by a synthesis of common motivational themes behind the implementation of electronic road pricing in a wide variety of settings.

FACILITY CONGESTION TOLLS

- **Toronto's 407 ETR Congestion Toll:** Faced with increasing traffic congestion, Ontario transportation officials partnered with private investors to construct a northern east-west route, the 407. In order to assure a return on investments, electronic tolling was introduced on the new roadway, making the 407 the first fully electronic toll road in the world.
- **Orange County's SR-91 Express Lanes:** Grappling with growing congestion between Riverside and Orange Counties, the Orange County Transportation Authority partnered with the private investor California Private Transportation Company to fund the construction of toll lanes along the SR-91 median. Drivers in these lanes are charged a variable fee reflecting anticipated levels of congestion.
- **San Diego's I-15 HOT Lanes**: In order to maximize the use of existing facilities and to fund new public transit services, the San Diego County Association of Governments converted High-occupancy vehicle (HOV) lanes to High-occupancy toll (HOT) lanes. These lanes utilized the world's first fully dynamic variable congestion toll for single-occupant vehicles.
- **Houston's I-10 QuickRide**: While Houston had an extensive network of HOV lanes, mounting traffic congestion necessitated a better use of these sometimes underutilized facilities. Although allowing two-occupant vehicles for free resulted in too much congestion in the lanes, permitting two-occupant vehicles to pay a fee optimized the utilization of the lanes.
- **Minnesota's I-394 MnPASS Program:** Partially inspired by the success of San Diego's HOT lanes, Minnesota transportation officials viewed HOT lanes as a critical component of the state's long-range congestion relief plan. A broad coalition of political supporters played a critical role in the ultimate implementation of the growing HOT network.

- **Santiago, Chile:** Due to rapid economic growth, traffic began overwhelming Santiago's road network. In order to fund a quick expansion in road capacity, Santiago turned to private sector investors, who introduced variable tolls on privately financed road facilities.

CORDON TOLLS

- **Singapore's Road Pricing**: Due to Singapore's unique political structure, its transportation leaders were able to implement manual cordon tolls years prior to technological developments that made the concept operationally (and politically) feasible elsewhere. Singapore adopted the tolls to efficiently manage the business district roadways and establish its position as a prominent business center, upgrading to an electronic system in recent years.
- **Stockholm Congestion Fee:** Propelled mainly by a concern about degrading environmental conditions, Stockholm officials introduced a congestion fee for travel within the central city. The improvement of the city's public transit system served as an essential component in the acceptance of the plan.
- **London's Congestion Pricing:** In order to solidify its standing as a worldwide financial center and to generate funding a badly deteriorated underground subway system, London's regional mayor championed the implementation of congestion pricing to both reduce chronic traffic delays and to generate needed revenues. Without Mayor Livingstone's political tenacity, it is unlikely that the dramatic pricing program would have been implemented.
- **New York City Congestion Pricing Proposal:** Following the success of cordon congestion pricing in London, New York City's Mayor Michael Bloomberg developed a similar proposal for New York. Although the proposal was originally pitched as a component of the city's environmental sustainability plan, congestion pricing ended up being viewed as more important to the city's economic sustainability by many supporters. However, the proposal failed to attain the necessary state legislative approval and died ceremoniously in April 2008.

WEIGHT-DISTANCE TRUCK TOLLS

- **Austrian GO Truck Tolls**: The significant expense of road maintenance coupled with an increasing portion of foreign freight movement through their country motivated Austrian transportation officials to implement a system of truck tolls. This tolling scheme generated substantial revenues thereby allowing private investors to play a role in infrastructure development and maintenance in Austria.
- **Switzerland's Heavy Vehicle Fee (HVF)**: The motivations behind Switzerland's HVF mirror many of Austria's concerns with through traffic. However, Swiss transportation

officials and residents have typically cited environmental concerns more often than fiscal concerns in supporting the implementation of the HVF.

- **German Toll Collect:** Like Austria and Switzerland, Germany experienced increasing levels of freight travel as the European Union opened up new trade routes. In order to off-set the costs these new users imposed on the road networks, Germany introduced the Toll Collect program, which is the first large-scale operation road pricing project to utilize satellite-based electronic fee collection technology.

MILEAGE BASED USER FEES

- **Oregon's Mileage Fee Concept**: The trial for Oregon's Mileage Fee was primarily motivated by the declining power and unsustainability of the current fuel-tax system. As nearly all other states are faced with similar funding crises, the trial has received substantial interest from transportation officials across the country.

ELECTRONIC ROADWAY TOLLING: LESSONS FROM AROUND THE WORLD

- **Technology**: Making Theory Reality: The rapid technological developments over the past twenty years have greatly eased the obstacles to implementing road pricing and, along with it, some of the popular and political wariness of pricing.
- **The Push of Revenue Crises**: Chronic revenue shortfalls are increasingly a strong motivating factor, particularly in places where there exists demand for new capacity and inadequate resources to finance them. This motivation has most often been cited as being behind the implementation of pricing projects in the United States, but increasingly jurisdictions around the world find themselves strapped for cash and in search of ways to accomplish more with less revenue from traditional sources.
- **Managing Congestion and the Need for New Capacity**: Even if the current transportation funding systems were sustainable, traffic congestion is rapidly increasing in cities around the world and road capacity is not keeping pace with rising travel in many places. Cost-effective alternatives to constructing new capacity are increasingly attractive; one way is through using road pricing to increase the "effective capacity" of metropolitan road networks with HOT lanes, cordon tolls, and the like.
- **Congestion Threatens Economic Development**: In our increasingly global economy, the leaders of metropolitan areas around the world are vying for economic advantage while coping with the travel demands of increasing trade. Reliable transportation systems are important to economic productivity, and the role of transportation systems in economic development planning remains central. Although opponents of congestion pricing often raise fears of economic losses to business districts as a major concern, such arguments typically ignore the cost congestion delays impose on businesses.

- **Climate Change: Reducing Emissions**: In addition to spurring economic development, many road pricing schemes were implemented with the explicit goal of mitigating environmental impacts by smoothing traffic flows thereby lowering emissions.
- **Charging Drivers for the Costs They Impose**: In that road pricing causes people to be more aware of the costs their travel choices impose on society, drivers make better informed and more societally optimal decisions about when, where, and even whether to drive.
- **Private Investments**: Private investments are playing an increasingly important role in transportation projects around the globe, and the ability to electronically toll roadways has played a critical role in attracting these investments with reliable revenue streams.
- **Federal Incentives & Legislative Changes**: Many of the electronic road pricing pilot projects are the result of incentives developed by a higher governing body. The European Commission supports member states in developing urban road pricing schemes that aim to internalize the external costs of private vehicle travel, and the federal government in the U.S. has in recent years provided both funding and other incentives for road pricing pilot projects. In addition, federal and state enabling legislation is often required before cities, counties, regions, or states can pursue road pricing projects.
- **Political Champions: Selling Projects to the Public**: While ideas about non-linear effects, internalizing externalities, and allocating scare public resources with prices may be well-understood by many transportation planners and economists, persuasive rhetoric from a trusted leader is often required to sell economic theory to wary policy makers and a skeptical public.
- **Coalition of Supporters**: Just as a broad array of motives contribute to the implementation of road pricing, so does a wide range of supportive interest. While this wide array of supporters often aid in the implementation of road pricing, the varied motivations of sometimes strange bedfellows can result in conflicts over implementation.
- **Political Traction: Success Cases from Around the World:** Politicians hoping to introduce road pricing to their jurisdictions today have the luxury of being able to refer to a growing number of successful initiatives around the world. Momentum continues to build as more and more jurisdictions successfully implement road pricing initiatives, helping to dissipate public opposition.

CONCLUSION

In each of the case studies examined for this report, the status quo – that is the old system of transportation planning and finance – is in crisis. Whether the problem is insufficient revenue or choking congestion, transportation planners and policymakers around the world are struggling to keep pace with the rise in motor vehicle traffic, and the problems that such growth engenders. As with many other policy areas, technology is facilitating the development of innovative

approaches to facilitating the transition from theory to reality. With respect to transportation planning and finance, we are at a unique juncture as the full range of possibilities for the potential of road pricing are only now being fully realized.

INTRODUCTION

Although the concept of road pricing has existed in theory for decades, it is only in recent years that this theory has been transformed into reality. First conceived of by the economist A.C. Pigou in 1920 and later expanded upon by William Vickrey in the 1960s and 1970s, the road pricing model efficiently distributes the cost of utilizing the road network among users. However, practical accounting and technological limitations in the first half of the 20th century favored funding roads through the fuel tax rather than road pricing, thus resulting in the current fuel-tax based transportation funding model (Wachs, 2003). This model, however, is breaking down as a fundamental shift in road financing is occurring around the world. Over the past fifteen years, electronic road pricing projects have appeared in a variety of forms – from the San Diego HOT lane to central London congestion cordon pricing, and the German weight-distance truck tolls to the Oregon mileage-based user fees. The forces behind this dramatic shift in transportation policy are the focus of this report.

The stated primary objectives of these projects are typically straight forward: a majority are designed to either raise revenue and/or manage traffic congestion. However, our review of recent tolling projects from around the country and the globe revealed several trends about the underlying motivations behind electronic road pricing. In particular, several factors combined to create a political environment ripe for the exploration of new approaches to road finance and operation. Impending fiscal crises, increased strain on existing roadway capacity, technological advances, environmental concerns, interest in public-private partnerships, greater public support electronic tolling, and aggressive political champions have all played a significant role in the recent rise of new road pricing schemes. Although many transportation economists have been pushing the concepts of road pricing for decades, implementation lagged due to an absence of a conducive political environment and appropriate technologies. Today, however, Pigou's road pricing schemes are becoming a reality.

Methodology and Logistics

This report explores the underlying motivations behind the implementation of many of the world's most innovative road pricing projects. In doing so, we first identified a set of case studies that we felt represented both a broad range of models of road pricing as well as geographic diversity. The dates of implementation range from the 1970s in Singapore to the present with New York's congestion pricing proposal, which is still in the planning stage. We then researched the history and background of each project to identify the reasons conceived and problems addressed by each initiative. A wide range of sources were utilized in this process, including academic journals, government publications, and media sources. For each case study, we identified a set of primary and secondary motivations that explain the introduction of the project.

We then synthesized the information gathered from the case studies to identify some common trends that cut across the projects. The major themes that resulted from the preliminary overview of the cases include technological advancements, political champions, revenue crises, and demand for new capacity. We followed the case studies with a discussion of implications and more broadly generalized conclusions for future road pricing initiatives. While there are limitations on general conclusions that can be drawn from any case studies, this report with a variety of road pricing cases certainly provides a better understanding of the motivations behind road pricing on a global scale.

Overview of Road Pricing Schemes

Electronic road pricing can take many forms. Most projects, however, fit into four distinct categories: (1) facility congestion tolls, (2) cordon tolls, (3) weight-distance truck tolls, and (4) mileage-based user fees (Sorensen, 2006). While the motivations to pursue electronic roadway pricing are in many ways unique to each of the cases examined for this research, we find that these motivations do tend to vary systematically by each of these four categories, as we will see below.

Perhaps the most familiar road pricing scheme within the United States is the facility congestion toll. This type of road pricing charges drivers tolls varying by the level of congestion for the use of a particular facility that ranges from a single lane to a bridge to an entire roadway. By varying tolls that affect the demand of travel, drivers are assured a constant flow of traffic on these facilities. A higher toll is charged during peak hours to lower the number of cars from an excess level to a moderate level, so that the throughput of the roadway increases; the total number of trips accommodated by this facility increases. In other words, the efficiency in the use of the facility improves. High-occupancy toll (HOT) lanes, which allows single-occupancy vehicles to pay a variable fee to utilize a former high-occupancy vehicle (HOV) lane while

HOVs are still able to use the designated lanes for free or a reduced fee, is one of the most prevalent form of facility congestion tolls. Cases of facility congestion tolls that will be discussed in this report include the San Diego's I-15 HOT lanes, Orange County's SR-91 express lanes, Houston's QuickRide, Toronto's 407 ETR congestion toll, Santiago's toll roads, and Minnesota's I-394 MnPASS program. Although facility congestion tolls could, in theory, provide an additional stream of revenue for transportation agencies, the congestion toll facilities that are already in place rarely produce revenue significant enough to serve as the sole justification for the project.

While facility congestion tolls might be the most common form of electronic road pricing, cordon tolls are perhaps the most controversial, sparking debates in some of the world's largest cities. Cordon tolls impose a fee on users for entering or traveling within a designated geographic area during specified hours. The cordoned area generally corresponds to a city's central business district. This tolling model aims to reduce traffic within the urban core, thereby reducing traffic congestion and associated pollution. Most cordon tolling models encourage travelers to shift trips to transit and utilize the toll revenue to enhance the city's transit system and increase its efficiency. Singapore, London, and Stockholm have all successfully implemented cordon tolls, while New York City is currently embroiled in a heated debate over a proposed cordon pricing plan.

Increasingly popular in Europe, weight-distance truck toll projects impose a fee on commercial freight haulers within a specific geographic area. The charge varies by vehicle weight and distance traveled. By assessing a fee on these commercial trucks, the jurisdictions are able to recover some of the costs imposed by the operation of these heavy vehicles and encourage different modes of freight transport, such as rail or shipping. The concept is particularly popular in Europe because European Union trade routes frequently result in freight being driven across multiple countries. Since many countries ended up serving as conduits for these heavy vehicles, the natural response was to develop a system of fees that would shift the costs onto the freight movers. Examples of weight-distance truck tolling include Austrian GO truck tolls, German Toll Collect, and Swiss HVF truck toll.

Finally, mileage-based user fees constitute perhaps the most comprehensive form of road pricing. Primarily driven by a desire to raise sufficient revenue and replace the fuel tax, this model of road pricing charges users based on distance traveled. It might also be possible to vary the fees according to congestion levels or vehicle emissions. Although this plan is not fully implemented yet, several jurisdictions have explored the feasibility of introducing such a scheme, including the state of Oregon.

In the following sections, the history, politics, and implementation of each of these projects will be discussed in detail, and the underlying motivations behind each case will be teased out. We will then discuss the lessons drawn from these examples and any general patterns exhibited in regards to motivations behind the implementation. One lesson that is clear from the beginning is that every case has a unique set of circumstances and motivations.

FACILITY CONGESTION TOLLS

Toronto's 407 ETR Congestion Toll: Private Investments Lead to Much-Needed Capacity

Faced with increasing traffic congestion, Ontario transportation officials partnered with private investors to construct a northern east-west route, the 407. In order to assure a return on investments, electronic tolling was introduced on the new roadway, making the 407 the first fully electronic toll road in the world.

The construction of Toronto's H-407, among the world's first fully electronic toll roads, highlights the role that public-private partnerships can play in funding much needed additional capacity and the importance of utilizing new tolling technology to ease the toll collection process. For years, metropolitan Toronto was serviced by a single east-west highway, H-401, which cuts through downtown Toronto. As population and travel demand grew, H-401 was expanded to 12 lanes, but any further capacity expansion along this route was unfeasible. The northern portion of the metropolitan area was developing rapidly, and resulted in a discussion of a construction of H-407, a northern east-west route first proposed in the 1960s. The province began establishing a right-of-way for this new road, and completed the process in 1992 (Commission for Integrated Transport, 2006).

Ontario lacked sufficient funds to construct the new roadway even though demand continued to grow rapidly. In 1993, provincial transportation leaders decided to fund construction through tolling and established a special-purpose "crown" corporation owned by the province, the Ontario Transportation Capital Corporation. Through this corporation, bonds were sold to design and construct the 407. The private company Raytheon constructed and operated the road from its opening in October 1997 through 1999. Instead of collecting the tolls through conventional toll booths, the 407-ETR became the first major toll road in the world to be entirely cash-free. In its system, most users use transponders to pay tolls, while those

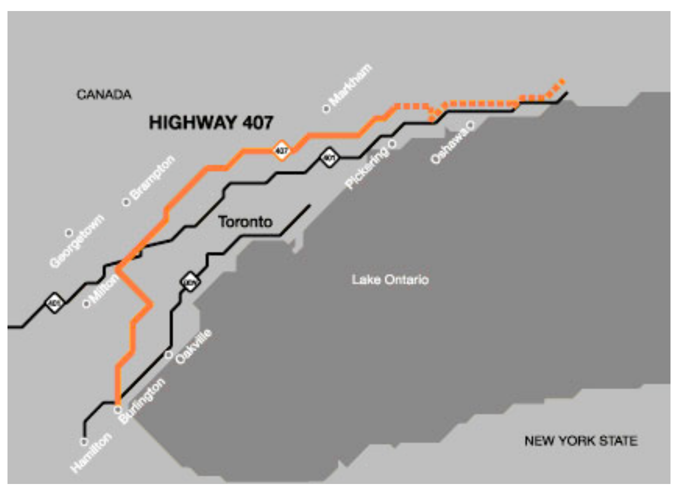

Figure 1: Location of the 407 (Commission for Integrated Transport, 2006)

without transponders pay via video system, which records the license plate numbers and then sends a bill by mail (Poole R. , 2007) (Table 1).

With the toll revenue, the province quickly paid off its debt within two years and then leased the road to a private investor for 99-years for CA$3.1 billion (US$3.15 billion), far exceeding the original CA$1.6 billion (US$1.63 billion) investment (Commission for Integrated Transport, 2006). The investor agreed to add capacity and improve interchanges during the leased period. The 407-ETR is now 67 miles with 43 interchanges (Poole, Samuel, & Chase, 2005). The lease agreement also requires the company to maintain free-flowing traffic conditions through a combination of appropriate tolls and construction of sufficient capacity to meet demand. The tolls along the 407-ETR average 35 cents per mile, and the average trip is 12.7 miles (Poole, 2007).

Figure 2: 407-ETR (Commission for Integrated Transport, 2006)

Without tolling, the 407-ETR may never have been built. In order to attract private investors to fund the original construction and operation, the province needed to be able to guarantee a return for the private investment. By charging drivers a fee for utilzing the facility, private companies are able to both cover their investment as well as maintenance costs, and still make a profit. Furthermore, the new electronic collecting technology resulted in even larger returns on their investments since operating costs were signifantly lower. The story of the 407-ETR highlights the critical role electronic tolling plays in creating valuable public-private partnerships to fund infrastructure projects.

Key motivations:

- Primary
  - Increasing congestion
  - Demand for new capacity & infrastructure construction
- Secondary
  - Public-private partnership
  - Revenue shortfall

Table 1: Toronto 407-ETR 2008 Toll Rate

	Light Vehicle		**Heavy Single Unit Vehicle**		**Heavy Multiple Unit Vehicle**	
	Transponder Recorded	Video Recorded	Transponder Recorded	Video Recorded	Transponder Recorded	Video Recorded
Regular Zone Peak Rate Weekdays 6am-10am, 3pm-7pm	19.25¢/km	19.25¢/km	38.50¢/km	38.50¢/km	57.75¢/km	57.75¢/km
Light Zone Peak Rate Weekdays 6am-10am, 3pm-7pm	19.00¢/km	19.00¢/km	38.00¢/km	38.00¢/km	57.00¢/km	57.00¢/km
Off-Peak Rate Weekdays 10am-3pm, 7pm-6am, Weekends & Holidays	18.00¢/km	18.00¢/km	36.00¢/km	36.00¢/km	54.00¢/km	54.00¢/km
Monthly Transponder Lease	$2.55	$0.00	$2.55*	$0.00	$2.55*	$0.00
Annual Transponder Lease	$21.50	$0.00	$21.50**	$0.00	$21.50**	$0.00
Monthly Account Fee	$0.00	$2.55	$0.00	$2.55	$0.00	$2.55
Video Toll Charge	0.00	$3.60 per Trip	$0.00	$50.00 per Trip (temporarily discounted to $15.00)	$0.00	$50.00 per Trip (temporarily discounted to $15.00)

Source: 407 ETR (http://www.407etr.com/about/custserv_fees.asp)

Orange County's SR-91 Express Lanes: Potential Pitfalls of Private Investment

> **Grappling with growing congestion between Riverside and Orange County, the Orange County Transportation Authority partnered with the private investor California Private Transportation Company to fund the construction of toll lanes along the SR-91 median. Drivers in these lanes are charged a variable fee reflecting current levels of congestion.**

The SR-91 Express Lanes in California's Orange County provide an example of a successful HOV-HOT conversion. Like Toronto's 407-ETR, a new public private partnership played an essential role in the development of the project (Boarnet & Dimento, 2004). The possibility of a public-private partnership originated with 1989 California state legislation, Assembly Bill 680. Originally motivated by the then recent failure of a statewide bond issue for highway improvement, AB680 permitted up to four private highway demonstration projects across California to explore the possible role that the private sector could play in infrastructure development. Private developers were encouraged to experiment with creative approaches to the state's transportation dilemmas (Evans, Gougherty, Morris, & Smirti, 2006).

Simultaneously, Orange County Transportation Authority (OCTA) proposed the construction of HOV lanes in the median of SR-91, a heavily congested corridor between Riverside County and Orange County. SR-91 cuts through the Santa Ana Mountains, one of the few passes between housing-rich Riverside and job-rich Orange Counties, which results in waxing traffic levels as both counties rapidly grew (Boarnet & Dimento, 2004).

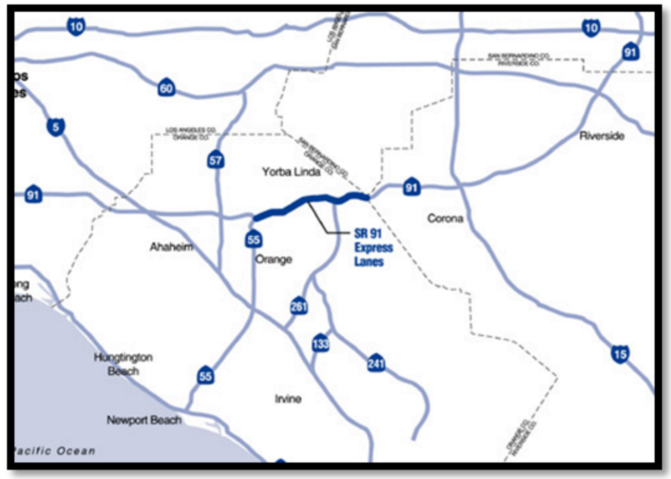

Figure 3: Location of SR-91 Express Lanes (Federal Highway Administration, 2003)

However, OCTA lacked sufficient funds, making the possibility of private-sector investments very appealing. Inspired partially by a policy study by Robert Poole, Director of Transportation for the Reason Foundation, Caltrans encouraged OCTA to seek out a private investor to fund HOT lanes rather than HOV lanes. Caltrans viewed the project as an opportunity to increase throughput along this route as well as to provide much needed funding. Additionally, by incorporating a private firm, some of the risks associated with the project were transferred from the taxpayer to the private investor. Following the advice of Caltrans, OCTA partnered with the California Private Transportation Company (CPTC) to develop ten miles of private toll lanes for the SR-91 median (Boarnet & Dimento, 2004; Poole R., 2005).

Figure 4: SR-91 Express Lanes (DeCorla-Souza, Jacobs, Ballard, & Smith, 2003)

The four SR-91 Express Lanes opened in 1995 along the SR-91 median with variable tolls that reflect congestion levels and maintain steady traffic flow, making it the first congestion pricing project in the United States. For those who choose to pay into the lanes, the tolls are collected entirely electronically (Boarnet & Dimento, 2004; Poole R., 2005).

While cash-strapped OCTA originally supported the project primarily as an experiment to add new capacity—tolling was seen as the only way to pay for the project—OCTA officials now appreciate and value the congestion management benefits of variable priced tolling (Evans, Gougherty, Morris, & Smirti, 2006).

CPTC ran the SR-91 Express Lanes for several years, until a clash with Caltrans over a capacity addition to the adjacent free lanes led to the sale of the facility back to OCTA. The original agreement between CPTC and Caltrans contained a "non-compete" clause that prevented public agencies from increasing highway capacity within a one-and-a-half mile corridor on either side of the toll lanes. However, in the late 1990s Caltrans developed a plan to construct additional merging lanes to a separate toll lane, the Eastern Transportation Corridor, with the goal of improving the safety of the roadway. CPTC contested the plans claiming it infringed on the non-compete clause. In order to facilitate Caltrans' plan, OCTA purchased the express lanes from CPTC in 2003 and now operates the facility. Unfortunately, the controversy left a negative impression of the role of the private sector in infrastructure development and management for many in Southern California (Boarnet & Dimento, 2004).

Despite this controversy, SR-91 illustrates that space does exist for private involvement in the construction of new facilities, with some clear lessons on how best to improve the process. Like Toronto's 407-ETR, it is unlikely the SR-91 Express Lanes would have been constructed without the involvement of the private sector and the incentive tolling provided the private sector to invest in infrastructure.

Key motivations:

- Primary
    - Rapidly increasing congestion
    - Demand for new capacity
    - Public-private partnership
- Secondary
    - Funding shortfall
    - Legislation

91 Express Lanes

91 Express Lanes — Toll Schedule — Effective October 1, 2008 — **Eastbound** — SR-55 to Riverside Co. Line

	Sun	M	Tu	W	Th	F	Sat
Midnight	$1.25	$1.25	$1.25	$1.25	$1.25	$1.25	$1.25
1:00 am	$1.25	$1.25	$1.25	$1.25	$1.25	$1.25	$1.25
2:00 am	$1.25	$1.25	$1.25	$1.25	$1.25	$1.25	$1.25
3:00 am	$1.25	$1.25	$1.25	$1.25	$1.25	$1.25	$1.25
4:00 am	$1.25	$1.25	$1.25	$1.25	$1.25	$1.25	$1.25
5:00 am	$1.25	$1.25	$1.25	$1.25	$1.25	$1.25	$1.25
6:00 am	$1.25	$1.95	$1.95	$1.95	$1.95	$1.95	$1.25
7:00 am	$1.25	$1.95	$1.95	$1.95	$1.95	$1.95	$1.25
8:00 am	$1.60	$1.95	$1.95	$1.95	$1.95	$1.95	$1.95
9:00 am	$1.60	$1.95	$1.95	$1.95	$1.95	$1.95	$1.95
10:00 am	$2.60	$1.95	$1.95	$1.95	$1.95	$1.95	$2.40
11:00 am	$2.40	$1.95	$1.95	$1.95	$1.95	$1.95	$2.40
Noon	$2.90	$1.95	$1.95	$1.95	$1.95	$3.00	$2.90
1:00 pm	$2.90	$2.75	$2.75	$2.75	$3.00	$4.65	$2.90
2:00 pm	$2.90	$3.90	$3.90	$3.90	$4.00	$4.60	$2.90
3:00 pm	$2.40	$4.20	$4.20	$5.45	$5.70	$9.50	$2.90
4:00 pm	$2.40	$6.55	$8.25	$8.75	$9.55	$9.30	$2.90
5:00 pm	$2.40	$6.35	$8.25	$8.25	$9.05	$7.75	$2.90
6:00 pm	$2.40	$4.20	$5.10	$4.60	$5.40	$5.05	$2.40
7:00 pm	$2.40	$3.00	$3.00	$3.00	$4.30	$4.70	$1.95
8:00 pm	$2.40	$1.95	$1.95	$1.95	$2.75	$4.30	$1.95
9:00 pm	$1.95	$1.95	$1.95	$1.95	$1.95	$2.75	$1.95
10:00 pm	$1.25	$1.25	$1.25	$1.25	$1.25	$1.95	$1.25
11:00 pm	$1.25	$1.25	$1.25	$1.25	$1.25	$1.25	$1.25

91 Express Lanes — Toll Schedule — Effective October 1, 2008 — **Westbound** — Riverside Co. Line to SR-55

	Sun	M	Tu	W	Th	F	Sat
Midnight	$1.25	$1.25	$1.25	$1.25	$1.25	$1.25	$1.25
1:00 am	$1.25	$1.25	$1.25	$1.25	$1.25	$1.25	$1.25
2:00 am	$1.25	$1.25	$1.25	$1.25	$1.25	$1.25	$1.25
3:00 am	$1.25	$1.25	$1.25	$1.25	$1.25	$1.25	$1.25
4:00 am	$1.25	$2.30	$2.30	$2.30	$2.30	$2.30	$1.25
5:00 am	$1.25	$3.80	$3.80	$3.80	$3.80	$3.65	$1.25
6:00 am	$1.25	$3.90	$3.90	$3.90	$3.90	$3.80	$1.25
7:00 am	$1.25	$4.35	$4.35	$4.35	$4.35	$4.20	$1.70
8:00 am	$1.70	$3.90	$3.90	$3.90	$3.90	$3.80	$1.95
9:00 am	$1.70	$3.15	$3.15	$3.15	$3.15	$3.15	$2.40
10:00 am	$2.40	$1.95	$1.95	$1.95	$1.95	$1.95	$2.40
11:00 am	$2.40	$1.95	$1.95	$1.95	$1.95	$1.95	$2.80
Noon	$2.40	$1.95	$1.95	$1.95	$1.95	$1.95	$2.80
1:00 pm	$2.80	$1.95	$1.95	$1.95	$1.95	$1.95	$2.80
2:00 pm	$2.80	$1.95	$1.95	$1.95	$1.95	$1.95	$2.80
3:00 pm	$2.80	$1.95	$1.95	$1.95	$1.95	$2.40	$2.80
4:00 pm	$2.95	$1.95	$1.95	$1.95	$1.95	$2.40	$2.95
5:00 pm	$2.95	$1.95	$1.95	$1.95	$1.95	$2.40	$2.95
6:00 pm	$2.95	$1.95	$1.95	$1.95	$1.95	$2.90	$2.40
7:00 pm	$2.40	$1.25	$1.25	$1.25	$1.25	$1.95	$1.95
8:00 pm	$2.40	$1.25	$1.25	$1.25	$1.25	$1.25	$1.25
9:00 pm	$2.40	$1.25	$1.25	$1.25	$1.25	$1.25	$1.25
10:00 pm	$1.25	$1.25	$1.25	$1.25	$1.25	$1.25	$1.25
11:00 pm	$1.25	$1.25	$1.25	$1.25	$1.25	$1.25	$1.25

Figure 5: Tolling Schedule for SR-91 Express Lanes - Effective October 1, 2008 (http://www.91expresslanes.com/tollschedules.asp)

San Diego's I-15 HOT Lanes: Optimization of Existing Facilities

In order to maximize the use of existing facilities and to fund new public transit service, SANDAG converted I-15 HOV lanes to HOT lanes. These lanes utilized the world's first fully dynamic variable congestion toll for single-occupant vehicles.

In 1988, San Diego opened two reversible high-occupancy vehicle (HOV) lanes along the I-15 median. The HOV lanes originated at the SR-163 junction and continued for eight miles to the SR-56 junction. By the early 1990s, the general consensus in San Diego was that these existing HOV lanes were being underutilized. Studies estimated that perhaps only a third of the lanes' capacity was utilized. Meanwhile, traffic congestion escalated along this route as Southern California development continued (Sorensen, 2006). Additionally, this route lacked sufficient public transit alternatives. The San Diego Association of Governments (SANDAG) developed a network of light-rail lines around the region in the 1980s and early 1990s, but the I-15 corridor was excluded from rail plans due to a lack of funding (Evans, Gougherty, Morris, & Smirti, 2006).

In an attempt to address both the growing congestion and the dearth of public transit in the corridor, SANDAG recommended converting the I-15 HOV lanes to high-occupancy toll (HOT) lanes. The I-15 HOT lanes would allow high-occupancy vehicles to continue utilizing the lanes for free while charging single-occupancy vehicles a fee, which would vary depending on congestion levels. The revenues raised through the tolls would be dedicated to fund transit improvements along I-15 route.

Figure 5: Location of 1-15 HOT Lanes (Federal Highway Administration, 2003)

Jan Goldsmith, the former Mayor of the City of Poway and newly elected State Assembly member, adopted the issue as one of his pet causes, proposing the I-15 HOT plan to state and federal agencies. Goldsmith envisioned an area eventually serviced by a monorail or high-capacity transit system, which planners had determined to be unfeasible for the foreseeable future. As a way of funding his vision, Goldsmith became a vocal supporter of the conversion of HOV lanes to HOT lanes and played an instrumental role in the 1994 passage of Assembly Bill 713, which allows single-occupancy vehicles to buy into an HOV facility as long as adequate traffic flow is maintained. The legislation also limits the use of revenue to transit capital and operations (Evans, Gougherty, Morris, & Smirti, 2006; Schreffler, 2003). While Goldsmith was motivated by the revenue raising potential of the HOT lanes, Kim Kawada, a senior SANDAG planner, viewed HOT lanes as a capacity management toll and pushed the project forward as such. These differing interests illustrate that even leaders on the same project can have distinctive objectives and motivations (Evans, Gougherty, Morris, & Smirti, 2006).

In the course of pushing for the I-15 HOT lanes, Goldsmith wrote op-ed pieces and frequented local talk radio shows. He also made a considerable effort to meet individually with the various stakeholders to build support among elected officials. Perhaps most importantly, Goldsmith reached out to the public and sold the project as a mechanism to capture revenue on an existing underutilized facility. SANDAG was also instrumental in communicating with the general public and media through a well-planned marketing campaign including I-15 Express Lane newsletters and town hall style meetings (Evans, Gougherty, Morris, & Smirti, 2006).

Figure 5: I-15 HOT Lanes (DeCorla-Souza, Jacobs, Ballard, & Smith, 2003)

Additionally, officials were motivated to introduce the I-15 HOT lanes in part because HOT lanes were viewed as an innovative concept at the time. The novelty of the project helped garner support from the state and federal levels in the form of funding through the Federal Highway Administration's Congestion Pricing Pilot Program, a part of the Intermodal Surface Transportation Efficiency Act (ISTEA) of 1991 (Sorensen, 2006).

In 1996, the I-15 HOT lanes opened with single-occupant vehicles paying into the lanes with a monthly flat fee. Phase II, FasTrak, was introduced in 1998, which incorporated the world's first fully dynamic variable congestion toll that assures free-flowing traffic. Tolls vary from 50 cents to $8 based on distance traveled, time of day, and level of congestion. The current amount is displayed on an electronic sign by the Express Lanes entrance, and single occupant vehicles now pay the variable fee via transponders. Revenues from the toll are dedicated to operations and funding the Inland Breeze Express Bus Service from Rancho Bernardo to downtown San Diego. While the I-15 HOT lanes are widely accepted and supported by the public, the success of the bus service has been questioned as it failed to attract the projected ridership (Schreffler, 2003). Despite the transit ridership shortfalls, the I-15 lanes are considered a success, and SANDAG is in the process of expanding the FasTrak program along I-15 with a twenty mile, four-lane project from SR-163 to SR-78, scheduled for completion in 2012 and also serviced by bus-rapid transit (SANDAG).

Key Motivations:

- Primary
  - Existing underutilized facility
  - Political champion
  - Transit investment
- Secondary
  - Legislative changes

Houston's I-10 QuickRide: Finding the HOV-HOT Balance

While Houston had an extensive network of HOV lanes, mounting traffic congestion necessitated a better use of these facilities. Although allowing two-occupant vehicles to use the lanes for free resulted in too much congestion in the lanes, permitting two-occupant vehicles to pay a fee optimized the utilization of the lanes.

Similar to I-15 case, the introduction of HOT lanes in metropolitan Houston resulted from a desire to increase utilization of existing HOV lanes. Traffic congestion has long been a hot topic of discussion in Houston, a rapidly growing city with few transit alternatives. The Katy Freeway was originally designed to accommodate 80,000 vehicles per day, but over 200,000 vehicles per day were on the freeway by 2006 (United States Government Accountability Office, June 2006).

The Houston metropolitan area has a history of incorporating HOV lanes into their highway plans dating back to 1979. The Katy Freeway (I-10) HOV lanes first opened in 1984 and were originally intended to carry only transit buses and registered vanpools. However, political pressure quickly mounted to better utilize this roadway capacity by opening the lanes up to vehicles with two or more passengers. These new HOV lanes soon

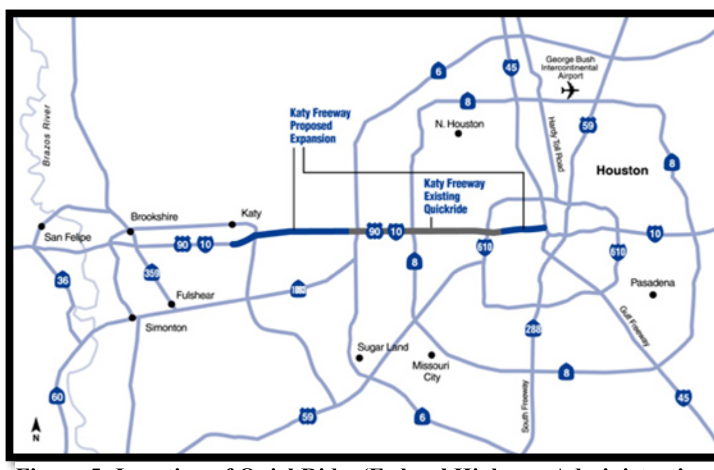

Figure 5: Location of QuickRide (Federal Highway Administration, 2003)

became congested and the Houston METRO and TxDOT restricted the usage of the lanes to vehicles with three or more passengers during the peak morning and evening rush hours. This restriction once again resulted in the underutilization of the lanes. Clearly some balance needed to be reached, leading to discussions of introducing HOT lanes (Burris & Stockton, 2004).

The development of Houston's QuickRide program emerged from these discussions as well as a partnership with the Federal Highway Administration, as part of the Value Pricing Pilot Program, which provided funding for the study and implementation of the project. Introduced in 1998 on the Katy Freeway, QuickRide allows vehicles with fewer than three occupants to pay a fixed fee (currently $2 in each direction) to utilize the lanes during the peak time periods when the lanes are normally restricted to vehicles with three or more passengers. Single occupant vehicles are not permitted to use the facility. Bus rapid transit also runs along these lanes with the toll-paying HOT lane users providing the revenue to fund the route (Regan, 2003).

Due to the success of the Katy Freeway HOT lane project, the QuickRide program was expanded to the Northwest Freeway in November 2000 (Burris & Stockton, 2004). Additionally, I-10's expansion includes eight general purpose lanes and four value-priced managed lanes with higher rates for peak hours, which are being financed by the Harris County Toll Road Authority, which is a division of Harris County's Public Infrastructure Department. The QuickRide project highlights the ability of electronic congestion pricing to maximize efficiency of existing capacity by allowing drivers to buy into HOV lanes in situations where capacity expansions fail to keep pace with rapidly increasing travel demand. The project resulted from a desire to best utilize existing capacity and was further encouraged by federal government incentives to experiment with innovative road pricing approaches.

Key Motivations:

- Primary
  - Existing underutilized facility
  - Increasing congestion
- Secondary
  - Federal incentive
  - Replication of successful tolling model

Minnesota's I-394 MnPASS Program: The Importance of Tenacious Political Figures

Partially inspired by the success of San Diego's HOT lanes, Minnesota transportation officials viewed HOT lanes as a critical component of the state's long-range congestion relief plan. A broad coalition of political supporters played a critical role in the ultimate implementation of the plan.

Prior to the introduction of the MnPass program in 2005, the Minneapolis-St. Paul metropolitan area had no toll roads. Today, travelers along Minnesota's I-394 corridor have the option of buying into value-priced HOT lanes. The MnPass implementation resulted from strong political champions and a broad coalition of forces who focused on educating the public as to the importance of variable road pricing as a long-term congestion mitigation strategy.

The Minnesota Department of Transportation (Mn/DOT) and the Twin Cities Metropolitan Council had been exploring the possibility of introducing value pricing in the Minneapolis/St. Paul metropolitan area since 1994. These studies were primarily funded through the Federal Highway Administration's Congestion Pricing Pilot Program under ISTEA and TEA-21's Value Pricing Pilot Program. The Minnesota coalition was especially inspired by the success of the Orange County's SR-91 HOT lanes. In 1997, the state legislature approved an HOT lane demonstration project on I-394, a heavily congested route into Minneapolis's western suburbs.

Figure 5: Location of I-394 (Minnesota Department of Transportation, 2005)

Studies had concluded that the existing HOV lanes along I-394 were underutilized and the best use of the capacity would be open them up to general use. However, if the HOV lanes were opened up to all vehicles, the state would lose critical federal funding. Transportation officials therefore recommended to following San Diego's I-15 example and converting the existing HOV lanes to HOT lanes. However, the proposal was met with resistance from the public and was subsequently withdrawn. Although there was also some talk of introducing value pricing to the reconstruction of the I-35W and TH62 common areas, these proposals were also rejected as too controversial for the already complex projects. These failures highlighted the importance of fostering public support for future proposals (Buckeye & Munnich, 2004).

Not to be deterred, a 30-member Value Pricing Advisory Task Force, which consists of state legislator, mayors, and business, environmental and transportation leaders, pushed for another demonstration project starting in 2001. Led by researchers at the Hubert Humphrey Institute at the University of Minnesota and funded through FHWA value pricing grants, the coalition continued to champion for the implementation of value pricing through a communication campaign. As a result of this outreach work, public acceptance began to grow.

Figure 5: MnPass Lanes (MnDOT, 2006)

Beyond the education campaign, several other factors may have helped bolster more support that the earlier attempt. At the time the state budget deficit exceeded $4 billion, and the governor had pledged no new taxes. Furthermore, the Minneapolis-St. Paul metropolitan area's population was rapidly growing, exacerbating the already congested road network. Under these circumstances, state politicians reached an agreement that transportation issues needed to be placed at the forefront of policy debates. This bipartisan support, along with the backing of a newly elected Governor Tim Pawlenty and Lt. Governor and Transportation Commissioner Carol Molnau, led to the passage of 2003 legislation that allowed for the conversion of HOV lanes to HOT express lanes. The legislation also stipulated that revenue is to be used first to pay back the state trunk highway fund for the costs of implementation and administration of the project. Any excess revenue is to be split to enhance transit service in the corridor and to expand road capacity in the corridor. At the time, Minnesota Congressman Mark Kennedy was also promoting the introduction of FAST lanes at the national level, which would permit states to use toll revenue to add capacity to existing interstate highways. His efforts highlighted Minnesota's commitment to exploring innovative transportation policy approaches (Buckeye & Munnich, 2004).

With the legislation and public support in place, the Minnesota HOT lanes opened along I-394 in May 2005. The lanes feature dynamic pricing, with tolls for non-carpools varying from

25 cents to $8.00 depending on congestion levels (United States Government Accountability Office, 2006). The project was implemented as a public-private partnership between the State of Minnesota and service vendor Wilbur Smith Associates, with the firm funding 20 percent of the project.

Receiving high levels of public support since its introduction in 2005, the MnPass program is largely considered a success by the Minnesota Department of Transportation, who claims that traffic in the HOT lanes maintain the speed limit for 95% of the time. The successful implementation of the MnPass illustrates the importance of building a broad coalition of support, the role that the federal government can play, and the importance of emulating successful models.

Key Motivations:

- Primary
  - Increasing congestion
  - Follow San Diego's I-15 model
  - Political champions/broad coalition
- Secondary
  - Public-private partnership
  - Budget deficit
  - Coalition supported both new road capacity and transit investment
  - Federal incentives

Santiago, Chile: Rapid Economic Development Leads to Demands on Infrastructure

Due to rapid economic gains, the strain on Santiago's road network became overwhelming. In order to fund the quick expansion of the road network, Santiago turned to private sector investors, who introduced variable tolls on the new facilities.

As a rapidly increasing portion of the population owns and drives cars, planners in Santiago saw the city increasingly choked by rising levels of traffic congestion and air pollution. Chilean transportation infrastructure was failing to keep pace with the rapid economic development during the 1980s and 1990s. The vehicle fleet in Chile had increased from 900,000 in 1982 to 1.3 million in 1992 with traffic accidents nearly doubling over the same decade (Lorenzen, et al, 2000). The government tried to reduce the number of vehicles on the road by license-plate number schemes. However, the need for new roadway construction to reduce congestion became evident. At the time, the government was also under intense pressure to expand social services in addition to improving transportation infrastructure. Given such competing demands, the government turned to the private sector to fund the necessary transportation infrastructure improvements (Constance, 2004). By developing concessionaires to finance the needed highways, the government was able to avoid raising taxes or increasing public debt. In addition to financing the projects, the private sector was involved in the management of the construction, maintenance, and operation of the projects (Constance, 2004).

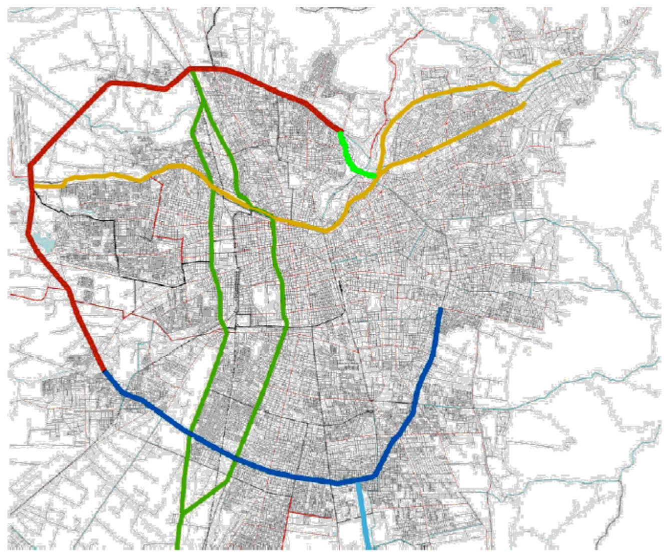

Figure 5: Santiago ETC System (Commission for Integrated Transport, 2006)

The government commenced developing a legal and regulatory framework in 1994 and then opened the road concessions to proposals from international firms. During the bidding process, the criteria considered included the following: rate structure and level; the subsidy requested from the state; payments to be made by the concessionaire for the use of preexisting infrastructure; minimum revenue levels guaranteed by the state; and the distribution of risks between the state and the concessionaire (Lorenzen, et al., 2000). In total, 21 road concessions were awarded across Chile between 1993 and 2001, resulting in 27 consortia with more than 40 Chilean and foreign firms. In Santiago, four major urban toll roads were constructed around the metropolitan area under agreements with private consortia with the final road opening in 2006 (Commission for Integrated Transport, 2006).

In order to be guaranteed a return on their investment, the private investors would need to toll the facilities. Starting in 2004, drivers on these road networks were assessed a fee based on both distance traveled and time of day. The Santiago model is unique because of the level of integration achieved among the various toll roads, which are each managed by a separate concession agreement. Drivers need only one transponder and receive one bill at the end of the month detailing charges on all four toll roads. Additionally, the fee varies by congestion levels on the road network to assure free-flowing traffic. The charges are all collected electronically.

Due to the apparent success and public acceptance of the initiative, discussions have moved towards introducing congestion charges on the rest of Santiago's road network (Commission for Integrated Transport, 2006).

Key Motivations:

- Primary
  - Public-private partnerships
  - Fund new capacity
  - Growing congestion
  - Limited revenue
- Secondary
  - High levels of air pollution
  - Economic development

Figure 5: Santiago Tolling (Transit New Zealand, 2007)

CORDON TOLLS

Singapore's Road Pricing: No Political Barriers

> **Due to Singapore's unique political structure, its transportation leaders were able to implement manual cordon tolls prior to technological developments that made the scheme politically more feasible elsewhere. Singapore adopted the tolls to efficiently manage the business district roadways and establish its position as a prominent business center.**

Singapore pioneered the implementation of road pricing years before the concept became politically feasible elsewhere. As rising incomes made vehicle ownership increasingly commonplace, congestion on the streets of Singapore increased significantly. The severe congestion threatened both the environmental conditions and the economic prowess of the city-state. Its leaders wanted to establish Singapore as a major South-East Asian business center in the manufacturing, commercial, and trade industries, and an uncongested central business district was seen central to this objective. The dense development and geographic nature of the city made it virtually impossible for Singapore to significantly increase road capacity, so the government had to consider alternatives.

Accordingly, the government adopted a two-pronged approach to reducing congestion: limit vehicle ownership and reduce vehicles on the road. Vehicle ownership was suppressed by imposing a tax on new vehicle registration starting in 1972. Dissatisfied with the effectiveness of this tax, the government introduced a vehicle quota system in 1990, which limited the numbers of vehicles (May & Sumalee, 2003).

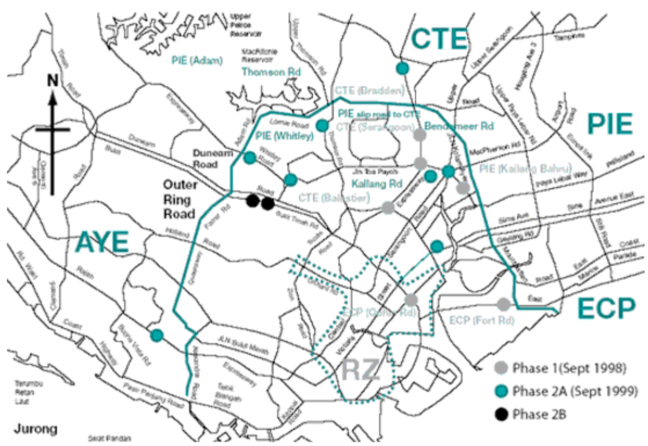

Figure 6: Map of Area License Scheme in Singapore (Commission for Integrated Transport, 2006)

In addition to limiting vehicle ownership, the Singapore Government's Land Transport Authority (LTA) attempted to keep vehicles off the road by implementing a road pricing scheme, making Singapore the first jurisdiction in the world to do so. In 1975, the area licensing scheme (ALS) limited vehicles in the central business district by requiring drivers to purchase a permit to drive into the central business district during peak hours along the major routes.

Since the technology was not developed at the time, the scheme was enforced manually with police officers at the designated check points. The scheme experienced marked success in shifting trips from private vehicles to public transit with public transit ridership increasing from 33% of commuting trips in 1974 to 67% in 1992 (May & Sumalee, 2003). Although a significant portion of trips into the central business district was diverted to feeder roads, the government addressed this traffic spillover problem by introducing a manually-operated road pricing scheme in 1995. In this scheme, the road pricing scheme extended the charge to enter the restricted downtown zone to include the three expressways and the congested feeder roadways.

Since the manual operation of these systems was cumbersome and expensive, the government introduced the electronic road pricing system (ERP) in 1998. Unlike the original scheme, where drivers purchased a pass that allowed them to cross into the cordon area for the entire day, the ERP charges vehicles on a per crossing basis. The technology of the ERP also allows for fee variation according to type of vehicle, time of day, location, and day of the week. The ERP resulted in a 17% traffic volume reduction.

Figure 7: Singapore ERP (Commission for Integrated Transport, 2006)

Unlike later cordon tolling projects, Singapore planners did not target revenue from the tolls solely towards transportation improvements, but instead placed the funds into the general government revenue (Jones, 2003). Even though revenue was not specifically dedicated to transit improvements, the government did undertake an extensive improvement of their mass transit system in 1988 with ALS funding (May & Sumalee, 2003). Of course, the unique political situation in Singapore allowed the government officials to implement the tolling project without the planning and political process that for years hindered so many other attempts of similar schemes. Additionally, Singapore was able to implement road pricing prior to the development of modern electronic tolling technology that enabled the rapid expansion of road pricing programs today. But even in the early case of Singapore, once the electronic road pricing technology was introduced, the feasible possibility multiplied and the system was run much more efficiently.

Key Motivations:

- Primary
  - Increasing congestion
  - Economic competition
- Secondary
  - Environmental pollution
  - Limited space for new capacity
  - Political structure

Stockholm Congestion Fee: Evolving Program Reflects Evolving Goals

Propelled mainly by a concern about degrading environmental conditions, Stockholm officials introduced a congestion fee for travel within the central city. The improvement of the city's public transit system served as an essential component in the acceptance of the plan.

Originally introduced on a trial basis, Stockholm's congestion tax became a permanent element of Swedish transportation policy in September 2007 amid high levels of support among Stockholm residents. Like other cordon pricing schemes, the improvement of the city's public transportation network played a critical role in the development and acceptance of the plan. Today, vehicles that pass within a 29.5 square-kilometer ring around central Stockholm are assessed a congestion tax varying by time of day. Stockholm's plan was motivated largely by desire to reduce levels of traffic congestion and improve accessibility to the city center. By reducing congestion, the government also hoped to enhance residents' perception of the street-level environment and reduce the levels of harmful greenhouse gas emissions (Miljöavgiftskansliet/Congestion Charge Secretariat, 2006).

Although Stockholm already possessed a well-developed public transportation system, increasing traffic congestion in the urban core was a growing cause of concern. Stockholm is located on a series of islands, connected together by a network of bridges. These limited access points result in heavily congested road networks. Despite recent and planned improvements to the road networks, including the New Arsta Bridge and the South Link tunnel, road capacity remained inadequate to handle the continued growth of vehicle travel. In autumn 2005, surveys found that over half of Stockholm residents were concerned that worsening traffic congestion was contributing to poor air quality, and three-quarters felt that congestion was particularly acute on radial streets leading into the city center. That year, 73 percent of rush hour trips into and out of the inner city were on public transportation. Despite this very high transit mode split, during these peak travel periods traffic congestion on the major radials and arterials leading to Stockholm's inner city was still signficant (Civitas, 2006).

The idea of implementating congestion pricing in Stockholm was first discussed in the 1970s, and a plan was proposed in the late 1980s but failed to garner adequate support. In 1992, the so-called "Dennis Agreement," a compact between three political parties in Stockholm City and Stockholm County, proposed to construct a ring toll road around the inner city and improve public transit with revenue from the congestion tolls. However, a final agreement on the project was never reached, and the proposal was finally abandoned in 1997 (Harsman, 2003; May & Sumalee, 2003).

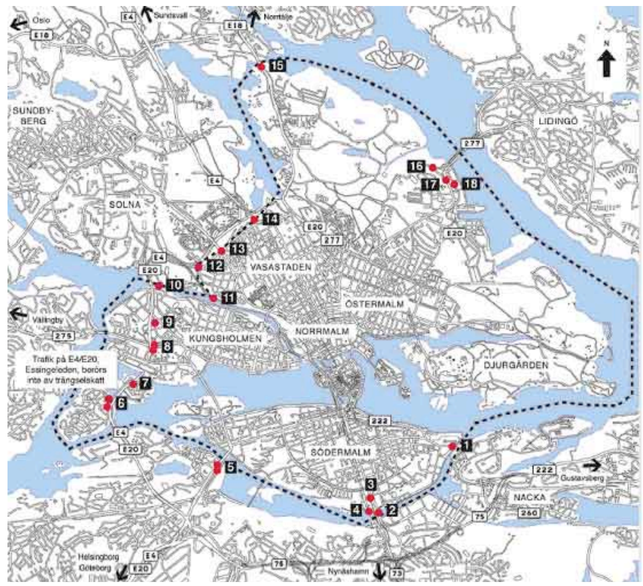

Figure 8: Map of Stockholm Congestion Fee Cordon (Commission for Integrated Transport, 2006)

By the end of the 1990s, mounting enviromental concerns led to renewed political pressure to addresss traffic congestion. A new program was developed allowing local municipalities to take the lead on congestion charging. Among the diverse agencies pushing for congestion pricing were the Swedish Socity for Nature Conservation, the Swedish Institute for Transport and Communications Analysis, and the Swedish Environmental Protection Agency (May & Sumalee, 2003). The 2002 Swedish general election led to an agreement between the Social Democrats, the Left Party, and the Green Party that included a provision allowing the conduct of a trial run of a congestion tax in Stockholm. In June 2003, Stockholm City Council passed a proposal to introduce congestion pricing trials, and the Swedish Parliament, the Riksdag, passed the Congestion Charges Act in June 2004, allowing Stockholm to proceed with the trial (Civitas, 2006).

Figure 9: Stockholm Congestion Fee (Commission for Integrated Transport, 2006)

While the primary goal of the Stockholm congestion fee was to reduce the number of vehicles on the busiest roads during peak periods, financial improvements to the city's public transit system played a key role in the trial. By reducing congestion and enhancing public transit, planners aimed to improve sustainable accessibility to Stockholm's downtown core. In order to maintain access to the city center throughout the trial, improvements to the public transportation system began prior to the implementation of the congestion tolls. The improvements constituted the largest coordinated expansion of the transit system since the initial Underground subway construction project in the 1950s (Civitas, 2006). Most of the public transportation improvements focused on enhancing bus service by introducing new routes and new buses. Rail lines and existing bus lines were improved as well. Finally, park-and-ride sites received funding for improvement (Civitas, 2006). The seven-month trial of the cogestion tolls commenced in January 2006.

At the conclusion of the trial period in July 2006, the Congestion Charge Secretariat evaluated the trial run by examining a number of criteria that reflect the aims and motives behind the implementation of congestion pricing. During the congestion toll period, the Secretariat study determined that traffic in Stockholm decreased by 22 percent, exceeding expectations, and public transit ridership increased by six percent. The study also concluded that carbon dioxide emissions within inner-city Stockholm decreased by 40 percent. The effect of the reduced congestion levels on perceptions of the urban environment was more difficult to measure accurately (Miljöavgiftskansliet/Congestion Charge Secretariat, 2006). Prior to the referendum on whether to make the congested tolls permanent, the Swedish government distributed to all residents a pamphlet summarizing the results of the congestion fee trial.

6:30 – 6:59 AM	**SEK 10 (USD 1.26)**
7:00 – 7:29 AM	**SEK 15 (USD 1.89)**
7:30 – 8:29 AM	**SEK 20 (USD 2.52)**
8:30 – 8:59 AM	**SEK 15 (USD 1.89)**
9:00 AM – 3:29 PM	**SEK 10 (USD 1.26)**
3:30 PM – 3:59 PM	**SEK 15 (USD 1.89)**
4:00 PM – 5:29 PM	**SEK 20 (USD 2.52)**
5:30 PM – 5:59 PM	**SEK 15 (USD 1.89)**
6:00 PM – 6:29 PM	**SEK 10 (USD 1.26)**

Source: Vägverket (http://www.vv.se)

In a general referendum in September 2006, residents of Stockholm voted in favor of maintaining the congestion fee, while residents of outlying suburbs voted to do away with it. In this same election, the Green Party, whose leaders had originally introduced the congestion scheme, was voted out of office. However, a new Alliance of center-right parties collectively decided to reinstate the congestion fee, honoring the Stockholm resident's vote. During political debates over whether to continue the fee, a compromise altered the use of revenue from the congestion tolls to be divided between new road construction in and around Stockholm and transit improvements, instead of the policy during the trial of using the funding solely for transit (Savage, 2006).

This shift in revenue use illustrates the importance of the political party's goals in determining the structure of the program as the motivations behind the continuation of the congestion fee differed from the original intent. The modified congestion fee was reintroduced in September 2007. While the congestion fee significantly reduced on congestion, time will tell whether the acceptance of this new congestion fee will increase now that funding goes towards new road capacity and public transit improvements.

Figure 10: Stockholm Roads (Naparstek, 2006)

Key Motivations

- Primary
  - Reduce congestion and improve accessibility
  - Reduce harmful emissions
  - Improve environmental conditions within city
- Secondary
  - Invest in public transit
  - Finance new road capacity
  - Political compromise

London's Congestion Pricing: Paving the Way for the Implementation of Pricing

> **In order to solidify its place as a worldwide financial center, London's Mayor considered the implementation of congestion pricing essential to creating a reliable and efficient transportation network. Without Mayor Livingstone's political tenacity, it is doubtful the scheme would have been implemented.**

In May, 2000, residents of greater London elected Ken Livingstone as their Mayor and in doing so took a step towards dramatically altering the future of transportation policy in London. Leading up to his election, traffic congestion was a mounting concern on the streets of London with little possibility of adding new capacity to the road networks. Additionally, the underground subway system required significant repairs and upgrading. Livingstone's election platform included the proposal to enact congestion pricing to reduce traffic in central London, and using the toll revenue to improve the public transit system (Santos & Shaffer, 2004). In addition to reducing vehicle emissions levels, Livingstone was motivated to introduce congestion pricing to maintain London's economic vitality, which was threatened by the growing congestion levels. The business community provided Livingstone with a strong base of support in introducing the congestion pricing (May & Sumalee, 2003).

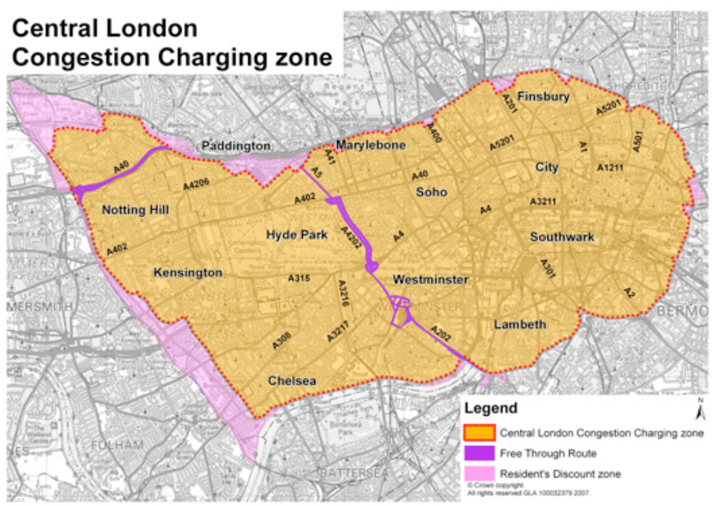

Figure 11: Map of London Congestion Charging (Transport for London, 2007)

The Greater London Authority (GLA) Act passed in 1999 granted Livingstone the power to impose congestion charges for the first time. Although the origins of the London scheme can be traced back to 1964, Livingstone was the first London mayor armed with the power to finally put theory into action. The 1964 Smeed report originally outlined the principles of congestion pricing for London, but due largely to a lack of appropriate technology, the plan could not be implemented at that time. In 1967, the U.K. Ministry of Transport published *Better Use of Town Roads*, which proposed charging a flat fee within a cordon area. This proposal was expanded on in the Greater London Council's Supplementary Licensing plan of 1974, which aimed to reduce car traffic entering the cordon area by 45 percent. The Greater London Council leaders seriously considered implementing the proposal, but ultimately rejected it out of concerns regarding equity and economic implications. In the 1990s, road pricing entered a policy discussion again in the United Kingdom due to a loss in faith in transportation policy that focused on providing additional capacity (May & Sumalee, 2003). In 1992, the UK government studied the feasibility of London congestion charging, which ultimately resulted in the Labor government's passage of legislation in 1998 that provided local governments the authority to implement congestion pricing. Thus, when Livingstone took the office, the legislative framework had been laid for the implementation of long-planned congestion pricing.

Figure 12: London Congestion Pricing (Varone, 2007)

Prior to the implementation of the scheme, an extensive outreach campaign focused on improving public acceptability through meetings with key stakeholders, distribution of thousands of information leaflets on the proposed scheme to all London boroughs, and newspaper and radio advertisements containing details of the scheme and information about participating in the consultation process (Santos & Shaffer, 2004). Additionally, the proposal was met with acceptance because it was presented as one component of a broad transportation strategy, including public transit investments, signal improvements, and infrastructure repairs (Turner, 2003).

Enacted on February 17, 2003, the London scheme charges motorists £5 (USD 9.90) to enter or drive within the cordon area in central London. The original cordon area incorporates 22 square kilometers and covers the city's major centers of government, law, business, finance, and entertainment (Sorensen, 2006). Upon entry into the cordoned area between the hours of 7:00 AM and 6:30 PM on weekdays, cameras in an automatic number plate recognition system record the vehicle license plates, which are then stored in a database. Drivers can pay the charge via a website, by text message, in shops equipped with a PayPoint, or by phone. If the payment is not received by the following day, the driver is charged a fine.

Following Livingstone's re-election, in 2005, the congestion charge was raised to £8 (US $12) to enter or to drive within the cordoned area between the hours of 7:00 AM and 4:00 PM

Monday through Friday. The charge does not apply on weekends, English public holidays, designated non-charging days, and between 4:00 PM and 7:00 AM. If the charge is not paid on the same day it was incurred, the fee is raised to £10 (US $15). In February 2007, the scheme was expanded from central London to incorporate portions of western London.

When originally developed, Livingstone's scheme aimed to reduce traffic by 10-15 percent year-round, increasing transportation reliability within London. According to the Transport for London's 2007 Annual Report, traffic levels entering the cordon zone in 2006 were 21 percent lower than levels in 2002 (Transport for London, 2007). In 2006/2007, the congestion pricing had generated a net revenue of £123 million (US $248 million), which was spent on public transit improvements, specifically focused on enhancing bus services (Transport for London, 2007).

Beyond mitigating London's traffic congestion, the scheme plays a significant role on the global level, paving the way for congestion projects elsewhere. While Singapore had implemented congestion pricing decades earlier, London is the first major city in a democracy to enact congestion pricing, proving that the policy is politically viable (Hensher & Puckett, 2005).

Key Motivations:

- Primary
  - Political champion
  - Congestion inhibiting economic development
  - Legislative changes
- Secondary
  - Lack of space to build new capacity
  - Improve public transit

New York City Congestion Pricing Proposal: An Ultimately Unsuccessful Plan for Economic Sustainability

In December 2006, New York City Mayor Michael Bloomberg challenged New Yorkers to develop a comprehensive plan to address sustainability issues within the city. With a burgeoning population and waxing global climate change concerns, New York City, Bloomberg argued, needed a vision for the future. Between 2006 and 2010, the Department of City Planning projected that the population of New York will increase by 200,000 people, and the total population will exceed nine million by 2030, up from 8.2 million today. Additionally, New

Following the success of the London congestion pricing scheme, New York City's Mayor Michael Bloomberg developed a similar proposal for New York. Although the plan was originally pitched as a component of the city's environmental sustainability plan, congestion pricing is perhaps more important to the city's economic sustainability.

York City accounts for one percent of the total carbon emissions within the United States, a level equivalent to the emissions for the entirety of Ireland (The City of New York: Michael R. Bloomberg, 2007). After several months of development, Mayor Bloomberg introduced PlaNYC, a collection of 127 sustainability initiatives that incorporate improvements to land, air, water, energy, and transportation policy.

One of the most controversial elements of PlaNYC was the Mayor's congestion pricing proposal, which aimed to relieve congestion for the dual purpose of reviving economic activity in New York City's central business district and reducing harmful emissions. The final proposal would have imposed a fee on drivers who travel below 60th Street in Manhattan between 6 am and 6 pm (Traffic Congestion Mitigation Commission, 2008). Vehicles traveling within the designated zone would have been charged $4 during designated peak hours. In particular, trucks would be charged a higher fee of $21 to travel in this designated area while low-emission trucks would pay $7. The stated goal was to reduce vehicle miles traveled in Manhattan south of 86th Street by 6.3 percent (Interim Report to the Traffic Congestion Mitigation Commission, 2008).

Parameter	Plan
Northern Boundary	60 St
Direction of Charge	Inbound
Fee Rate	Flat $8
Hours of Charge	6 am – 6 pm
E-ZPass Toll Offset	Yes
LPR Surcharge	$1
Supplements	
$1 taxi/livery trip surcharge for trips that start and/or end in zone	
Increased metered parking rates within zone	
Eliminate resident parking tax exemption within zone	
Implementation Measures	
Residential parking permit program	
Dedication of revenues to transit	
Short-term transit enhancements	
Privacy protections	
Environmental review	

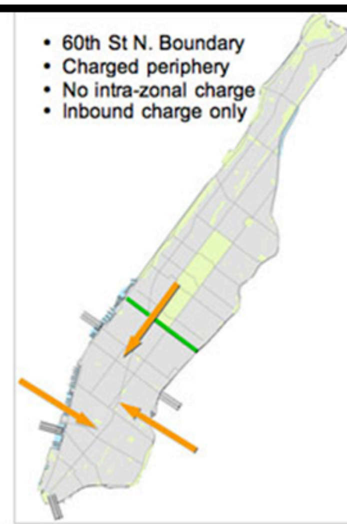

Figure 13: New York Traffic Congestion Mitigation Commission Recommendation (Traffic Congestion Mitigation Commission, 2008)

Like London, the congestion pricing proposal also aimed to raise revenue for the city's public transit system. Although ideas for congestion pricing in New York City have been around since the 1950s, Bloomberg became the first high-level champion for implementation of the plan as congestion levels have soared. Eighty-seven percent of New York City voters viewed traffic congestion as very serious or somewhat serious problem in 2007, providing Bloomberg with public support in addressing transportation concerns (Quinnipiac University Polling Institute, 2007).

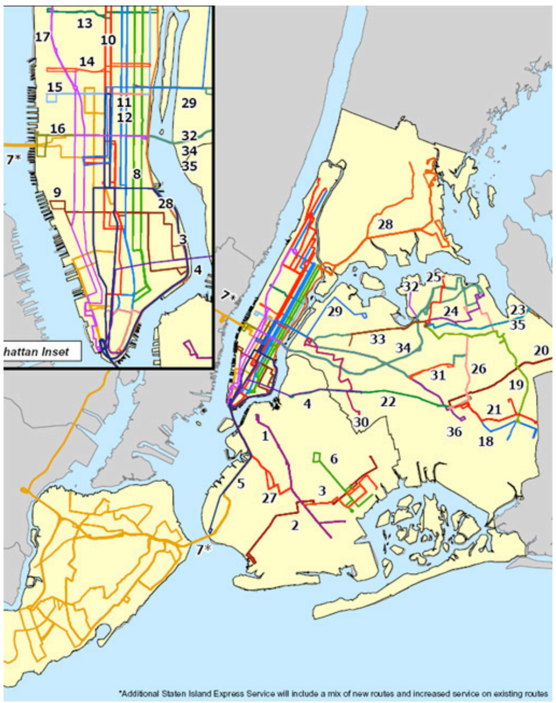

Figure 14: Proposed Bus Service Expansion (Traffic Congestion Mitigation Commission, 2008)

Also similar to London, New York's dense development limits space available to construct new road capacity. In addition, like Stockholm, the island geography of the city makes the implementation of congestion pricing more feasible since drivers access the cordon area through a limited set of access points. As was the case with Stockholm and London, the New York proposal dedicated significant funding to improving public transit (Traffic Congestion Mitigation Commission, 2008). As the cases in the two European cities illustrated, the dedication of revenue to transit improvements is critical in maintaining access to the central business district. It is also critical to achieving high levels of public support as polls indicated that New York residents were more accepting of congestion pricing if funds were dedicated to mass transit improvements. In a Quinnipiac University Poll, New York City voters would have supported congestion pricing by a margin of 53-41 percent if it provided funding to prevent a hike in mass transit fares (Quinnipiac University Polling Institute, 2007).

The success of London congestion pricing scheme played a significant role in the initial development of Mayor Bloomberg's congestion pricing proposal – not only as inspiration but as motivation to improve transportation reliability in an economically competitive world. Not only did Bloomberg now have a successful London model to point towards, but a certain trans-Atlantic competitive spirit over which city is the most important in the global financial capital market drove Bloomberg's proposal. Traffic congestion is thought to inhibit economic development by leading to corporations establishing offices in cities with more reliable transportation networks. While critics of congestion pricing fear that the additional fees will hurt economic growth, London and New York's economic development is more threatened by choking congestion levels, which prevent businesses from operating efficiently. New York City's business community supports the congestion pricing proposal, including the Partnership for New York City, a nonprofit organization dedicated to maintaining and enhancing the city's economy. A study by the Partnership for New York City estimated that New York City regional traffic congestion is responsible for losses amounting to $3.252-$4.022 billion to the Gross Regional Product and 37,623-51,512 employment losses across the region, with the greatest job loss in the financial sector (Partnership for New York City, 2006).

New York and London also vied for the 2012 Olympic Games, magnifying the rivalry between the two cities. To prepare for the bid, Daniel Doctoroff, the Deputy Mayor for economic development, extensively researched the competition between London and New York and commissioned a report from McKinsey to determine how New York could be most competitive with London (Schuerman, 2007). As part of the final PlaNYC proposal in 2007, competition with London was cited as a reason to support the proposal: "Our competition today is no longer only cities like Chicago and Los Angeles—it's also London and Shanghai. Cities around the world are pushing themselves to become more convenient and enjoyable, without sacrificing excitement or energy. In order to compete in the 21st Century economy, we must not only keep up with the innovations of others, but surpass them (The City of New York: Michael R. Bloomberg, 2007, p. 10)."

In August 2007, the New York City congestion pricing proposal was selected by the U.S. Department of Transportation as one of the five Urban Partners programs. These five projects are eligible for federal funds to assist in the exploration of pricing-based congestion reduction strategies. If New York had been able to get a congestion pricing scheme approved, the City and State would have received $354 million for transit and transportation system improvements. As tempting as federal funds might have been in times of budget shortfalls, federal funding alone was not enough to persuade skeptic state legislators.

Despite the many motivations for introducing congestion pricing to New York City, the proposal was unable to overcome intense political opposition within the New York State

Legislature. Although the congestion pricing measure was approved by the New York City Council on March 31, 2007 by a 30-20 vote, the proposal died soon thereafter in the state legislature. Assembly Speaker Sheldon Silver contended that there was inadequate support among assembly members to justify voting on the legislation, effectively killing the project in April 2008. Much of the opposition at the state level focused on equity concerns, demonstrating the importance of satisfactorily addressing fairness issues in developing road pricing proposals. Despite the ultimate fate of the proposal, without the leadership of Mayor Bloomberg, it is unlikely that the proposal would have survived as long in the political process, highlighting the importance of a champion to see through controversial projects.

Key Motivations:

- Primary
    - Congestion inhibiting economic development
    - Political champion
    - Economic competition
    - London model
- Secondary
    - Environmental concerns
    - Federal legislation & funds

WEIGHT-DISTANCE TRUCK TOLLS

Austrian GO Truck Tolls: Geographic Conditions Result in Innovative Funding

The significant expense of road maintenance coupled with an increasing portion of foreign freight movement motivated Austrian transportation officials to implement a system of tolls. This tolling scheme allowed for private investors to play a role in infrastructure development and maintenance.

While the Alps create stunning scenery, they also lead to substantial challenges in developing a transportation network. The mountainous Austrian landscape requires numerous tunnels and bridges, greatly increasing the construction and maintenance costs for the road and rail networks. In addition to the high costs, the Austrian road system was heavily used by foreigners as the nation's central European location. As a result, some of the higher cost sections of the roadways have been tolled since the late 1960s in attempt to impose the burden of road system costs on users from other countries. Despite these tolls, the Austrian government still lacked sufficient funds for the road system. And with the inception of the European Union, trade-related traffic was rapidly increasing, placing additional strains on the network.

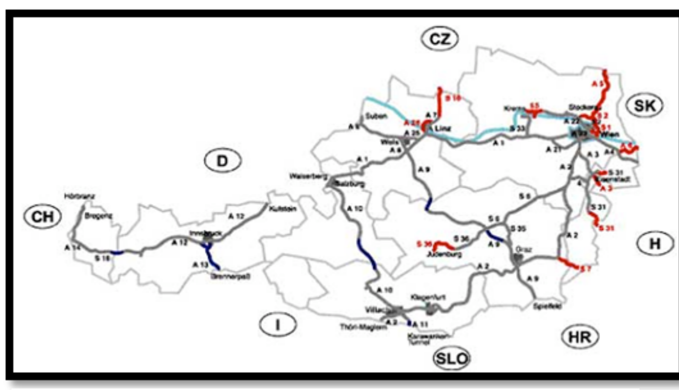

Figure 15: Map of Austrian Road Network (Commission for Integrated Transport, 2006)

To join the European Union in 1995, Austria needed to reduce its debt to satisfy EU requirements. One strategy pursued was to generate new construction and maintenance revenues for Austria's high-cost roadway system. Austrian officials decided to seek private sector investors to take on road system debts by selling the rights to the entire motorway network to ASFINAG, a state-owned stock company. In 1996, the Austrian Parliament passed legislation permitting ASFINAG to impose tolls on its motorways. In 1997, ASFINAG introduced a time-based sticker system wherein vehicle owners purchased a sticker for a fixed rate for time periods ranging up to two years that allowed them to travel on any Austrian motorway (Schwarz-Herda, 2005).

Figure 16: Austrian Tolls (Commission for Integrated Transport, 2006)

In 2001, ASFINAG began seeking bids for the implementation of an electronic tolling system to partially replace the manually-administered sticker system. The bid eventually went to the Italian firm, Europpass, which is a subsidiary of Autostrade, an Italian motorway concessionaire. The electronic tolling system was fully implemented in January 2004. Now all vehicles exceeding 3.5 tons must pay an electronic distance-based toll, while lighter vehicles still pay a time-related toll via the sticker system. The heavier vehicles are equipped with a so-called "GO-Box," which tracks the progress of the vehicle over the Austrian road network. Higher toll rates apply to portions of the road network that cross the Alps and had previously been tolled. Larger trucks with higher emissions are also assessed higher toll rates. Toll revenues are dedicated to the maintenance, operation, and upgrades of the road network. To date the state-owned motorway company is entirely financed through these new tolls and receives no additional governmental funding.

In recent years, the toll rates have come under some scrutiny from the European Commissioners who have requested lower rates. However, Austrian officials contended that the tolls were justified because of recent increases in traffic diverted from the parallel routes through the Swiss Alps due to Switzerland's new toll for heavy goods vehicles. Both the Austrian and Switzerland road networks cut through environmentally sensitive Alpine areas, and thus, argued Austrian officials, environmental concerns justified maintaining the road pricing scheme (Schwarz-Herda, 2005). While the environmental goals may have proven essential in defending the tolls, the original motivations lay elsewhere – in a desire to transfer debt to the private sector and raise revenue to finance the expensive-to-maintain Austrian road system.

Key Motivations:

- Primary
  - Revenue shortfalls
  - Public-private partnership
  - Desire to impose costs on users

➢ Secondary
  - Funding new expensive capacity
  - Increase in trade traffic
  - Environmentally sensitive area

Switzerland's Heavy Vehicle Fee (HVF): A Long Political Battle to Protect the Alps

The motivations behind Switzerland's HVF mirror many of Austria's concerns. However, Swiss transportation officials and residents cited environmental concerns rather than fiscal concerns for their implementation of the HVF.

Similar to Austria, Switzerland's central European location resulted in heavy use of the nation's roadways for foreign goods movement, which imports a disproportional amount of roadway damage and congestion from elsewhere. The dilemma of properly allocating roadway costs among users has been the center of Swiss transportation policy debates for years. Back in 1972, the Swiss government commission concluded that the heavy vehicles traveling on Swiss roads were not covering the costs these vehicles imposed on the highway system. In response, the Swiss officials began developing a user fee system for freight transport. Although the commission recommended in 1972 a fee that varied to reflect costs imposed, the Swiss Parliament concluded that this type of fee was not technologically feasible (Balmer, 2004).

The 1980 opening of the St. Gotthard road tunnel facilitated a rapid increase in heavy truck movements across the Swiss Alps, particularly on the north-south routes. In order to shift some of these costs onto road users, Switzerland introduced in 1983 a flat fee on heavy trucks in addition to a motorway user permit, which was a flat fee for passenger cars (Balmer, 2004).

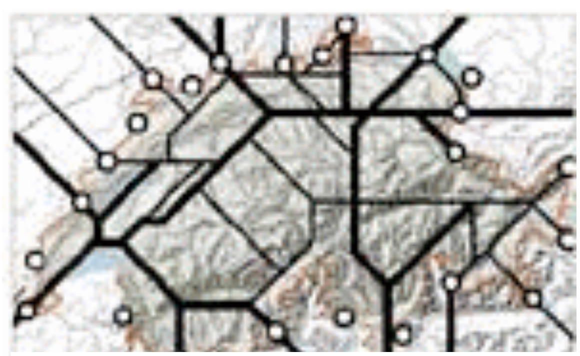

Figure 17: Swiss Border Crossings (Kallweit, 2003)

The flat fee was quickly contested by the Swiss Association for Transport & Environment (ATE), whose leaders pushed for performance-related fees that were considered necessary to promote a more environmentally-conscientious freight transport. Additionally, Swiss officials considered road pricing in the mid-1980s, but as a short-term method to address environmental concerns and concluded that the ultimate goal of Swiss goods movement policy should be to shift freight travel from road to rail. In order to achieve this objective, two new rail tunnels extending across the Alps would need to be constructed. The proposed new rail lines would be funded by a combination of loans and vehicle excise taxes.

The proposal was heavily criticized by both environmentalists and drivers groups. These debates dragged on until 1992, when a majority of Swiss voters gave the projects the green light. Voters' support stemmed largely from popular support for improving public transportation, addressing ecological concerns, decreasing traffic on roadways, and achieving international economic integration (Balmer, 2004). In 1994, the Swiss voters supported performance-related road user fees in a referendum entitled, "Initiative for the protection of the Alpine region against transit traffic," which sought the transfer of all freight through the Swiss Alps from road to rail. Although the Swiss government rejected the proposal as unduly discriminatory against trucking, it developed in response a compromise proposal to enact performance-related fees on trucks (Balmer, 2004).

Following the 1994 vote, the Swiss Transport Ministry drafted a law for the implementation of the fee, which was met with a great deal of criticism. Specifically, questions were raised over: (1) the proposal to calculate the fee based on consumption of diesel fuel and engine emissions, rather than performance, (2) a fear of shippers moving to more, lighter vehicles in order to avoid the paying the fee, (3) the lack of a reliable technology currently on the market, and (4) a desire to wait until the EU developed an official road pricing policy. After the rejection of this law, Switzerland entered a new round of negotiations with the EU that resulted in a compromise where higher weight limits were permitted for trucks and longer hours of freight operation were allowed in exchange for the right to impose substantial user charges on heavy trucks. Collectively, these compromises were thought to allow trucking firms to maintain efficient operation in a new regime of user fees.

This new compromise proposal was voted on in a national referendum in 1998. The proposal received majority support from the Swiss populace, and the Heavy Vehicle Fee (HVF) was implemented in January 2001. The introduction of the HVF was possible due to the Swiss decision not to join the European Economic Area (EEA) in 1992. If Switzerland had joined the EEA, EU regulations would have limited the ability of Switzerland to enact performance-related fees (Balmer, 2004). Additionally, if Switzerland were a member of the EEA, the Swiss industry most likely would have rejected the HVF bill. Thus, most observers agree that the Swiss people supported the HVF bill in the interests of protecting the environment and in solidarity with the communities living along roadway routes.

Figure 18: Swiss Control Gantries (Commission for Integrated Transport, 2006)

The HVF applies to vehicles over 3.5 tons and is calculated based on: (1) the distance driven on Swiss roadways, (2) the weight in excess of 3.5 tons, and (3) the emissions class of the vehicle. All Swiss heavy vehicles are equipped with an on-board unit, which records mileage within Switzerland and all foreign vehicles are either equipped with the on-board unit or receive a chip card that stores the relevant information. As of 2002, approximately 22 percent of HVF charges were paid by foreign vehicles. The HVF revenue is dedicated entirely to improving transportation infrastructure, with two-thirds of the revenue set aside for financing national rail projects with the remaining revenue going towards road construction and maintenance (Commission for Integrated Transport, 2006).

The implementation of the Swiss HVF highlights the complex political process behind the introduction of any road pricing scheme. While the original policy goals to shift more freight transport from road to rail (and thereby aiding in protecting the sensitive alpine region environments) remain intact, compromises along the way may have shifted the structure of the model to address a broader array of concerns, such as improvements to public transportation and international economic integration. In the Swiss case, a long-standing interest in road pricing was realized with the availability of reliable technologies that made the HVF a reality.

Key Motivations:

- Primary
  - Environmental concerns
  - Desire to impose costs on users
- Secondary
  - Use of facilities by foreigners
  - Legislation/unique political situation

- New capacity
- Technological advances

German Toll Collect: Imposing Costs on Foreigners

Like Austria and Switzerland, Germany experienced increasing levels of freight travel as the European Union opened up new trade routes. In order to offset the costs these new users imposed on the road networks, Germany introduced the Toll Collect program, which is the first large-scale operation road pricing project to utilize satellite-based electronic fee collection technology.

Located in the heart of Europe, Germany has long served as a central hub for European transport. Estimates indicate that up to 35% of truck travel miles are by foreign vehicles or 470,000 of the 1.2 million heavy goods vehicles on the road each year (Hensher & Puckett, 2005). The Single European Market and the development of the European Union have increased the amount of intra-European trade and levels of freight traffic traveling through Germany. Current projections are for truck traffic to increase by 64% between 2005 and 2015 (May & Sumalee, 2003). As freight travel has increased, so has the strain on the roadway systems, and the costs to maintain and upgrade these roadways.

Germany, of course, is not alone among European nations witnessing significant increases in foreign freight transport. In 2001, an alliance of countries, including Belgium, Denmark, Germany, Luxembourg, the Netherlands, and Sweden, imposed a license charge on all trucks exceeding 12 tons, with fees varying according to number of axles and engine emission levels (May & Sumalee, 2003). However, with the expansion of the EU to the east, freight traffic in and through Germany continued to grow. In response, the German government sought to incorporate distance fees for heavy trucks on German roadways. On April 12, 2002, the Motorway Toll Act for Heavy Commercial Trucks was approved, providing the legal basis for collecting the new, distance-based toll with the revenue going towards infrastructure projects (May & Sumalee, 2003).

In January 2005, Germany introduced the German Toll Collect System, which electronically charges all trucks over 12 tons fees that vary according to distance traveled, weight of the vehicle, and vehicle emissions. The program is administered by Toll Collect, a consortium formed by Daimler, Deutsche Telecom, and Cofiroute, on behalf of the German Federal government (LKW-MAUT, 2008). Every truck is equipped with an on-board unit that utilizes GPS and digital road maps to track the vehicle's use of the highway network and assesses the appropriate fee automatically. Although some trucks still pay tolls manually, the German Toll Collect System is the first large-scale operation road pricing project that utilizes satellite-based electronic fee collection technology (Hensher & Puckett, 2005).

The motivations behind the German Toll Collect system are fourfold. First, the toll collect system aims to maximize the use of roadway capacity. Second, it seeks to raise revenue for maintenance and capacity expansion. Third, the program aims to allocate the costs imposed on the infrastructure fairly to the users with part of the goal to rectify the price ration between rail and road sectors. Finally, Toll Collect is designed to provide incentives to utilize the best of environmental technology to reduce the environmental costs of freight transport (Rothengatter & Doll, 2002).

While Austria and Switzerland experienced drawn out political debates in the implementation of their road pricing schemes, German officials were able to develop and introduce Toll Collect in a much shorter time frame, perhaps in part due to the Austrian and Swiss tolling precedence.

Key Motivations:

- Primary
  - Desire to impose costs on users
  - Raise revenue
- Secondary
  - Environmental concerns
  - Public-private partnerships

MILEAGE BASED USER FEES

Oregon's Mileage Fee Concept: Replacing an Unsustainable Revenue Source

The trial for Oregon's Mileage Fee was primarily motivated by the declining power and unsustainability of the current fuel-tax system. As nearly all other states are faced with similar funding crises, the trial has received substantial interest from transportation officials across the country.

Like all other U.S. states, Oregon's main source of revenue for repairing, maintaining, and constructing roadways is the motor fuel tax. In fact, Oregon led the way in establishing this tax in 1919. Today, the state is leading all states in efforts to replace the venerable levy. Although several attempts had been made to raise the state gas tax in the 1990s, none was able to gather enough political support for passage. Because it is levied per gallon, the buying power of the fuel tax is eroded both by inflation and increasing vehicle fuel efficiency. The Oregon fuel tax now stands at 24 cents/gallon, with the last fuel tax hike taking place in 1993. In 2001, the Oregon House Transportation Committee began discussing the declining buying power of the fuel tax due to the increased popularity of alternative fuel vehicles and increased vehicle fuel efficiency. While the committee members viewed the new vehicles as a critical step in cutting carbon emissions, the inevitable consequence of moving to alternative fuel sources is a decrease in gasoline consumption and, in turn, highway revenues, creating a major revenue crisis for the state's roadways (Whitty, 2007; Pryne, 2004).

As a result, Republican state representative Bruce Starr introduced a bill that led to the creation of the Road User Fee Task Force assigned with the mission "to develop a design for revenue collection for Oregon's roads and highways that could replace the current system for revenue collection (Whitty, 2007, p. vi)." In a 2003 report, the task force concluded that, as gas prices rise, cars will continue to become more fuel efficient. The committee concluded that in 2014 Oregon's fuel tax revenues would begin to decline in absolute terms. After researching several different funding schemes, the committee decided to proceed with a 12-month pilot program to test the technological and administrative feasibility of the Oregon Mileage Fee Concept. The pilot initiative examined the feasibility of incorporating some form of congestion charging into the design of the scheme.

Essential in developing the technology for the pilot program was the new Office of Innovative Partnerships and Alternative Financing, which allowed the Oregon DOT to avoid the normal bureaucratic steps that often prevent partnerships with outside agencies and the private sector. Instead, the appropriate technology was developed with the assistance from two researchers at Oregon State University (Hunter, 2007). Additionally, Oregon received significant support from the Federal Highway Administration, which contributed $2.9 million over six years.

The pilot program concluded in March 2007 and the task force determined that existing technologies make it possible to implement the program on a wide scale. The review also found potential for integrating a diverse set of criteria into the distance-based fees, such as congestion charging or emissions fees. The greatest challenge the committee identified would be the cost of installing mileage trackers on all vehicles. Not surprisingly, the most efficient approach to equip the vehicles would be for the car manufacturers to include the features. However, such a commitment by auto manufacturers would not be likely until other states (or countries) adopt similar initiatives (Graf, 2007).

As with other pricing projects discussed, the Oregon proposal serves as a model for other states and countries facing similar revenue crises. James Whitty, Manager of the Office of Innovative Partnerships and Alternative Funding, has become a vocal supporter of the mileage-based fees and continues to travel around the country promoting the benefits of the initiative (Hunter, 2007). States across the country are taking note of Oregon's successful pilot program with Minnesota, Texas, and Colorado all contemplating feasibility studies of their own.

Key Motivations:

- Primary
  - Revenue - replacement of gas tax
  - Funding from federal agency
- Secondary
  - Strong leadership

ELECTRONIC ROADWAY TOLLING: LESSONS FROM AROUND THE WORLD

These case studies of electronic roadway tolling innovations make clear the wide variety of unique circumstances behind the rise of electronic road pricing in cities, states, and countries across the globe. Does such situational diversity offer any consistent lessons for policymakers in California? We think so.

The problems motivating electronic tolling are surprisingly similar and enduring – revenue shortfalls, rising needs, and increasing congestion are widespread. What's changed in recent years is the technology that now makes it possible to put decades of pricing theory into practice. But these cases clearly suggest that while technology may be necessary for implementation, it's not sufficient. In most, if not all, of the cases, a strong political champion helped to push the project through obstacles to completion.

The accompanying tables (Appendix A) summarize the primary and secondary motivations behind the cases discussed in the preceding pages. The desire to reduce congestion is a primary motivation behind a majority of the projects discussed, followed closely by a need to raise revenue. Among facility congestion-toll projects, a desire for public-private partnerships and a need for new capacity were most common. Among the cordon-toll initiatives, public transit funding needs were most common, followed by concerns over the effects of congestion on regional economic development. In contrast, all of the weight-distance tolling projects were motivated first and foremost by a desire to impose costs onto outside users, and secondarily by a need to fund new capacity. The distance-based fees were also frequently motivated by the goal of charging users for the road damage and environmental costs users, and in particular trucks, impose on society.

Turning from facility type to geographic location, the European projects tend to be motivated by a desire to fairly and efficiently allocate costs among users, and in particular motivating users to reduce vehicle emissions. In contrast, U.S. projects are more often motivated by revenue shortfalls. And only in the U.S. did projects aim to encourage use of existing underutilized facilities.

Over time, the growing number of successful electronic roadway tolling programs and projects reduces the risk of pursuing tolling by public officials elsewhere. In general, electronic road pricing initiatives in the United States tend to be pitched to the public as a benefit to the individual traveler, such as through travel time savings due to reduced congestion. In contrast, European programs tend to emphasize overall societal benefits, such as environmental improvements (Jones, 2003). In France, for example, public acceptance of road pricing programs was higher when they aimed to impose social and enviornmental costs on users, while public acceptance in the United States and the United Kingdom was higher for road pricing projects that aimed to relieve congestion (CERTU, 2007). Further, road pricing initiatives in the United States were more likely to be accepted when they were structured as options – like with HOT lanes – that increase travelers' choices, rather than with mandatory projects, such as cordon and road network tolls like those in London or Germany.

Technology: Making Theory Reality

As noted earlier, transportation economists have been touting the benefits of road pricing for decades. Officials in New York City first considered road pricing in the 1950s, London in the 1960s, and Switzerland in the 1970s. But despite a compelling logic and potentially enormous efficiency gains, implementing congestion in years past presented a host of challenges. Traditional toll booths require vehicles to stop to pay fees to an attendant, resulting in high operating costs, long queues, greater congestion, and more air pollution – the act of paying tolls would actually diminish the time-savings benefits being priced. While Singapore proceeded with introducing such a manual congestion toll system prior to the development of newer electronic toll-collection technologies, few other places possessed the political wherewithal to introduce such an invasive program. However, the rapid technological developments over the past twenty years have greatly eased the obstacles to implementing road pricing and, along with it, some of the popular and political wariness to pricing.

May and Sumalee divide these recent technological advances into two categories: (1) the Dedicated Short-Range Communications (DSRC) system, and (2) the Global Navigation Satellite System (GNSS) or the General Packet Radio System (GPRS). The DSRC systems consist of roadside equipment and an in-vehicle unit to charge users when they pass by a specified location utilizing two-way communication (May & Sumalee, 2003). The earliest and most prevalent form of the DSRC systems is the windshield-mounted transponders that were designed to speed up passage through toll-booths. Once engineers confirmed that these transponders could work at highway speeds, open road tolling without the presence of toll booths became a real possibility. Automated license plate recognition via video cameras typically provides the necessary enforcement mechanism for those who attempt to use a priced roadway without a transponder. If the vehicle is lacking a transponder, the license plate recognition system can register the license plate number—as is done in Santiago, Chile—or send a bill in the mail to the address where the vehicle is registered—as is done in Toronto, Canada (Poole R., Life in the Slow Lane, 2007). These enforcement systems are best-suited for facility-congestion tolls or cordon tolls. The GNSS and GPRS systems can be used in either point or distance-based charging schemes, and are required for the implementation of any distance-based program (May & Sumalee, 2003). These technologies are still rapidly improving and the many potential applications of road pricing are only just beginning to be explored. For example, the Oregon pilot program focused on mileage based fees, but the possibility exists in such a pricing regime to integrate emissions fees or congestion pricing.

Not only do the necessary technologies now exist, but people around the world are becoming increasingly comfortable with and trusting of these tolling and tracking systems. The introduction of electronic toll collection on bridges and roads with flat tolls, such as FasTrack and E-Z pass here in the U.S., illustrates to many the user-friendliness of electronic tolling (Wachs, 2003). But while users appear increasingly comfortable with transponder technologies, wariness remains with the GNSS and GPRS technologies required for mileage-based schemes, particularly concerning privacy. In cases where the vehicles are tracked using satellite-based technologies, many citizens have expressed concerns about the government and potentially insurance companies being able to track their every move. As both the Oregon trial and the Austrian GO project illustrate, however, there are technological ways to address these privacy concerns. For example, some projects collect and retain data only on the distance traveled, not on the specific locations, time, or speed traveled. Additionally, in some cases, drivers can establish numbered accounts to ensure anonymity (Sorensen & Taylor, 2005).

Although technological advancements have clearly played a central role in enabling the implementation of congestion pricing, the cause and effect may work in reverse as well. Waxing interest in road pricing applications has likely encouraged and spurred the development of new technology applications (Worrall, 2003). The role of technology in enabling the implementation of electronic roadway tolling is slated to be examined in more detail in a subsequent paper for this project.

The Push of Revenue Crises

In addition to enabling effects of technological advancements, a common motivation to test the waters of road pricing appears be desperation. Specifically, chronic revenue shortfalls particularly in places where there exists demand for new capacity and inadequate resources to finance them; such cases have most often appeared in the United States, but jurisdictions around the world increasingly find themselves strapped for revenue and in search of ways to accomplish more with less revenue from traditional sources.

In the United States, most funding for highways has for decades come from federal and state fuel taxes, supplemented by other federal and state fees and taxes (such as vehicle registrations, drivers' license fees, etc.), bonds and other public borrowing, and, increasingly, locally generated revenues. Since the fuel tax is levied per gallon and not per dollar, it needs to be increased regularly to keep pace with inflation and/or increased vehicle fuel efficiency. But in an environment of increasingly partisan rancor over tax increases of all sorts, increases to the fuel tax has proven increasingly difficult at both the federal and state levels. As a result, the proportion of highway construction and maintenance needs financed by fuel taxes has declined over time. The last time the federal fuel tax was raised was on October 1, 1993. Between 1993 and 2007, the purchasing power of the fuel tax had declined by 29 percent (Samuel, 2007). The U.S. Department of Transportation Secretary Mary Peters recently predicted that, by 2009, the federal highway trust fund will have a negative balance (Replogle & Funderburg, 2006).

Beyond a political reluctance to increase the fuel tax per gallon levy to keep pace with inflation, increasing vehicle fuel efficiency means that less fuel is consumed per mile traveled, and therefore less tax revenue is collected per vehicle mile of travel on the road network. In the 1960s, fuel taxes averaged six cents in 2001 dollars per vehicle-mile traveled compared to three and a half cents in 2007, partially due to improved fuel efficiency of vehicles (Samuel, 2007). While the increasing share of light trucks and sport utility vehicles (SUVs) in the vehicle fleet during the 1980s and 1990s slowed the rise of vehicle fuel efficiency considerably, recent significant increases in fuel prices have renewed interest among consumers in vehicle fuel efficiency, and we are likely to see another ramp up in fleetwide fuel efficiency in the coming years; while such a trend is good news for the environment, it's bad news for a highway finance system dependent on per gallon fuel taxes. Recent analyses suggest that hybrid vehicle sales grew twenty fold between 2000 and 2005 from 9,400 to over 200,000 and are expected to reach 1.5 million vehicles by 2025; the very high fuel efficiency of many hybrid vehicles promises to further diminish the buying power of the fuel tax (United States Government Accountability Office, 2006).

A common supplement to fuel taxes for transportation projects are sales or property taxes. However, this mechanism is regressive to both income and road network use, unfairly distributing costs to non-users of the transportation networks (Sorensen & Taylor, 2005). While many critics cite equity concerns in new road pricing systems, the current funding system can be viewed as inequitable as well – just with a different set of winners and losers (Sorensen & Taylor, 2005). In fact, road pricing mechanisms can minimize inequity more efficiently than the inequity in sales or property taxes. By using tolling revenue to subsidize public transit, road pricing benefits lower-income groups. Additionally, DeCourla-Souza developed the FAIR lane concept, which provides credits for occasional use of HOT lanes (Sorensen & Taylor, 2005).

Compounding the decreasing purchasing power of the fuel tax is the increasing expense of maintenance of existing infrastructure, which has for many years risen faster than the Consumer Price Index, meaning that higher proportions of state transportation budgets are spent on maintenance and rehabilitation instead of constructing new capacity (Wachs, 2003). Additionally, multi-modal transportation agencies are frequently tasked to mitigate the effects of highway construction by funding public transit projects, which further diverts highway funds from roadway construction and maintenance.

While revenue generation is clearly a strong motivation behind many recent electronic roadway tolling projects, among these only mileage-based fee schemes aim to replace the fuel tax. Most of the other programs and projects aim to supplement existing transportation revenues sources, often by financing particular road or transit projects. Several studies have concluded that, given their sometimes narrow scope, it is unlikely that most road pricing projects could completely replace the fuel tax. According to Weinstein, et al., "one cannot estimate with even rough precision the likely toll revenue generated statewide from new facilities (2006 p. 60)" in California. However, tolls are widely considered a promising supplement to fuel tax revenues that are likely to generate the most significant revenues (1) in congested corridors where few alternatives exist or (2) in areas experiencing substantial population growth (Weinstein, et al., October 2006). Consistent with this observation, a majority of the case studies examined in this paper, such as the SR-91 Express Lanes and the MnPass program, have occurred in areas with rapidly growing populations amid congested road networks.

In the case studies we examined outside of the United States, the demand for additional revenue mostly stemmed from a need for specific capacity expansions or transit improvements, rather than as a more general strategy to fund maintenance of the roadway system. For example, in both Toronto and Santiago, tolls were put in place specifically to fund new road capacity projects. In Austria, the high-cost of maintaining a road network traversing the Alps and used widely by non-Austrians prompted a search for a new, targeted revenue stream. Austria was also faced with an EU mandate to reduce transportation-related debt. Finally, we find that electronic roadway tolling programs outside of the U.S. are more likely dedicated to fund public transit or inter-city rail in addition to road maintenance.

Managing Congestion and the Need for New Capacity

Even if the current funding systems were sustainable, traffic congestion is rapidly increasing in cities around the world. Mitigating this growth in traffic by adding capacity is very expensive, particularly in already built up areas. Such supply-side approaches to addressing traffic congestion have come under increasing criticism for being inefficient and environmentally unsustainable.

Clear demand for new capacity is highest in areas with rapid population growth, such as in Orange County, California and Houston, Texas, where available revenues have fallen far short of funding desired new road capacity. Within the United States, between 1993 and 2002, lane-miles increased by 0.2 percent annually while traffic demand increased by 2.5 percent annually. Within the U.S.'s urban highways, the lane miles increase by 51% while travel demand increased by 168 percent between 1980 and 2004 (Samuel, 2007). The Texas Transportation Institute's 2007 Urban Mobility Report examined differences between lane-mile growth and traffic growth. Metropolitan areas with significant traffic-capacity mismatches (defined by the TTI as traffic increases 45 percent greater than road capacity over a given time period) include Miami, Minneapolis-St Paul, San Diego, and Washington DC. Moderate mismatches (traffic growth was between 30 and 45 percent greater than road growth) include Seattle, New York, San Antonio, Denver, and Boston (Schrank & Lomax, 2007). Many of the metropolitan areas experiencing significant mismatches between traffic growth and road capacity are cities experimenting with road pricing options – such as San Diego, New York, and Minneapolis-St. Paul. Additionally, a U.S. Government Accountability Office (GAO) survey found that a state's rate of population growth is directly related to a state's likelihood to implement tolling (United States Government Accountability Office, 2006). While tolling have proven more politically acceptable in these rapidly expanding metropolitan areas, the density of vehicle travel – which is a function of population density and the share of a jurisdiction's population that resides in urban areas – is too low to support road pricing in more rural states like Montana, North Dakota, and Wyoming (United States Government Accountability Office, 2006).

In many congested places, road pricing not only provides the revenue to construct new capacity, but variable tolls can also signal where new capital investment is most needed. If a variable congestion toll is consistently high in order to maintain an uncongested flow of vehicles, this is an unambiguous signal of a location that should be targeted for capacity expansion (United States Government Accountability Office, 2006). Furthermore, road pricing encourages more efficient utilization of under-utilized facilities, such as HOV lanes, to aid increase throughput and reduce the need for new capacity. Often, converting existing un-priced or regulated lanes into managed HOT lanes can be more cost efficient than building new capacity because the free-flowing lanes move far more vehicles than congested ones. Experience shows, for example, that properly priced and managed HOT lanes move far more vehicles than parallel free, congested lanes (Replogle & Funderburg, 2006).

In many densely developed, congested areas like London or New York City, little or no space exists to widen traffic-clogged roads. In such places, cost-effective alternatives to constructing new capacity is needed – such as through using road pricing to increase the "effective capacity" of metropolitan road networks. While HOT lanes have proven to work well on congested highway links with previously under-utilized HOV lanes, cordon pricing has proven more effective in unclogging densely developed urban cores by both smoothing traffic flows in and out of central cities and shifting substantial numbers of travelers onto public transit. As such, cordon pricing in the U.S. is likely to work most effectively in the centers of cities like

Boston, New York, or San Francisco, as opposed to more sprawling places like Houston or Phoenix (Wachs, 2003).

Congestion Threatens Economic Development

Failing to successfully manage congestion can have direct consequence on a city's economic vitality, as reliable transportation networks are an essential component in any economic development strategy. Time loss due to congestion translates into economic loss. According to the Texas Transportation Institute's 2007 Urban Mobility Report, the time and fuel costs of congestion in 2005 amounted to $67.7 billion across the 85 urban areas in the United States, up from $59 billion in 2003. The 14 U.S. urban areas with populations exceeding 3 million were estimated to have wasted 1.7 billion gallons of fuel due to traffic delays alone (Schrank & Lomax, 2007).

As the case studies of Singapore, London, and New York noted, congested central business districts are widely viewed as bad for business. Mayors Bloomberg (New York) and Livingstone (London) received substantial, if not universal, support for congestion pricing from their respective city's business community. While loathe to pay tolls, the managers of most businesses value reliability of arrivals and departures of workers, customers, production inputs, and product outputs. In our increasingly global economy, the leaders of metropolitan areas around the world are vying for economic advantage, and a reliable transportation system is key to economic productivity. Although opponents of congestion pricing often cite economic losses to the central business district as a major concern, such arguments typically ignore the cost congestion delays impose on businesses.

Climate Change: Reducing Emissions

In addition to spurring economic development, many road pricing schemes were implemented with the goal of mitigating environmental impacts by smoothing traffic flows thereby lowering emissions. Santiago achieved this goal by constructing new road capacity to improve traffic flow, and Stockholm by reducing the number of vehicles on the road through a congestion fee. Although environmental concerns were a primary motivation in a few of the cases examined in this report, reducing emissions was generally a secondary consideration. As global climate change becomes central to more policy discussions, however, it is possible that emissions reduction may spur more road pricing initiatives in the years ahead.

As mentioned earlier, road pricing projects in Europe tend to tout to improvements in the general good, which include environmental enhancements and emissions reductions. The cases of London, Stockholm, Austria, and Switzerland all incorporated environmental concerns in their stated programmatic objectives. The Stockholm congestion fee was particularly focused on reducing emissions, and included an evaluation that measured changes in emissions levels during the trial.

Although environmental goals have been more commonly cited in projects implemented outside of the United States, such objectives have not been absent from U.S. projects. For example, the Oregon Mileage Fee concept grew out of concerns for lagging revenue due to an increase in alternative fuel vehicles in the fleet, and rising gas prices. While environmental concerns and global warming have been on the forefront of European policy-making for years, the urgency of the climate change situation is starting to be reflected in American politics as well as the public becomes increasingly aware of the issue. The New York City congestion pricing proposal stems from Mayor Bloomberg's PlaNYC, which emphasizes environmental responsibility and sustainability. According to a 2006 Washington Post-ABC opinion poll of environmental trends within the United States, only 16 percent of American adults considered global warming/climate change to be the single biggest environmental problem the world faces, whereas a year later, 33 percent of American adults considered climate change to be the most significant environmental problem (The Washington Post, 2007). As climate change may be slowly creeping into the forefront of the American consciousness, new environmental attitudes may bode well for road pricing in the years ahead.

Charging Drivers for the Costs They Impose

Another recurring motivation across the cases is the desire to make roadway users pay for the costs they impose on society, particularly with the weight-distance and mileage based fee projects. In places where outsiders are frequently using and damaging roadways, charging these users in proportion to the costs they impose is both efficient and equitable. The damage imposed on the roadway is particularly unequal in regards to trucking. The road wear from a 40 ton truck can be up to 60,000 times higher than that of a car (Commission for Integrated Transport, 2006). Therefore, routes with heavy truck traffic occasion significantly higher maintenance costs than those roads that host few trucks. This problem is exacerbated when many users are just passing through and make little or no contribution to operation and maintenance revenues. In a fuel-tax system, foreign truckers can avoid paying for their share of utilization of the roadways by not purchasing fuel in that country, which is entirely possible in small European countries (Sorensen, 2006). Similarly, mileage-based fees charge users for the distance traveled, and thus indirectly for the damage occasioned on the road network. Variable road pricing measures provide a more accurate reflection of road wear and tear than the fuel-tax. With a fuel tax, an individual with a fuel-efficient vehicle will pay less to use the same road network as an individual with a lower gas-mileage. While this system might be efficient in reducing fuel consumption or gas emissions, it fails to reflect the costs imposed on the roads.

The goal of making people pay for the costs imposed by their driving was a common motivation for the cordon tolls, such as in Singapore and Stockholm. In contrast to efforts to price trucks, however, the emphasis tends to be on "internalizing" the costs congestion delays and vehicle emissions rather than roadway damage. In that, road pricing causes people to be aware of the costs their travel choices impose on society, drivers make better informed and more societally optimal decisions about when, where, and even whether to drive.

Private Investments

Private investments are playing an increasingly important role in transportation projects around the globe, and the ability to electronically toll roadways has played a critical role in attracting these investments. As global capital firms seek alternatives to traditional investments, electronic toll roads have proven attractive (Replogle & Funderburg, 2006). Prior to 1990, private investments in transportation infrastructure were rare. But during the 1990s, this began to change, and by 1998 nearly $30 billion in private capital had been invested in transportation infrastructure around the globe (Replogle & Funderburg, 2006). And by 2006, Goldman Sachs estimated that $250 billion in private capital was available for private infrastructure investements worldwide (Samuel, May 2007).

Private investment in transportation infrastructure can take many forms, ranging from private contract operation of public facilities, to complete finance, design, build, and operation of roads and the like. Private investments in public transportation facilities are supposed to allow governments to secure infrastructure improvements without a full public assumption of risk. Evidence suggests that roadways are often operated more efficiently by private firms, who tend to be politically freer than public entities in setting tolls at optimal levels. Additionally, some research suggests that governments around the world are more likely to invest in areas widely viewed as direct, public responsibilities, such as emergency health care, education, and police, than in infrastructure that can be publicly or privately funded (Hensher & Puckett, 2005).

The case studies reviewed here suggest that a correlation exists between the local demand for new capacity and the popularity of public-private partnerships. This is because private investments can speed the development of new facilities and correspondingly reduce public-sector risk. Austria, Orange County, California, and Toronto have all witnessed significant private investment in transportation infrastructure in recent years, financed via toll revenues. While facility congestion tolls appear to be the most common form of road pricing involving the private sector, an increasing number of banks are expressing interest in financing area-wide congestion pricing schemes, which could serve as the next major venue for private investment in road pricing (Hensher & Puckett, 2005).

In the United States, many road pricing initiatives have been inspired, funded, or both, by federal legislation. The current Bush administration supports privatization in a wide variety of policy fields, including transportation. Secretary of Transportation, Mary Peters, has made clear her support of private investments in road pricing. This support for privatization has translated into legislation and funding that supports innovative public-private partnerships (though such efforts have been tempered by some wariness in Congress, particularly from Transportation and Infrastructure Committee Chair James Oberstar). The 2005 federal surface transportation legislation, dubbed "SAFETEA-LU," expanded the role that the private sector could play in financing transportation infrastructure. While these policy initiatives indicate that public-private partnerships will most likely play a waxing role in the future of transportation investment, the experience of Orange County's SR-91 serves as reminder of the importance of long range transportation planning and careful contract negotiation.

Federal Incentives & Legislative Changes

Many of the electronic road pricing pilot projects are the result of incentives developed by a higher governing body. The European Commission supports member states in developing urban road pricing schemes that aim to internalize the external costs of private vehicle travel (CERTU, 2007). The federal government in the U.S. has in recent years provided both funding and other incentives for road pricing pilot projects. In addition, federal and state enabling legislation is often required before cities, counties, regions, or states can pursue road pricing projects (May & Sumalee, 2003).

In the U.S., the Value Pricing Pilot Program, authorized as part of Intermodal Surface Transportation Efficiency Act (ISTEA) of 1991, encouraged states, regions, and local governments to develop and evaluate congestion or "value" pricing approaches to managing congestion. In doing so, the ISTEA legislation loosened many pre-existing federal regulations regarding tolling in Interstate roadways (United States Government Accountability Office, 2006). The Value Pricing Pilot Program funded road pricing experiments in San Diego, Houston, and Minneapolis during the 1990s.

In 2005, SAFETEA-LU created incentives and room for jurisdictions to experiment with a broader array of road pricing initiatives. The bill requires state transportation plans to focus on four objectives: (1) improve mobility, (2) promote economic development, (3) minimize fuel use, and (4) minimize air pollution (Replogle & Funderburg, 2006). Additionally, SAFETEA-LU established 15 express lane demonstration projects with the goals of managing high congestion levels, reducing emissions to meet the Clean Air Act requirements, and/or financing new capacity. In addition, SAFETEA-LU authorized states to convert underutilized HOV lanes to HOT lanes. As noted above, SAFETEA-LU also created space for greater private sector involvement in transportation policy and planning. Most recently, the Urban Partners Agreement (UPA) incentivizes municipalities to consider road pricing as a method of reducing congestion. UPA is a component of the U.S. Department of Transportation's *National Strategy to Reduce Congestion on America's Transportation Network,* which focuses on reducing traffic congestion by promoting the "Four Ts" – tolling, transit, telecommuting and technology. As of March 2008, New York City, Miami, Minneapolis-St. Paul, Seattle, and San Francisco were all exploring the feasibility of road pricing with the promise of federal funds to help implement the proposals. However, by failing to attain appropriate legislative approval by the April 7, 2008 deadline, New York forfeited federal funds for both road pricing and traffic congestion relief initiatives. As the New York case study illustrated, even the promise of federal funding sometimes is not enough to overcome substantial political hurdles.

Political Champions: Selling Projects to the Public

With Jan Goldsmith in San Diego, Ken Livingstone in London or Michael Bloomberg in New York, many road pricing schemes have had passionate and influential political champions. The voice of an influential leader has frequently proven essential to communicating the sometimes opaque logic of road pricing to an often skeptical populace. While ideas about non-linear effects, internalizing externalities, and allocating scare public resources with prices may be well-understood by many transportation planners and economists, persuasive rhetoric from a trusted leader is often required to sell economic theory to wary policy makers and a skeptical public.

While a clear political champion has often proven key to moving road pricing experiments along, well-organized coalitions in support of road pricing can serve a similar role in the absence of a widely visible political champion. For example, in Minnesota, a task force of local officials, citizens, and business leaders convened to explore and promote road pricing with the conversion of HOV lanes to HOT lanes (United States Government Accountability Office, 2006). The more controversial the proposal, however, the greater the need for a steadfast political champion, such as Ken Livingstone or Michael Bloomberg.

In addition, politicians today find themselves answering to accountability demands from a public in favor of improved transportation networks. The bridge collapse on I-35 in Minnesota in the summer of 2007 placed the spotlight on the nation's aging infrastructure. As a result, the public has grown more accepting road financing alternatives, such as road pricing. A 2007 survey conducted shortly after the bridge collapse by the AAA Mid-Atlantic concluded that, while 54 percent of respondents opposed increasing gas taxes to pay for increased road and bridge maintenance and repair, 57 percent would support tolling for this purpose (Poole R. W., 2007).

Beyond concerns over failing infrastructure, constituents in many states have lost faith in the ability of federal government to make sound transportation policy decisions, given the significant rise in transportation earmarks in each of the last three pieces of federal transportation legislation – such as Alaska's notorious "bridge to nowhere." SAFETEA-LU contained 5,700 earmarks, totaling $21.1 billion, compared to just eleven such projects in 1982 (Samuel, 2007). Thus, as the public becomes increasingly dissatisfied with transportation policy status quo, politicians may be more likely to explore new innovative approaches to transportation funding and management.

Of course these political leaders do not ascend to power in a vacuum. All require the support of various coalitions and interest groups, which can have a profound effect on the political agenda. Examples of these influential organizations are discussed in the next section. Based on the information gathered on the cases reviewed within this paper, however, it is difficult to decipher just how significant a role these groups play in shaping a politician's actions versus the influence of the particular leader. The literature analyzed for this research suggested that strong political leadership was often essential in ensuring the success of a program, irrespective of interest group politics. Unfortunately, untangling the relative contributions of interest groups and political champions to the success, or failure, of road pricing programs is beyond the scope of this paper.

Coalition of Supporters

Just as a broad array of motives contribute to the implementation of road pricing, so does a wide range of supportive interest groups. As the case studies demonstrate, these interest groups have proven far ranging – from business and economic development groups to environmental interests. In the New York proposal and the London scheme, many business leaders rallied around the cause of creating a more economically viable central business district that would attract corporations with a more reliable transportation system. Similarly, many environmental groups, such as Environmental Defense and Friends of the Earth, support road pricing in hopes that it will reduce resource consumption and emissions by discouraging solo driving in favor of public transit, ride sharing, biking, and walking. Environmental supporters often want to see revenue dedicated to the development of public transit options rather than the construction of additional capacity (Replogle & Funderburg, 2006). Another fequent group of supporters includes libertarian organizations, such as the Reason Foundation, whose members view road pricing as market driven approach to funding the construction and maintenance of our roadways. For pro-market groups, electronic tolling is also viewed as a way to encourage private investment in transportation networks, thereby minimizing the government's involvement in such large-scale endeavors. While these wide arrays of supporters often aid in the implementation of road pricing, the varied motivations of sometimes strange bedfellows can result in conflicts over implementation.

Political Traction: Success Cases from Around the World

Politicians hoping to introduce road pricing to their jurisdictions today have the luxury of being able to refer to a growing number of successful initiatives around the world. Not only are these projects successful in operation, but most of them have high levels of public support amidst smaller groups of sometimes vocal detractors. Stockholm, London, and the I-15 HOT lanes in San Diego County all have relatively widespread support among local voters. Such politically and operationally successful projects can assist political supporters in selling road pricing projects to skeptical elected officials and the voters who elect them. Furthermore, as more programs are implemented, the pioneers have worked out many of the kinks, and toolkits for successful projects are being developed as officials learn what aspects of road pricing do and do not work in which contexts. Many of the cases discussed in this report were heavily influenced by earlier projects – MnPass followed the lead of the I-15 HOT lanes, and New York attempted to follow the lead of London. Although congestion pricing had existed in politically closed Singapore for many years, the implementation of congestion charges in central London proved that the concept could work in a large, open, and diverse western city where politicians can easily be ousted from office (Hensher & Puckett, 2005). Not surprisingly, planners and elected officials interested in pricing frequently consult with those who have implemented road pricing elsewhere. For example, James Whitty of Oregon's Office of Innovative Partnerships and Alternative Funding travels around the United States to tout the idea of mileage-based fees in order to encourage other states to consider implementation. Momentum continues to build as more and more jurisdictions successfully implement road pricing initiatives, helping to dissipate public opposition.

CONCLUSION

In every place where pricing has been implemented or is being seriously considered, the status quo – that is the old system of transportation planning and finance – is in crisis. Whether the problem is insufficient revenue or choking congestion, transportation planners and policymakers around the world are struggling to keep pace with the rise in motor vehicle traffic, and are addressing the problems that such growth engenders. As with many other policy areas, technology is facilitating the development of innovative approaches to facilitating the transition from theory to reality. With respect to transportation planning and finance, we are at a unique juncture as the full range of possibilities for the potential of road pricing are only now being fully realized.

Perhaps in part due to the enabling technologies, the political attitudes towards road pricing have also shifted significantly in recent years, with the mayors of some of the world's largest cities now embracing road pricing. It is no longer political suicide to propose road pricing schemes, as constituents gradually come to see that road networks cannot simply be free to all comers, and worsening traffic congestion brings with it a host of costs. This is not to say that road pricing programs are now widely embraced. While significant opposition to road pricing still exists, it is slowly being quelled as the political momentum continues to build. Thus, technological advancements have combined with a shifting polticial landscape to rapidly altering how we view both transportation funding and congestion management in the years ahead.

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Appendix A

Table A-1: Primary and Secondary Motivations – Type of Road Pricing

	Technology	Revenue Shortfall	Reduce Congestion	Construction of New Capacity	Underutilized Existing Facility	Public-Private Partnership	Political Champion/Coalition	Federal Incentives	Legislative Changes	Distribute Costs to Users	Public Transit Investment	Economic Development	Environment Concerns	Replicating Successful Tolling Models
I-15 San Diego			2		1		1		2		1			
SR-91 Orange County		2	1	1		1			2					
QuickRide Houston			1		1				2					2
407 ETR Toronto	2	2	1	1		2								
MnPass Minnesota		2	1			2	1	2						1
Santiago			1	1		1							2	
Singapore			1							2	2	1	2	
Stockholm			1	2					2	2	2		1	2
London			1				1		1		2	1	2	
New York			1				1	2			2	1	2	1
Swiss HVF Truck Toll		1		2						1			2	
German Toll Collect		1					2			1				
Austria		1	2	2		1				1			2	
Oregon Mileage Fee		1					2	1		1			2	

Table A-2: Primary and Secondary Motivations - Geographic

	Technology	Revenue Shortfall	Reduce Congestion	Construction of New Capacity	Underutilized Existing Facility	Public-Private Partnership	Political Champion/Coalition	Federal Incentives	Legislative Changes	Distribute Costs to Users	Public Transit Investment	Economic Development	Environment Concerns	Replicating Successful Tolling Models
I-15 San Diego			2		1		1		2		1			
SR-91 Orange County		2	1	1		1			2					
QuickRide Houston			1		1				2					2
Oregon Mileage Fee		1					2	1		1			2	
MnPass Minnesota		2	1			2	1	2						1
New York			1				1	2			2	1	2	1
407 ETR Toronto	2	2	1	1		2								
Santiago			1	1		1							2	
Singapore			1							2	2	1	2	
Stockholm			1	2					2	2	2		1	2
London			1				1		1		2	1	2	
Swiss HVF Truck Toll		1		2						1			2	
German Toll Collect		1					2			1				
Austrian GO		1	2	2		1				1			2	

Table A-3: Primary and Secondary Motivations - Chronological

	Technology	Revenue Shortfall	Reduce Congestion	Construction of New Capacity	Underutilized Existing Facility	Public-Private Partnership	Political Champion/Coalition	Federal Incentives	Legislative Changes	Distribute Costs to Users	Public Transit Investment	Economic Development	Environmental Concerns	Replicating Successful Tolling Models
Singapore - 1975			1							2	2	1	2	
SR-91 Orange County - 1995		2	1	1		1			2					
I-15 San Diego - 1996			2		1		1		2		1			
407 ETR Toronto- 1997	2	2	1	1		2								
Austria – 1997		1	2	2		1				1			2	
QuickRide Houston - 1998			1		1				2					2
Swiss HVF Truck Toll - 2001		1		2						1			2	
London – 2003			1				1		1		2	1	2	
Santiago - 2004			1	1		1							2	
German Toll Collect – 2005		1					2			1				
MnPass Minnesota - 2005		2	1			2	1	2						1
Stockholm - 2006			1	2					2	2	2		1	2
New York – Present			1				1	2			2	1	2	1
Oregon Mileage Fee – Present		1					2	1		1			2	