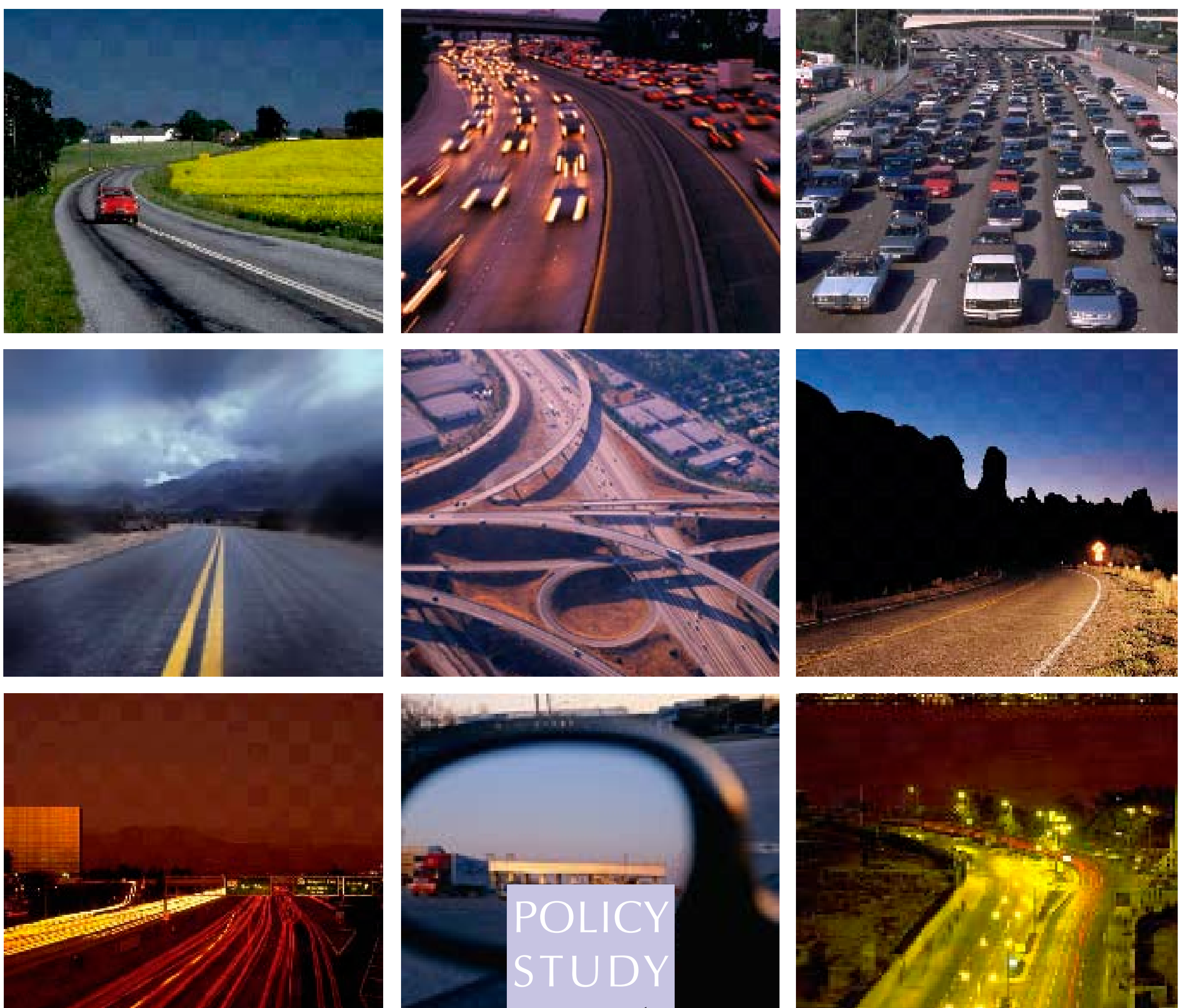
The Galvin Mobility Project

November 2006

Reducing Congestion in Atlanta: A Bold New Approach to Increasing Mobility

By Robert W. Poole, Jr.



POLICY STUDY 351

The Galvin Mobility Project

America's insufficient and deteriorating transportation network is choking our cities, hurting our economy, and reducing our quality of life. But through innovative engineering, value pricing, public-private partnerships, and innovations in performance and management we can stop this dangerous downward spiral. The Galvin Mobility Project is a major new policy initiative that will significantly increase our urban mobility and help local officials move beyond business-as-usual transportation planning.

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The Galvin Mobility Project

Traffic congestion is choking our cities, strangling our economy, and reducing our quality of life. Rush-hour delays rob us of time with our families, and commute times often dictate where we live and work. The impact our inadequate transportation network has on our economy is alarming. We waste an estimated $63 billion annually in time and fuel while sitting in traffic. Moreover, businesses and their customers bear enormous costs associated with traffic-related logistics problems, delivery delays, poor transportation reliability, and fewer potential employees within commuting distance.

This project is premised upon the conviction that the consequences of ignoring this threat will be dire. Inaccessibility leads directly to the depreciation of commercial and personal property values. This along with the gridlock will lead to the death of major cities in the United States and elsewhere in the developed world by mid-century if dramatic change is not implemented. But just as cardiac surgery can sustain our circulatory systems, we can prevent these clogged arteries that will stop the economic heart of cities from pumping.

The Galvin Project and the Reason Foundation have joined forces to develop practical, cost-effective solutions to traffic congestion, a policy initiative that will save our cities and significantly increase our urban mobility through innovative engineering, value pricing, public-private partnerships, and innovations in performance and management.

The old canard “we can’t build our way out of congestion” is not true. Adding innovative new capacity and improving the management of roads can eliminate chronic congestion.

A substantial new industry is developing as the private sector captures the opportunity in the value of our time wasted in traffic and seeks to profit from affordable, uncongested tollways. Public-private partnerships to build and operate these toll facilities have sparked innovations in engineering and design, overcoming obstacles such as limited right-of-way and noise pollution. Capital markets also provide access to much needed investment capital and ensure that new highway capacity is built where it is most needed.

In addition to adding road capacity, changing the way highways are managed can help to maximize the use of the capacity we have. The introduction of Intelligent Transportation System technologies can speed resolution to traffic delays, and electronic toll collection technologies can make extensive tolling practical. More importantly, variable pricing of lanes can keep traffic flowing all day by responding to changing demand.

Any city that ignores the threat and refuses to take up the challenge of eliminating congestion will find itself at an economic standstill by mid-century. We can solve our congestion woes. We can upgrade to an innovative, market-driven, world-class transportation infrastructure. We can change the institutions that guide our transportation decisions to create greater responsiveness, robustness, and efficiency. This project provides the ideas and tools needed to make change happen.

Reducing Congestion in Atlanta: A Bold New Approach to Increasing Mobility

By Robert W. Poole, Jr.

Executive Summary

Productive cities are mobile cities, and Atlanta's productivity is seriously threatened by rising traffic congestion. Congestion is increasingly clogging the arteries of metro Atlanta and threatens to strangle the region over the longer term. The ability to move goods and services quickly and efficiently, combined with the need to provide a high quality of life for workers and families, should put eliminating traffic congestion at the top of Atlanta's priorities. While the cost of eliminating traffic congestion will be significant, the consequences of ignoring this growing problem are dire.

The Atlanta metro area is already plagued by serious traffic congestion, whose direct cost is estimated at $1.75 billion per year. But if the current long-range transportation plan is implemented, by 2030 congestion will be much worse. A rush-hour trip that today takes 46 percent longer than at off-hours will take 67 percent longer in 2030 (defined as a travel-time index of 1.67), according to the Atlanta Regional Commission. (A recent Reason Foundation study found congestion in 2030 could be even worse than that, estimating that Atlanta's rush-hour trips will take 85 percent longer than at off hours - a level of gridlock worse than today's traffic in Los Angeles).

In December 2005, the Governor's Congestion Mitigation Task Force recommended a dramatic change in the focus of transportation planning, making congestion-reduction its principal focus. It set a goal of reducing Atlanta's travel-time index from today's 1.46 to 1.35 by 2030 (in sharp contrast to the current projected increase). While the leadership of all four principal transportation agencies signed on to these recommendations, no one has yet set forth the changes in transportation plans and investments needed to bring about this reduced congestion. That is the purpose of this report.

Our analysis concludes that Atlanta's current plan, of investing heavily in mass transit, carpooling, and land-use changes to reduce the extent of driving, is not compatible with the congestion-reduction goal. The current long-range plan, despite devoting the majority of its funding to transit and carpool lanes, would lead to no increase in the fraction of commute trips made by carpool, and a less than two percentage point increase in transit's low market share—while overall congestion soars.

The new approach we recommend deals with both major sources of congestion. For the half that is caused by incidents (accidents, work zones, weather, etc.), Atlanta should continue worthwhile efforts under way such as quicker identification of, response to, and clearance of incidents. On arterial streets, improvements in traffic signal coordination and access management will also help.

But for the other half of congestion—the kind that occurs every day during rush hours because demand greatly exceeds roadway capacity—there is no alternative to increasing the capacity of the roadway system. This does not mean paving over the landscape with ever more freeways, nor does it mean ignoring air quality mandates. Our modeling (using the Atlanta Regional Commission's traffic model) shows that a careful program of catch-up capacity additions over the next 25 years can substantially reduce congestion (vehicle hours of travel) without increasing total driving (vehicle miles of travel). Preliminary modeling suggests no adverse impacts on air quality. The result would be the elimination of the worst congestion (defined as Level of Service F) by 2030, and achievement of the Congestion Mitigation Task Force's travel-time index goal.

We devoted considerable attention to figuring out where the needed amount of new freeway capacity might go. We recommend four major projects, as follows:

- A network of express toll lanes added to the entire freeway system instead of the currently planned (but only partially funded) set of HOV lanes. These priced lanes would also function as the guideway for regionwide express bus service.
- A double-decked tunnel linking the southern terminus of Georgia 400 with I-20 and later with the northern terminus of I-675, providing major relief to the Downtown Connector (I-75/85), the most congested portion of the freeway system.
- Extension of the Lakewood Freeway eastward to I-20 as a tunnel, and westward to I-20 as a freeway, providing an additional east-west corridor and new access to the airport.
- A separate toll truckway system, permitting heavy trucks to bypass Atlanta's congestion in exchange for paying a toll; a portion of this system would be tunneled below downtown.

The estimated cost of these four mega-projects is $25 billion. By using value-priced tolling on nearly all of this new capacity, we estimate that more than 80 percent of the cost could be financed based on the projected toll revenues. And to reduce the risks inherent in such mega-projects, we recommend that they be carried out under long-term concession agreements in which the private-sector partners would bear the risks of cost overruns and revenue shortfalls. Projects of this scale are being done successfully under concession arrangements in Europe and Australia.

There would be large benefits from implementing this approach. Valuing the time saved at a conservative $12 per hour, the time savings over 20 years would be more than $98 billion. That means the time saving benefits alone would be nearly four times the $25 billion cost. But there would also be major economic benefits. Studies have shown that by allowing employers to recruit from a wider radius (and employees to seek jobs within a wider radius), better matches of skills with needs would occur, making Atlanta's economy more productive.

Individual motorists would benefit every day, as average trip times would be shorter than today, rather than considerably longer. With a network of uncongested priced lanes on the whole freeway system, everyone who signed up for a windshield-mounted transponder would have the peace of mind of knowing that he or she had a time-saving option available, whenever it was really important to get somewhere on time. And the region's transit providers would gain the virtual equivalent of a network of exclusive busways, since the priced lanes would permit reliable, uncongested bus operations at all times.

Atlanta, long known as the crossroads of the South, is at a crossroads in transportation policy. Continuing down the status-quo road leads to a future of costly transit and carpool-lane expansion--but much worse congestion. The road suggested by the Congestion Mitigation Task Force, as interpreted in this report, accepts the reality that cars and trucks will continue to be the mainstays of transportation in Atlanta, and expands the highway infrastructure in smart, new ways to cope with that reality. This road promises a future of less congestion than today, and of new mobility options—for motorists, for bus users, and for trucking.

This report's recommendations, covering the next 25 years, should constitute the first phase of a longer-term plan to eliminate congestion as an everyday occurrence. Atlanta will still be faced with considerable congestion after 2030, especially if the region continues to grow. A longer-term vision should aim at making the highway system work so well that everyday congestion is eliminated, and congestion due to incidents is reduced to a bare minimum. To implement such a vision will require a continued combination of technology, capacity, and pricing, building upon what is set forth in this report.

"Congestion results from poor policy choices and a failure to separate solutions that are effective from those that are not," said former Transportation Secretary Norman Mineta in May 2006. We hope Atlanta will make wise policy choices for greatly increased mobility.

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Part 1

Atlanta's Congestion Problem

A. Introduction

Traffic congestion is a huge and growing problem in the 20-county metropolitan Atlanta region. At present, it takes 46 percent longer to go somewhere at rush hour, when congestion is severe, than during off hours. Researchers define this as a Travel Time Index of 1.46. If all the improvements to the region's transportation system included in the current long-range transportation plan, *Mobility 2030*, are implemented, by 2030 congestion will be so much worse that the same rush-hour trip will take 67 percent longer than during off-hours (i.e., the index will have increased to 1.67), according to the Atlanta Regional Commission. A recent Reason Foundation study found that congestion in 2030 could be even worse, reaching a travel-time index of 1.85.[1] To be conservative, we will continue to use ARC's estimate of 1.67 in this report.

Even the current level of congestion imposes serious costs on individuals, businesses, and the regional economy. The annual *Urban Mobility Report* from the Texas Transportation Institute estimates that, as of now, Atlanta drivers spend 104 million person-hours sitting in congested traffic.[2] This wasted time, along with wasted fuel from inefficient stop-and-go driving, totals $1.75 billion per year in delay costs, the equivalent of $1,127 per commuter per year. And these costs will increase significantly, if the approach represented by the current long-range transportation plan remains the region's approach to traffic congestion.

Fortunately, it appears that Atlanta's transportation leadership is beginning to rethink the status quo approach to congestion. In December 2005, the Governor's Congestion Mitigation Task Force made several landmark recommendations that, if fully implemented, would lead to significant *reductions* in future congestion.[3] Specifically, the three recommendations were:

1. Change the selection process for projects in the long-range transportation plan to increase the weighting factor for congestion reduction from 11 percent to 70 percent.

2. Develop and implement, among all four transportation agencies, a technically consistent and transparent methodology for benefit/cost analysis, to use in project selection.

3. Use the Travel Time Index as the principal measure of congestion, with a goal of reducing that index to 1.35 by 2030 (compared with the 1.67 it would otherwise reach).

These changes represent a bold step forward. If implemented and followed through, they would put Atlanta in the forefront of urban areas nationwide in committing to serious *reductions* in traffic congestion, rather than (at best) holding the line or (more typically) conceding that congestion will continue to get worse over time (as is the case with the current long-range plan).

But it is one thing to set an aggressive goal for reducing congestion. It is far more challenging to figure out how to actually go about implementing that goal. What would it mean to refocus transportation planning and investment on large-scale congestion reduction? To what extent could this be done by re-allocating existing resources (due to the change in emphasis when selecting projects)? To what extent would it require net new resources, either from taxes or tolls? And what sort of improvements to the transportation system would such an approach implement?

These are the kinds of questions this report sets out to address. It is part of a national Reason Foundation research project, the Galvin Mobility Project, whose purpose is to focus national attention on eliminating serious traffic congestion as a major urban problem in America.[4] Much of the project is doing research on why congestion has become so severe and what we've learned about what works and what doesn't work in reducing it. In addition to that research, the project is doing a small set of case studies that apply what is being learned from the research to several specific urban areas – including Atlanta. While time and resources do not permit this Atlanta case study to get to the level of detail that would be ideal, we hope this report will be sufficiently provocative and persuasive to inspire further, more detailed research, along the lines suggested here.

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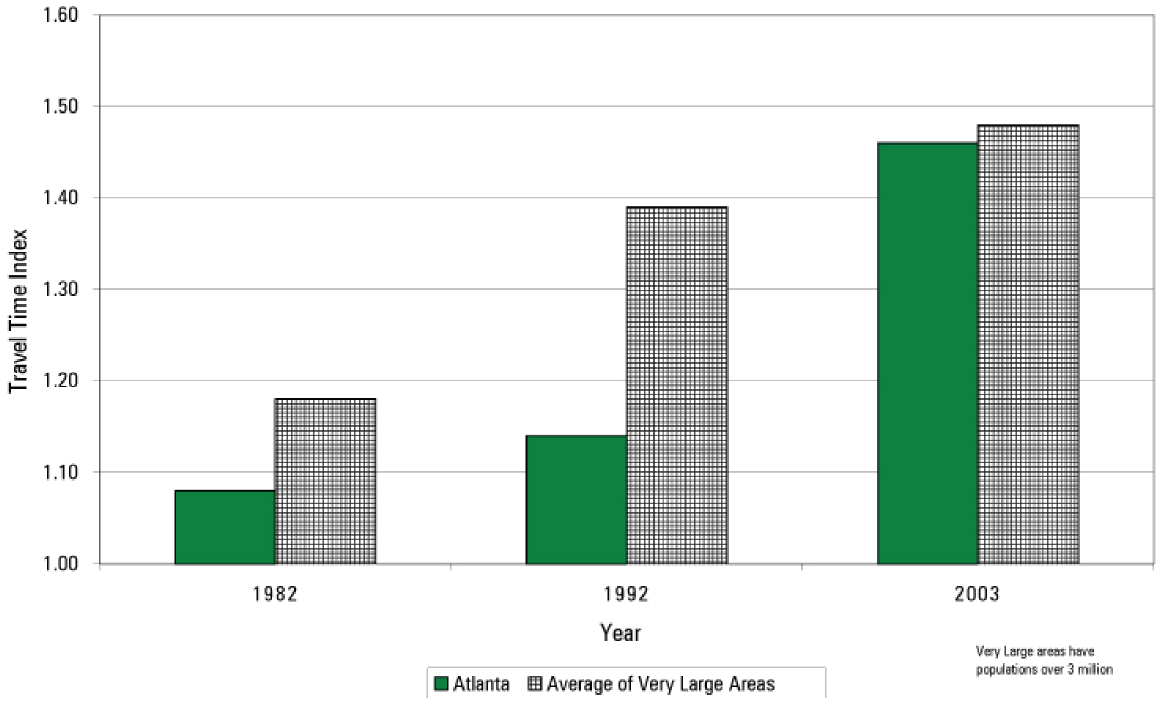
B. Dimensions of the Congestion Problem

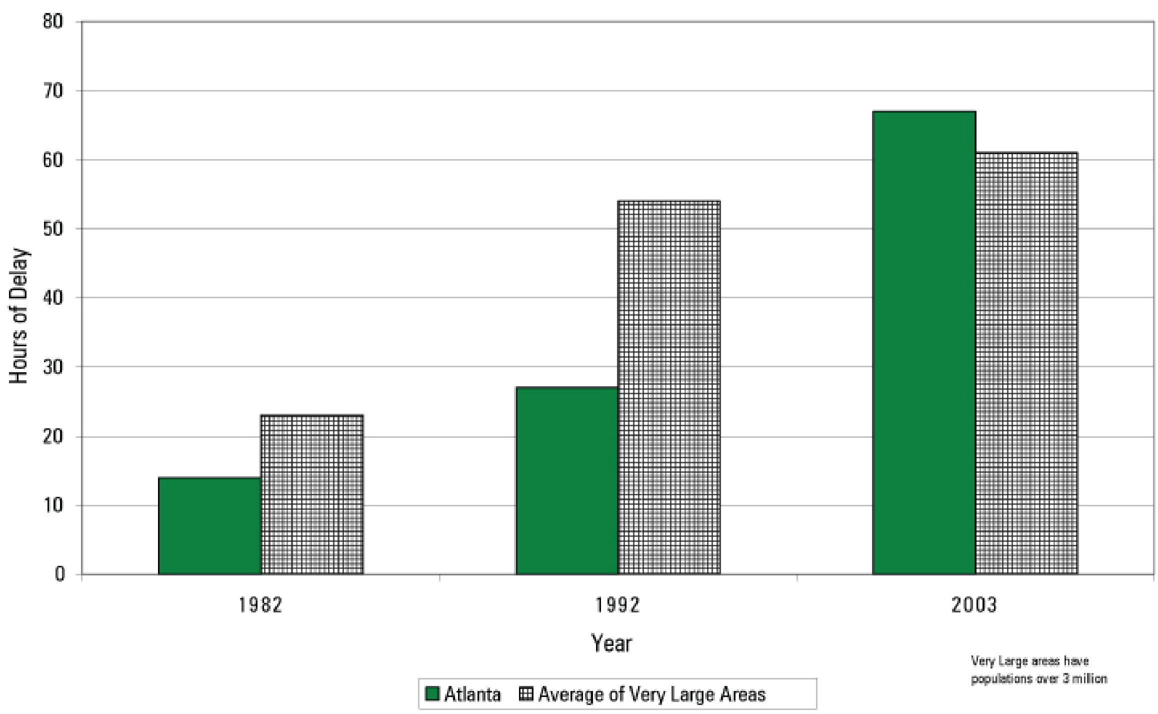
During the 1970s and 1980s, Atlanta's congestion was relatively modest for a major metro area, as can be seen in Figure 1. In 1982 and again in 1992, Atlanta's Travel Time Index was far below the average for "very large" urban areas. But by 2003, it had increased dramatically, as can be seen. The growth in delay per peak traveler was even more dramatic, as depicted in Figure 2. Whereas Atlanta's delay figure was half the average level for very large areas as recently as 1992, by 2003 it had begun to exceed the average for very large urban areas. It seems clear, in retrospect, that the kinds of transportation investments made (or not made) over the past 15 years have permitted an enormous increase in traffic congestion.

Figure 1: Growth in Atlanta's Travel Time Index



Source: Texas Transportation Institute

Figure 2: Growth in Atlanta's Delay per Peak Traveler



Source: Texas Transportation Institute

Congestion affects all of Atlanta's roadways, but since the freeways and arterials handle the lion's share of all traffic, our focus will be on those portions of the roadway system. Congestion is at its worst during the peak periods of each weekday, generally defined as from 6 to 10 AM and from 3 to 7 PM. And while a large fraction of peak-period trips are not simple work-to-home trips, commute trips are the focus of most transportation planning, since those are the trips that must be made during those hours. Table 1 shows how Atlantans typically made their work trips in 1990 and 2000. As can be seen, between driving alone and carpooling, the automobile totally dominates the work trip, at more than 90 percent. The largest changes in mode share between these two census years were (1) the decline in transit's share, from 4.6 percent in 1990 to 3.5 percent in 2000, and (2) the increase in working at home (mostly telecommuting), which grew from 2.2 percent to 3.5 percent.

Driving provides the quickest trip, despite the added time due to congestion.

Table 1: Work Trip Distribution, Atlanta Metro Area, 1990 and 2000

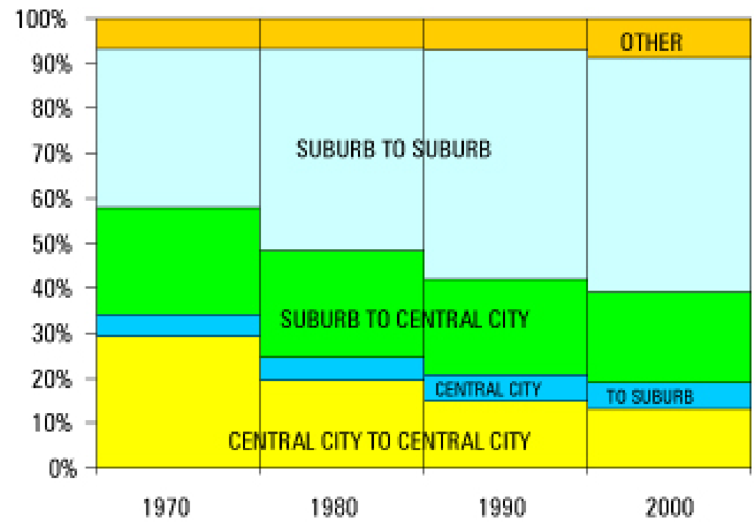
Travel Mode	1990 Mode Share	2000 Mode Share	Mean travel time, 2000 (min.)
Drive alone	78.0%	77.0%	26.8
Carpool	12.7%	13.6%	30.2
Transit	4.6%	3.5%	47.4
Bicycle	0.1%	0.1%	13.1
Walk	1.5%	1.3%	13.1
Work at home	2.2%	3.5%	n.a.
Other	0.9%	1.0%	n.a.

Source: U.S. Census data for 2000, 1990

From the travel time data, it should be clear why the automobile predominates. Except for the short work trips that can be made by foot or on bicycle, driving provides the quickest trip, despite the added time due to congestion.

Another key factor in understanding commuting in Atlanta is to realize that the stereotypical view of people journeying from suburbs to the "central business district" to go to work, whether by car or by transit, is increasingly inaccurate when it comes to actual work trips in the 20-county region. Figure 3 shows how the pattern of commuting has changed over the past four decades, to the point that suburb-to-suburb trips are now the predominant category. The same phenomenon has occurred in most metro areas during this time period.

Figure 3: Atlanta Work Trip Flows: 1970-2000



Suburb-to-suburb trips are now the predominant category. The same phenomenon has occurred in most metro areas

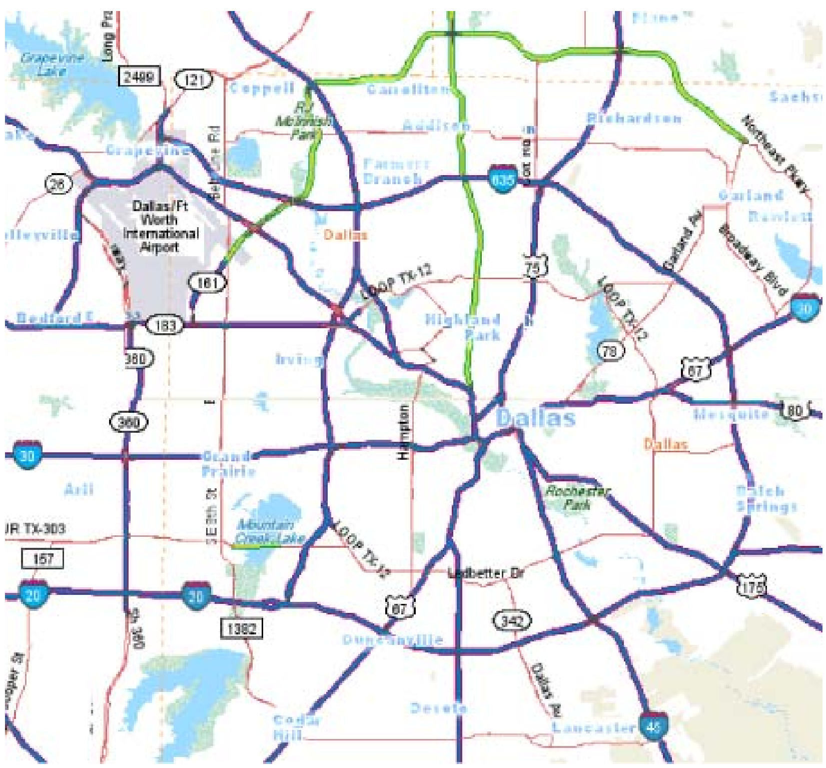
Given the continued predominant role of the automobile, and the suburb-to-suburb pattern of commuting, Atlanta's transportation system seems poorly matched to the Atlanta of today (as opposed, perhaps, to the Atlanta of 1970). Atlanta's freeway system is predominantly radial in nature—i.e., designed to feed traffic to and from the traditional central business district. Yet some 1,500 square miles have been added to the urbanized area since 1970 without any suburb-to-suburb freeway additions. Second, the Atlanta area lacks a regional grid of major arterials, which in other Sunbelt metro areas provides an important supplement to the freeway system. Most of the population growth of metro Atlanta since the 1960s has taken place outside the I-285 Perimeter, yet much of the new transportation capacity (such as the MARTA heavy rail system) has been added within the Perimeter. As a result, "Atlanta, which is one of the least core-oriented urban areas in the world, has one of the most core-oriented roadway systems."[5]

Figure 4 compares the Atlanta freeway system with those of several other Sunbelt metro areas, drawn to the same scale. As can be seen, these other regions tend to have much better suburb-to-suburb connectivity, as well as a denser grid of freeways (backed up by a grid of multi-lane arterials).

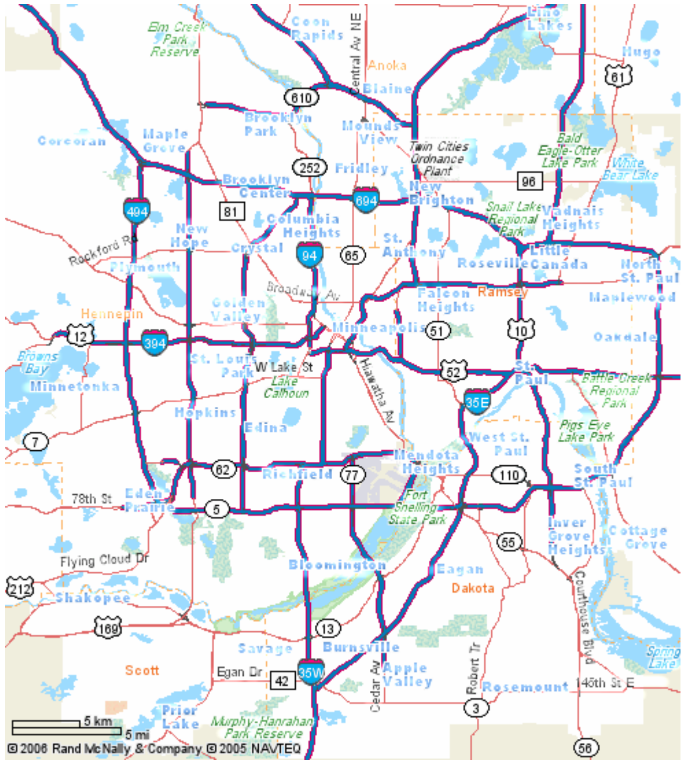
Figure 4: Atlanta Freeway System Compared with Other Large Metro Areas

Atlanta

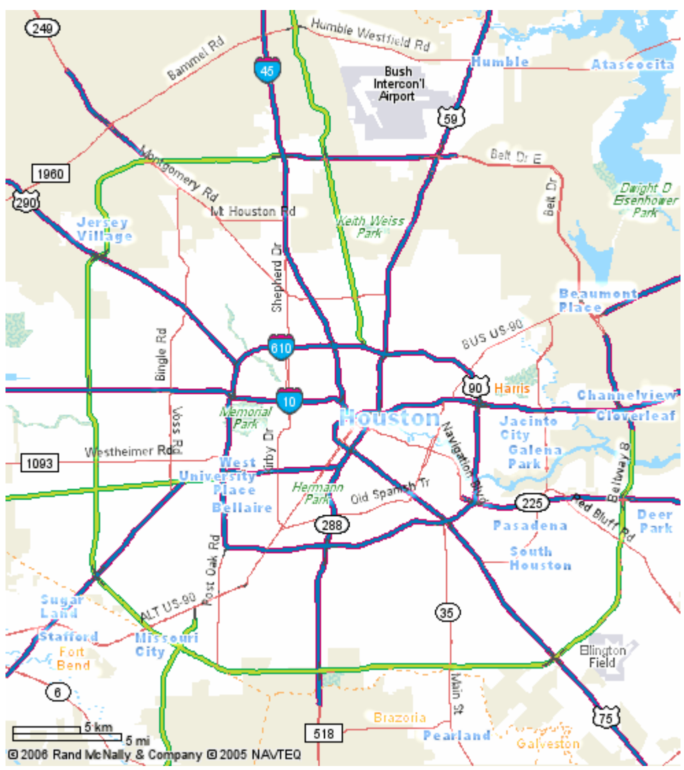
Dallas



Minneapolis



Houston



Source: Cox and Pisarski, *Blueprint 2030,* http://ciprg.com/ul/gbt/atl-report-20040621.pdf.

Next we show how the lack of a good arterial system overloads the freeway system. The data in Table 2 compare metro Atlanta's freeway and arterial systems with those of comparable urban areas. Atlanta has the heaviest intensity of freeway use, as measured by daily freeway vehicle miles traveled (VMT) per lane-mile. It also has only one-third to one-half as many lane-miles of arterial per square mile as comparable metro areas, so that even though Atlanta's arterials are heavily loaded, they cannot take on much of the traffic load (compare Phoenix's daily arterial VMT of 18.1 million with Atlanta's 10.3 million).

Table 2: Comparative Data on Freeways and Arterials, Large Urban Areas, 2003

Urban Area	Population (000)	Freeway VMT (000)	Freeway lane-mi	Freeway VMT 000)/ lane-mi	Arterial lane-mi.	Area (sq. mi.)	Art. lane-mi per sq. mi.	Art. VMT (000)
Atlanta	3,005	43,590	2,285	**19.08**	1,390	1,830	**0.76**	10,300
Dallas	4,300	51,870	3,105	16.70	4,050	1,935	2.09	25,810
Denver	2,050	17,960	1,140	15.75	1,820	855	2.13	14,675
Houston	3,750	46,665	2,460	18.97	2,900	1,800	1.61	19,290
Mpls/St Paul	2,475	27,580	1,590	17.52	1,325	1,245	1.06	8,530
Orlando	1,260	10,570	780	13.55	1,710	680	2.51	13,865
Phoenix	3,005	23,610	1,325	17.82	3,060	1,140	2.68	18,095

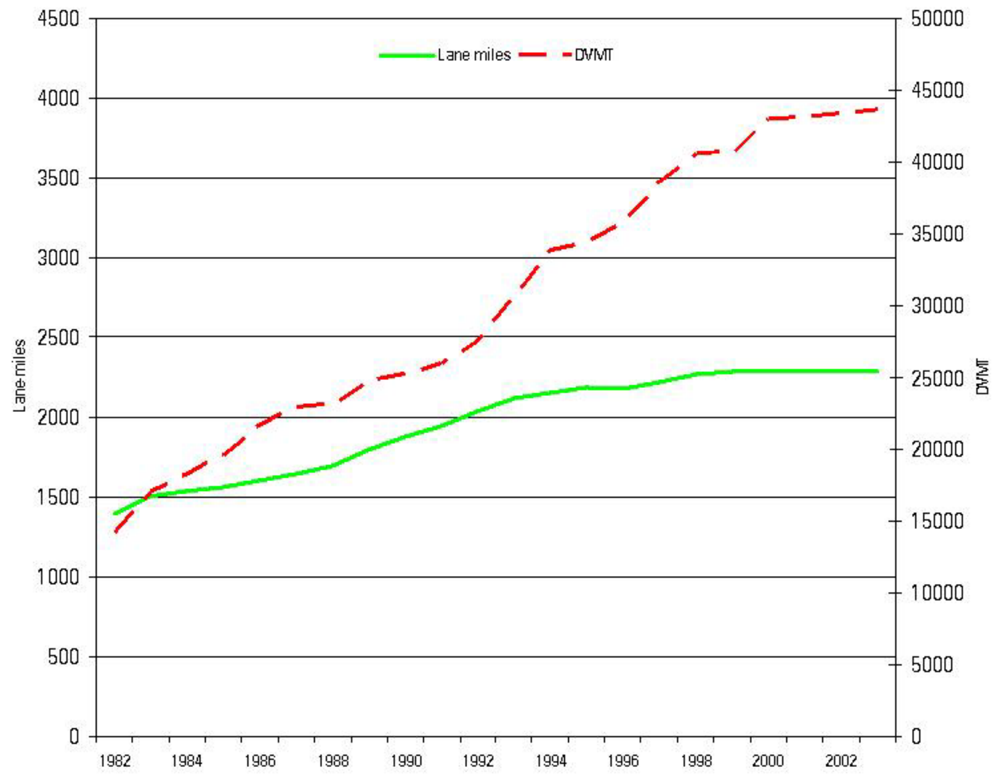
Source: Texas Transportation Institute, "congestion data" spreadsheet at http://mobility.tamu.edu

We can now return to the question of what happened during the 1990s that led to the sharp increase in traffic congestion that we can associate with the severe overloading of the freeways and the lack of arterial capacity noted above. Figure 5 shows that during the 1980s, as Atlanta expanded and driving grew along with it (the steady growth of daily vehicle miles traveled—VMT), the freeway system was expanded at a steady pace, as had been done in the 1970s as well. But starting in about 1992, the annual addition of freeway lane-miles suddenly slowed down, and by 1999 had stopped altogether. This was at least partially a response to the region becoming a non-attainment area under the Clean Air Act. Freeway VMT continued to grow, at more or less the same rate as before until 2001, when the combination of a recession and severe freeway overloading slowed freeway traffic growth, as well. What seems to be happening now, with the freeway system beyond its capacity in many places, is the spillover of traffic onto arterials, minor arterials, collectors, and even neighborhood streets.

Even the freeway expansion that did take place before the slowdown and stop was far less than the growth in traffic volume. From 1988 to 1998, VMT in the seven county core area of metro Atlanta increased by 59.6 percent. Yet the capacity of freeways, arterials, and collectors in those counties increased by only 16.2 percent.[6] Thus, traffic increased two and a half times as fast as roadway capacity during the decade before expansion stopped.

The highway capacity data also show a decrease in principal arterial lane-miles from 2,245 in 2000 to only 1,380 in 2001. These are figures reported annually by GDOT to the Texas Transportation Institute.[7] The explanation is that a number of arterials were downgraded from principal arterials to minor arterials or lower, which is unfortunately just the opposite of what motorists needed as freeway-building ground to a halt.

Figure 5: Freeway Lane-Miles vs Daily VMT



Source: Texas Transportation Institute "congestion data" spreadsheet.

C. The Full Cost of Congestion

The annual data presented in the Texas Transportation Institute's *Urban Mobility Report* are useful for tracking the growth of congestion over time, and for comparing its intensity in different urban areas. But it should be understood that the wasted time and fuel totaled up in these annual tabulations does not constitute the full cost of traffic congestion.

The chief economist of the U.S. Department of Transportation (DOT) has provided a more complete estimate of national traffic congestion costs. In addition to the $63.1 billion in wasted time and fuel reported by TTI for the largest metro areas, add another $12.8 billion for similar costs in all other metro areas. DOT estimates $38 billion in annual costs due to productivity losses (discussed below), another $38 billion due to unreliability, $3.8 billion due to cargo delay, and $12.6 billion in safety and environmental costs of congestion. The total then amounts to $168.3

billion, more than double the widely reported TTI figure.[8] Applying that ratio (168.1/63.1) to the TTI congestion cost figure for Atlanta ($1.75 billion), we estimate that the true annual cost is more like $3.9 billion.

To understand what leads to a more expansive definition of congestion costs, consider trucking. While truck congestion is counted in the Institute's methodology, the value of time used for trucks reflects only the hourly operating cost of trucks, not the value of trucking services to shippers. Trucks carry approximately 93 percent of the freight moved in the Atlanta area, according to the recent study of truck-only toll lanes.[9] Commercial vehicle traffic is expected to increase by 50 percent over the next 25 years, according to projections by the Atlanta Regional Commission. Atlanta is the trucking crossroads of the south, playing a major role in America's sophisticated logistics system, which depends increasingly on just-in-time delivery. In addition to wasting time, congestion wreaks havoc on the reliability of truck pick-up and delivery schedules, a cost that although very real, is not included in the *Urban Mobility Report* figures.

Several years ago, the National Cooperative Highway Research Program (NCHRP) funded pioneering research attempting to get a handle on the cost of congestion to regional businesses.[10] As noted above, congestion interferes with just-in-time delivery systems, thereby increasing inventory costs. It reduces the availability of skilled workers, and raises payroll costs needed to attract such workers. It shrinks the market area for local firms' products and services. And it reduces the range of job opportunities for workers.

The NHCRP research team used Chicago and Philadelphia to gather data enabling them to do some preliminary modeling of these effects. On the logistics effects, they estimated that a 10 percent reduction in congestion would save businesses $980 million per year in Chicago and $240 million a year in Philadelphia. The labor market effects were estimated at $350 million in Chicago and $200 million in Philadelphia.

The labor market impacts of congestion have also been researched in France and Korea. The basic idea is that, on average, most people will not spend more than a particular amount of time each day on the journey to work. As congestion gets worse, the number of miles they can go within this amount of time gets smaller. You can think of this as a radius of job opportunities centered around the person's home. When congestion is low or zero, that radius is quite large, but in a highly congested region like Atlanta, it is much less. But since the area of a circle is proportional to the radius squared, the area of a 20-mile radius circle is four times that of a 10-mile radius circle. If work possibilities are randomly distributed across the landscape, the 20-mile circle will include four times as many job opportunities as the 10-mile circle. And the same applies in reverse for an employer. It will have four times as many potential employees within a 20-mile circle as a 10-mile circle.

To those who study labor markets, this is not simply a matter of it being nice that people have more choices. In a large and diverse metro area, economic productivity depends on matching up skilled employees with employers who can make the best use of their abilities. When Remy Prud'homme and Chang-Woon Lee studied this question using data on travel times and labor productivity for

French cities, they reached some remarkable conclusions.[11] They found a robust relationship between the effective labor market size (the size of the available circle, as defined by acceptable travel time) and the productivity of that city. Specifically, when the effective labor market size increased by 10 percent, productivity (and hence economic output) increased by 1.8 percent.

Wendell Cox and Alan Pisarski applied the Prud'homme and Lee analysis to Atlanta in 2004. They found that a scenario that prevented the Travel Time Index from getting worse between then and 2030 would lead to a 2.4 percent increase in gross personal income in the Atlanta area. And a scenario that *reduced* congestion by 50 percent from current levels would increase personal income by 3.5 percent. Those numbers translate into increases of $2,450 and $3,560 per person in 2030.[12]

Congestion harms the citizens of Atlanta in many other ways, beyond those discussed above. With the roads gridlocked, emergency vehicles may be seriously delayed, meaning the paramedic may not get there in time to save a life, or the firefighters may not arrive in time to knock down a fire and save much of the building. With the after-work hours seriously congested, people may avoid restaurants and theaters that become too much of a hassle to get to. People's circles of opportunity are shrunk by congestion not just when it comes to employment. Congestion also shrinks their possibilities in entertainment, recreation, and social life. Even computer dating services report many participants being unwilling to be matched up with people who live more than X miles away, because congestion simply makes it too much of a hassle to try to develop a dating relationship.

Finally, there is also the issue of economic competitiveness. Atlanta is in competition with other Sunbelt metro areas as a place to live, work, and do business. While all its competitors are currently plagued by traffic congestion, that situation is changing. Texas cities, for example, in 2004 signed on to the *Texas Metropolitan Mobility Plan,*[13] under which each one has selected a target Travel Time Index to achieve by 2030. This effort was spearheaded by the Governor's Business Council in response to Dell Computer announcing that it would no longer expand its facilities in Austin, due to unacceptable traffic congestion. The Metropolitan Planning Organizations of the principal Texas cities—Austin, Dallas, Houston, San Antonio, and others—are in the process of rethinking and re-writing their long-range transportation plans to re-focus on reducing congestion as their primary goal.

A similar process appears to have begun in Washington State, with the legislature commissioning an independent study to assess various aggressive scenarios for reducing traffic congestion in the state's major urban areas.[14]

In short, Atlanta cannot assume that its competitor urban areas will continue to be traffic-choked indefinitely. Some appear to be committing their transportation planning to aggressive congestion-reduction strategies, while others seem content to continue with plans focused on land-use and transit, under which congestion will continue to increase. The Governor's Congestion Mitigation Task Force has taken the necessary first step in changing course. With this report, we hope to show Atlanta what the next steps might look like.

Part 2

The Sources of Congestion and Possible Solutions

A. Types of Congestion

Although the explanation for traffic congestion may appear to be as simple as "trying to stuff 10 pounds of potatoes into a 5-pound sack," the reality is somewhat more complex. Professionals who have spent many years studying the subject point out that there are two different types of congestion.

The first of these is what most people encounter every day on their trips to and from work—the overloading of the roadways with more vehicles than they can handle. Researchers refer to this as *recurrent* congestion. It does, indeed, result from a basic mismatch of highway capacity with vehicles, or what economists would call demand for road space far in excess of supply. This type of congestion is costly—but at least it's predictable.

The second type of congestion is called *incident-related* congestion. It results from a whole variety of causes, some completely unpredictable (breakdowns and crashes), some partially predictable (bad weather events), and some very predictable (construction work zones). Since most types of incident-related congestion are not known to motorists ahead of time, this type of congestion adds *unreliability* to people's trips. The additional delay added by the rubbernecking due to a fender-bender may add a random 30 minutes to what is already a congested 45-minute trip. When incidents are known to occur fairly often (though still at random), people who wish to arrive on time must add an additional cushion of time onto all such trips, even if only a random fraction of them actually encounter the extra delay of an incident. This "buffer time" is not included in standard measures of congestion, but is nevertheless part of its true cost.

It should be fairly obvious that different types of solutions are required for these two different types of congestion. The fundamental cause of recurrent congestion is a mismatch between demand and capacity. So the solution for this type must involve various ways of bringing demand and supply into balance. We will make the case below that the most cost-effective approach rests largely on adding to the transportation system's capacity.

For incidents, however, the broad category of solutions lies within the realm of better system management. Detecting, responding to, and clearing up breakdowns and accidents far more quickly is one example; this involves both technology and institutional changes. Construction projects can be planned and managed in ways that disrupt peak-period traffic flows less than is typically the case today.

There is no single magic bullet that can eliminate all traffic congestion. A very large-scale effort is needed between now and 2030, largely in the nature of a catch-up program. If this major effort can achieve something like the Congestion Mitigation Task Force's 2030 goal of significantly reducing the travel time index, then ongoing efforts in subsequent years can prevent congestion from worsening again, and could reduce it further. But those ongoing efforts will have to address both recurrent congestion and incident-related congestion.

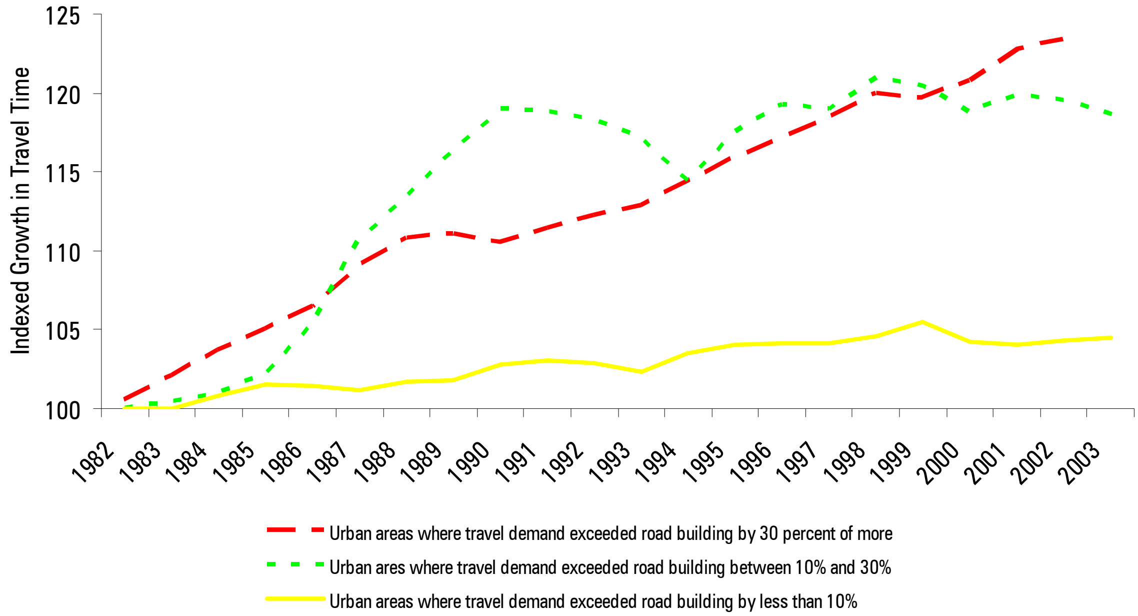
B. Countering Recurrent Congestion

As noted above, recurrent congestion is fundamentally about a large disparity between demand and supply. During the past two decades, the trend in urban transportation policy has been toward demand reduction rather than supply increases. It was believed (or hoped) that expanding mass transit systems, densifying land-uses near transit stations, and giving people incentives to carpool would significantly reduce the extent of solo driving within the planning horizon of typical long-range transportation plans, thereby reducing congestion.

Unfortunately, while good things can be said about each of these policies, there is no evidence, from Atlanta or from other urban areas, that they have reduced either solo driving or congestion. During the same two decades that these policies were increasingly carried out, congestion reached ever-higher levels, year after year, as carefully documented in more than 20 years of *Urban Mobility Report* data. Additional evidence comes from Atlanta's current long-range transportation plan, *Mobility 2030*, which is largely based on demand-reduction ideas. If fully implemented, as written, the plan would not prevent a large increase in congestion, with the travel time index increasing from 1.46 today to 1.67 by 2030. Even if the better-funded Aspirations plan were to be implemented, its additional billions would not be sufficient to reduce congestion; instead, as the Congestion Mitigation Task Force pointed out, congestion in 2030 would worsen "only" from today's 1.46 to 1.55.

Part 1 showed that prior to the 1990s, when Atlanta was still adding lane-mile capacity at a healthy rate, traffic congestion remained at moderate levels despite traffic growth. Data from the Texas Transportation Institute for America's largest 85 urban areas shows that those that kept increasing roadway capacity more or less in pace with travel demand (as Atlanta used to do) had only modest increases in congestion between 1982 and 2003, as shown in Figure 6. In effect, we have run a large national experiment over the past two decades, testing whether demand reduction or capacity expansion would do better at reducing recurrent congestion. The data clearly show that capacity expansion has worked better.

Figure 6: Congestion Growth vs. Highway Capacity Expansion (Data for 85 urban areas)



Source: Reason Foundation calculations from data provided by Texas Transportation Institute.

There are three distinct aspects to a capacity expansion strategy, and all three should be part of Atlanta's approach: bottleneck elimination, lane additions, and increased functional capacity.

1. Bottleneck Elimination

Bottlenecks are specific points in the roadway network (in particular, the freeway system), where traffic gets clogged due to specific physical features of the system. Minor bottlenecks occur where the number of lanes suddenly decreases by one and traffic has to squeeze into the remaining lanes. Others may occur where on- and off-ramps are too close together, resulting in excessive weaving as cars cross each others' paths getting on and off in too short a distance. Fixing these minor bottlenecks is part of the ongoing work program of a state department of transportation (DOT), as it modernizes the freeway system over the years. But even though they are called "minor," these projects are still costly, so they may not get funded for many years, even though the need is obvious.[15]

Major bottlenecks, however, often are freeway interchanges that were not designed for anything like the current level of peak-period traffic. Atlanta is home to four of the nation's worst interchange bottlenecks, according to two national studies by Cambridge Systematics.[16, 17] Atlanta has three of the nation's 20 worst overall freeway interchange bottlenecks and also three of the 20 worst interchange bottlenecks for trucks. Table 3 identifies these bottlenecks.

Table 3: Atlanta's Major Freeway Interchange Bottlenecks			
Interchange	**National Rank, All Bottlenecks**	**National Rank, Truck Bottlenecks**	**Average Daily Traffic**
I-75N & I-85N	#6	n.a.	259,128
I-285 & I-85N	#10	#2	266,000
I-285 & I-75N	#17	#7	239,193
I-20 & I-285W	n.a.	#11	187,200

Source: Cambridge Systematics, Inc.

Fixing these bottlenecks will not be easy, but it is not rocket science, either. In many cases, the interchange design is obsolete, in addition to the capacity being inadequate. Bottleneck interchanges of this sort are being redesigned and rebuilt nationwide, as money can be found to pay for these major projects.

The cost of such projects varies widely, but is generally at least $100 million per interchange, and can be far higher. Table 4 lists some recent projects to reconstruct bottleneck interchanges around the country. Some include considerable addition of adjacent freeway lane-miles, making the reported cost higher than just the cost of rebuilding the interchange alone. Atlanta's current Mobility 2030 plan includes reconstruction of two major interchanges: I-75N & I-285 ($202 million) and SR-400 & I-285 ($830 million). Unfortunately, the other three listed in Table 3 are not planned for reconstruction between now and 2030.

Table 4: Recent Interchange Bottleneck Reconstruction Projects				
	Project Description	**Costs**	**Miles of Lane Added**	**Construction Dates**
Albuquerque I-40/I-25	Reconstruction of interchange and addition of frontage road	$228 million	111	7/00-7/02
Chicago I-290/I-88/ I-294	Addition of collector-distributor roads and advance ramps; reconfiguration of interchange and arterial improvements	$100 million		2000-2002
Cincinnati I-75/I-71 Brent Spence Bridge	Rebuilding of bridge inclusive of entrance and exit ramps	$750 million		Construction to start 2008
Denver I-25/I-225	Known as T-Rex, a multi-modal project with light rail	$795 million (costs approximate due to multi-modality)	44 lane miles added, 17 lane miles improved	9/01-11/06
Houston I-610/I-10	Reconstruction of interchange and bridges	$262.5 million	No new lanes added	Started Oct, 2003 Phase 1 complete Phase 2 almost complete Phase 3 est. 2008
Houston US-59/I-610	Interchange ramps extended and braided,	$113.5 million	No new lanes added	Completed

Table 4: Recent Interchange Bottleneck Reconstruction Projects				
	Project Description	**Costs**	**Miles of Lane Added**	**Construction Dates**
	additional access ramp, frontage road and HOT link			
Las Vegas US-95/I-15	All new directional ramps at interchange	$91.8 million	No new lanes added	1997-2000
Los Angeles I-5/I-405	Reconstruction of El Toro Wye in Orange County	$103 million		Construction finished 2001
Washington DC Fairfax, VA I-95/I-495	Rebuild interchange ramps including express lanes to accommodate later widening of I-95	$676 million	No new lanes added	Construction 10/03-7/07

Sources: State Department of Transportation Offices, except for Chicago (Illinois State Toll Highway Authority), El Toro (Orange County Transportation Authority) and Washington (US Department of Transportation.) Cincinnati costs from American Highway Users Alliance; "Unclogging America's Arteries 1999-2004."

If freeways and arterials were added at the same rate as in the 1980s, Atlanta would eliminate severe congestion.

2. Adding Lane Capacity

Basic capacity expansion means adding more lane-miles of freeway and arterial to the system, to catch up with the huge growth in travel in the metro area. As part of another research effort in Reason's Mobility Project, Prof. David Hartgen of the University of North Carolina at Charlotte worked with the transportation modelers at the metropolitan planning organizations of 32 urban areas, including Atlanta, to estimate how many lane-miles would have to be added to each region's roadway system to eliminate all severe congestion (what DOTs define as Level of Service F, usually written as LOS F) by 2030.

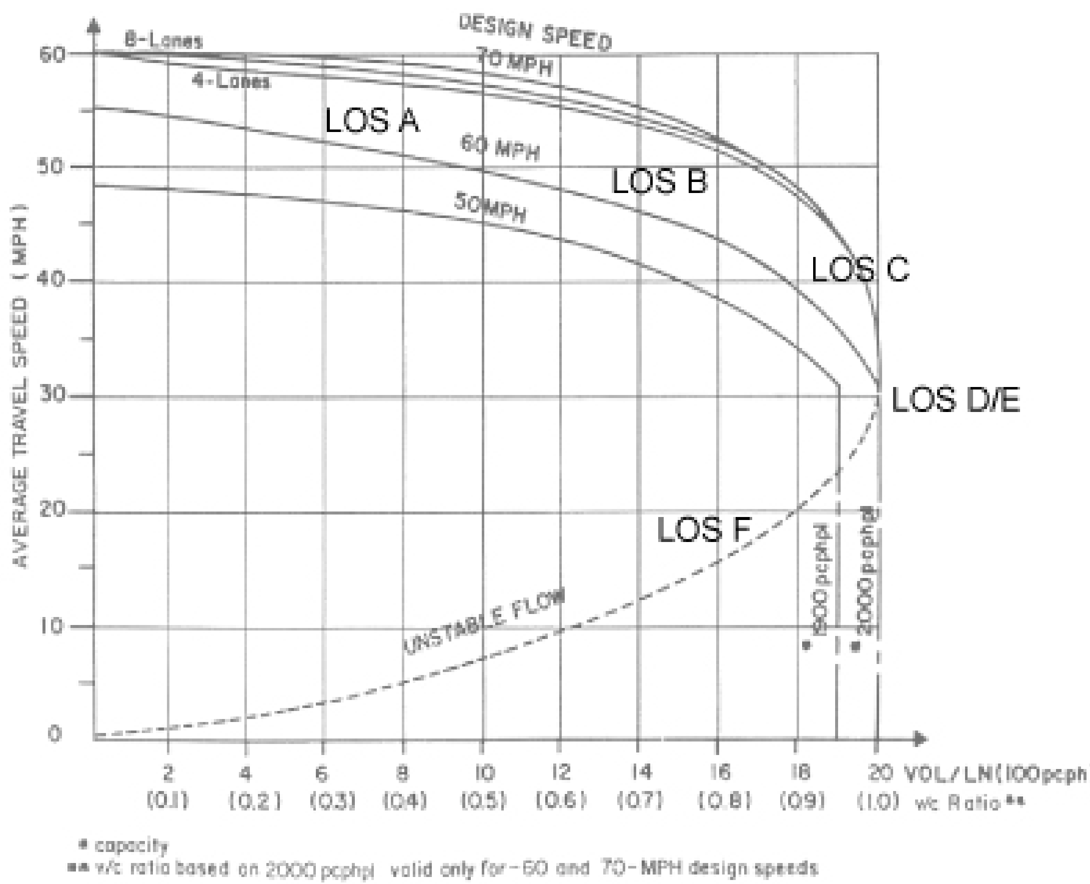
This exercise was run on the Atlanta Regional Commission's traffic assignment model. The results were that a total of 2,613 lane-miles of all types (freeway, arterial, collector, and other) would need to be added over the 25-year period from 2005 through 2030. Freeway lane-miles were 1,653 of this total. That would mean adding an average of 66 freeway lane-miles per year. That is hardly out of line with the pace of freeway-building during the 1980s, when Atlanta kept capacity in pace with traffic. From 1983 through 1992, Atlanta added an average of 64 freeway lane-miles per year. During that same period, arterial lane-mile additions averaged 69 per year. Thus, if both freeways and arterials were enhanced at the same rate as in the 1980s, Atlanta would add 3,325 freeway and arterial lane-miles between 2005 and 2030, far more than what the modeling showed would be enough to eliminate severe congestion.

Where lane-additions might go is addressed in Part 3 of this report.

3. Increasing Functional Capacity by "Managing" Lanes

Another way of adding capacity is to manage traffic flow in roadway lanes so that they do not get into the severely congested state characterized by LOS F conditions. When traffic flow breaks down in that manner, it becomes mathematically "chaotic"—sometimes at a standstill, sometimes moving at 10 mph, sometimes at 20 mph, but nothing consistent. When traffic degenerates into this condition, the throughput (number of vehicles per lane per hour) of the freeway decreases considerably. Whereas a freeway full of traffic but still moving steadily at something like 40 mph may have a throughput of 2,000 veh/ln/hr, once more vehicles try to crowd onto it, the flow rate can degenerate to 1,500, 1,200, or even less as speeds drop into the zero to 20 mph range.[18] These conditions are shown in the traffic engineers' speed/flow curve, one version of which is shown here as Figure 7.

Figure 7: Traffic Throughput vs. Speed



In the last 10 years, California and several other states have gained considerable experience with using variable pricing to manage traffic flow, to prevent the kind of unstable flow shown in the lower portion of Figure 2-2. By raising the price as demand increases, roadway managers are able to keep traffic on the upper portion of the curve, where there is both high speed and high throughput. "Managed lanes" of this sort are typically priced to offer significant time savings, by allowing those willing to pay for a faster and more reliable trip to travel at, say, 60 mph. A single-lane facility of this type can maintain uncongested Level of Service C conditions with about 1,700 vehicles/lane/hour, while a dual-lane facility can handle 1,800 at uncongested conditions. (Extreme stop-and-go congestion is termed LOS F.)

During the busiest peak periods on California's 91 Express Lanes (a dual-lane facility), the two priced lanes handle 49 percent of the peak-direction throughput on this six-lane freeway, even though they represent only 33 percent of the *physical* lane capacity. Thus, priced managed lanes operating at LOS C during rush hour have about 50 percent more *functional* capacity (throughput) than the highly congested (LOS F) general-purpose lanes alongside.

Therefore, if the likely *longer-term* result of adding general-purpose lanes to Atlanta's freeways is that they would eventually fill up to LOS F conditions, it would be wiser to add priced, managed lanes instead. Their long-term functional capacity will be significantly higher, which means fewer total new lane-miles need to be added.

C. Countering Incident-Related Congestion

While we do not have accurate figures on the extent of incident-related congestion on Atlanta's freeways and arterials, national figures for large urban areas (greater than one million population) suggest that it may well be more than half of the congestion experienced on any given day. Table 5 is excerpted from a recent report from the National Cooperative Highway Research Program. Given the rather severe overloading of freeway lanes in Atlanta, we estimate that Atlanta's recurring congestion (demand exceeding capacity) is at the top end of that range. And given the low occurrence of snow and ice conditions in Atlanta, weather is probably a smaller factor than the 5 to 6 percent national average. Even with these modifications, it still appears likely that non-recurrent congestion accounts for more than half of daily congestion in Atlanta.

Table 5: Sources of Congestion in Very Large Urban Areas

Source of Delay	Percentage Contribution
Demand greater than capacity	37%
Poor signal timing	5%
Total Recurring Congestion	*42%*
Crashes	38%
Breakdowns	7%
Work zones	8%
Weather	6%
Special events, other	--
Total Non-Recurring Congestion	*58%*

Source: Steve Lockwood, "The 21st Century Operations-Oriented State DOT," Washington, DC: National Cooperative Highway Research Program, Transportation Research Board, April 2005.

As noted previously, one consequence of non-recurrent congestion is that the reliability of travel times deteriorates, and many people add buffer time into their planned travel times, just in case an incident occurs. A recent federal report illustrates the magnitude of the problem by using data for Atlanta, as summarized in Table 6. In just three years, from 2000 to 2003, the buffer index increased significantly in nearly all the corridors shown. It should be remembered that the value of the time people waste as buffer time is not included in the reported cost of congestion (such as the $1.75 billion for Atlanta in 2003).

Table 6: Buffer Time Added to Trips Due to Non-Recurrent Congestion

Atlanta Freeway Corridor	2000	2001	2002	2003
I-75S (I-285 to I-20)	21%	29%	33%	35%
I-75S (I-20 to I-285)	12%	22%	25%	33%
I-75/85, northbound	48%	59%	58%	100%
I-75/85, southbound	24%	36%	32%	56%
I-75N (I-85 split to I-285)	30%	39%	32%	35%
I-75N, (I-285 to I-85 split)	13%	29%	42%	50%
I-85N (I-75 split to J. Carter)	22%	49%	19%	23%
I-85N (J. Carter to I-75)	41%	37%	31%	34%

Source: FHWA Office of Operations, "Traffic Congestion and Reliability: Trends and Advanced Strategies for Congestion Mitigation," Washington, DC: Federal Highway Administration, 2005, Table ES.1. (www.opsw.fhwa.dot.gov/congestion_report/executive_summary.htm)

The general term for the kinds of measures needed to cope with non-recurrent congestion is "operations strategies." The most important of these strategies include the following.

Freeway Ramp Metering: When a freeway is running near capacity at LOS E, very near the point in Figure 7 where small increases in volume can push the situation into chaotic, stop-and-go conditions, too many vehicles crowding on from an on-ramp can trigger that change. Ramp metering puts a traffic signal on the on-ramp that introduces a calculated time interval between entering vehicles (as GDOT has begun to do). Extensive data now exist to show that ramp metering can have a significant impact on preventing this type of flow breakdown into LOS F conditions. The San Francisco region's Bay Area Toll Authority has estimated a 14:1 ratio of benefits to costs for ramp metering in its region.[19] It should be noted that aggressive ramp metering can lead to backups on the on-ramps, which may require additional capacity on nearby arterials.

Improved Incident Response: The Washington State DOT estimates that the throughput on a six-lane (three per direction) freeway can be cut 20 percent by a car out of gas on the shoulder, 50 percent by a disabled car blocking one lane, and 85 percent by an accident blocking two lanes.[20] Rapid response and rapid clearance of such incidents can significantly reduce the duration of such congestion, allowing the freeway's capacity to be reclaimed. The Bay Area Toll Authority estimates a benefit/cost ratio for such projects as 8:1. Such projects typically involve advanced video systems for quickly spotting incidents, dispatch center(s) to send appropriate response crews, and freeway service patrols to deal quickly with minor incidents.

Signal Timing on Arterials: Synchronizing traffic signals on busy arterials, so as to provide a "rolling green" signal in the peak direction, can significantly reduce travel times in many instances. Signal timing cannot do much about highly congested arterials where traffic is heavy in both directions, but for those arterials where flow is very directional, the benefit/cost ratio can be as high as 35:1, according to the Bay Area Toll Authority.

Other "operations strategies" include better management of construction work zones, provision of real-time traveler information (to enable people to choose alternate routes), and accurate prediction of impending weather impacts.

The techniques discussed here have been quantified in the NHCRP report referred to earlier. Table 7 summarizes the range of impacts that these techniques may be expected to have, if fully implemented, in urban areas of 1-3 million people.

The low-hanging fruit would appear to be the system operations measures, which have the additional advantages of being (1) relatively inexpensive, and (2) able to be implemented within a matter of years, rather than decades.

Table 7: Estimated Leverage of Systems Operations and Management on Congestion

Problem	Percent of Total Delay	Strategy/Tools	Potential Effect (% of Total Delay)
Uncoordinated Signals	4-13%	Regionwide re-timing	2-5%
Crashes & breakdowns	20-42%	Integrated freeway service patrol, incident management program	10-20%
Work zones	8-27%	Advanced work-zone traffic control; automated speed control	4-13%
Weather impacts	5-10%	Prediction/advisory, pre-treatment	2-5%

Source: Steve Lockwood, "The 21st Century Operations-Oriented State DOT," Washington, DC: National Cooperative Highway Research Program, Transportation Research Board, April 2005, Table 5.

In 2000, the California DOT (Caltrans) estimated the cost-benefit ratio of a package of system operations measures and found it to have a benefit-cost ratio of 8.9:1.[21] By contrast, the addition of conventional highway capacity had a benefit-cost ratio of 2.7:1. While both are clearly worth doing, the low-hanging fruit would appear to be the system operations measures, which have the additional advantages of being (1) relatively inexpensive, and (2) able to be implemented within a matter of years, rather than decades.

Part 3

Where and How to Add Capacity

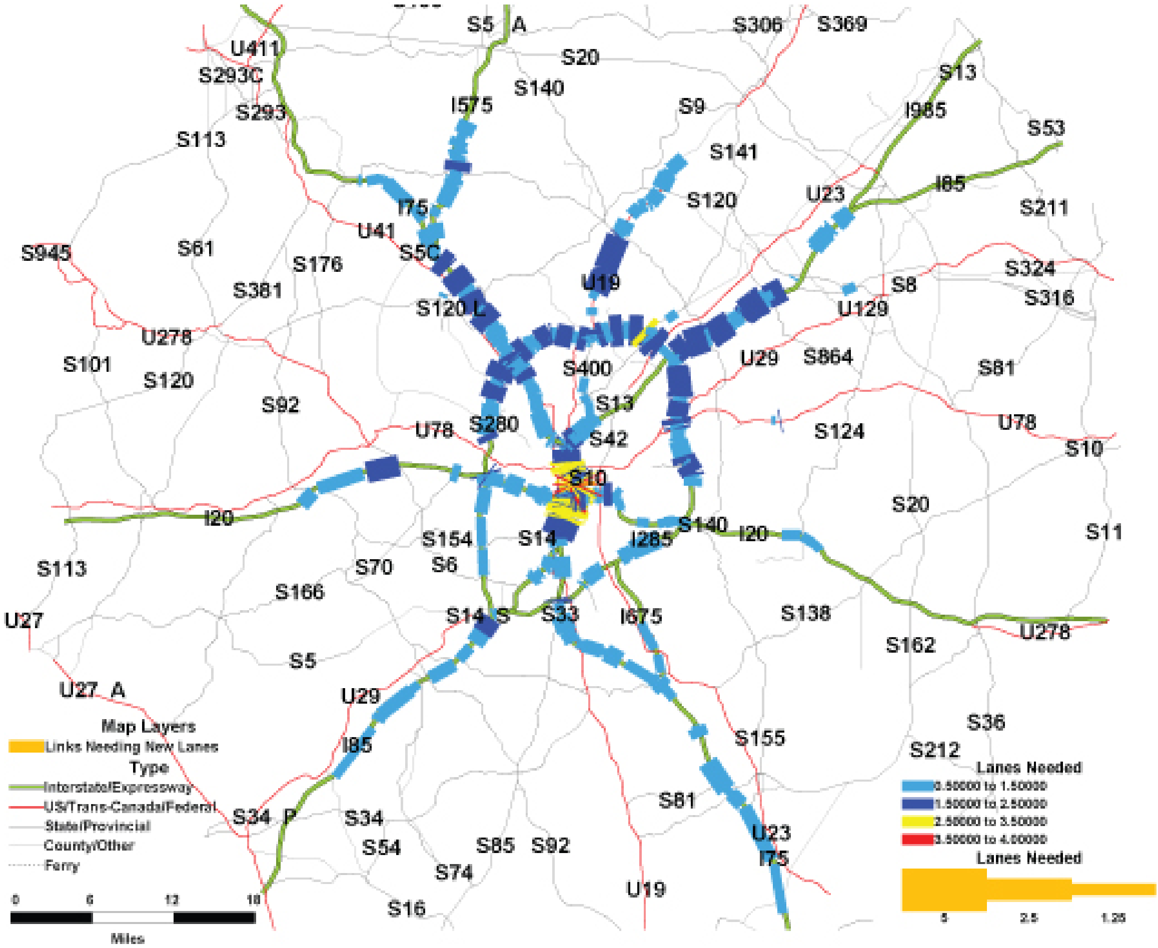
A. How Much Capacity?

Given the limitations on Atlanta's roadway system noted in Part 1, it would be nice to start with a clean sheet of paper and design a state-of-the-art roadway system for the entire urbanized area. Unfortunately, given the extensive and expensive land uses that have grown up in the region over the past 40 years, it is neither politically nor economically feasible to do that. Instead, we must add capacity where possible to existing freeways (or parallel corridors), make selective additions of new links to the network, and upgrade arterials to provide higher levels of service, where this can be done consistent with community needs and desires.

As a starting point, the modeling work described in Part 2 estimated the number of lane-miles that would need to be added to the existing freeway system (i.e., more lanes on existing freeways but not new links) to eliminate serious, recurring congestion (Level of Service F) by 2030. Figure 8 shows the corridors where this new capacity is needed. These additions are *over and above* what is already planned between 2005 and 2030 in the current long-range transportation plan, *Mobility 2030*. That plan calls for adding 688 lane-miles worth of HOV and busway lanes, nearly all of them on or outside the Perimeter; it also provides for making improvements to several congested interchanges.

Interestingly, when the full set of needed additional lanes, per Figure 8, was modeled using the ARC model, not only were LOS F conditions on the freeways eliminated, but traffic flow on the arterials decreased, as some travelers shifted onto the freeways from the over-stressed, inadequate arterial system. The collectors and arterials shifted in function to being feeders for the freeway system rather than serving as corridors for long-distance trips. Overall, there was a small *decrease* in total regional vehicle miles traveled (VMT) and a 27 percent *decrease* in vehicle hours of travel (VHT), due to reduced freeway congestion.[22]

Figure 8: Additional Lanes Needed, Atlanta Freeway System



The challenge taken up in this chapter is where to add this amount of needed additional capacity. Our assessment has identified four key improvements. They are:

- A complete network of variably priced express toll lanes (ETLs) on the existing freeway system, totaling 1,258 lane miles, providing reliable, uncongested travel for buses, vanpools, and paying vehicles.
- A north-south tunnel linking the southern end of Georgia 400 with the current terminus of I-675, with interchanges at I-20 and Freedom Parkway (to serve downtown); this new link would provide the equivalent of six additional lanes on the I-75/85 Downtown Connector.
- A new east-west link to relieve I-20, made up of the existing Lakewood freeway, extended to the east by a new toll tunnel and to the west by upgrading portions of Campbellton Road and Camp Creek Parkway to freeway level.

- A separate, voluntary toll truckway system allowing through trucks the option of bypassing Atlanta's congestion in exchange for paying a toll.

None of these proposed projects has been embraced by any governmental agency or discussed at a neighborhood or public involvement level. They are conceptual proposals, offered for consideration by those interested in reducing congestion in Atlanta. They have also not been modeled for air quality compliance, though our overall modeling exercise showed that the proposed set of lane additions would slightly reduce overall vehicle miles traveled (as more vehicles shifted from arterials to more direct freeway and toll-lane routes).

This set of capacity additions would achieve the goal of eliminating LOS F conditions as of 2030. As such, implementing them would represent a huge, one-time catch-up to better match the system's capacity to the growth in population and travel over the past 20-30 years during which very little capacity was added. From then on, it would take more modest additions to maintain the new less-congested conditions, or move on to achieve a more aggressive congestion-reduction goal. We suggest the kinds of additions that might be considered post-2030 in the concluding portion of this section.

B. Express Toll Network

Atlanta has recently gained national attention in transportation circles for considering development of its planned region-wide HOV network as a network of HOT lanes instead. Officially, the *Mobility 2030* plan still calls for adding 688 lane-miles of an ultimate 1,200-lane-mile HOV system, in accordance with GDOT's HOV Strategic Implementation Plan. But recent events have been shifting emphasis from HOV to HOT lanes. SRTA published a fairly detailed HOT lanes analysis in 2005,[23] which made the case that building the network as HOT lanes instead of HOV lanes would produce greater transportation benefits while providing much-needed transportation revenue. GDOT in late 2005 and early 2006 accepted two public-private partnership proposals that would add HOT lanes (rather than HOV lanes) to I-75N and I-575, and GA-400, respectively. Moreover, as of mid-2006 GDOT has begun work on a new managed-lane system plan that will encompass HOT and TOT lanes. Thus, the region seems to be shifting emphasis from HOV lanes to HOT lanes as the preferred approach to implementing a "managed lanes" strategy for improving its freeways.

Our plan builds on these developments. The HOT lanes analysis for SRTA compared the performance and revenue-generating potential of HOT lanes under three different access policies: allowing HOV-2 vehicles continued free access, restricting free access to HOV-3 or greater, or restricting it to HOV-4 or greater. The report showed that the higher the occupancy level required for free passage (i.e., the less capacity that is given away to HOV vehicles), the greater the potential revenue that is generated to help pay for the new lanes (with HOV-4 being the preferred approach). Since the number of HOV-4 vehicles would be very low, but the enforcement costs high, we propose charging *all* personal automobiles and light trucks (pickups, SUVs, etc.) the same market price, reserving free access only for super-HOVs (buses and vanpools) and emergency vehicles. There are three reasons for this recommendation.

First and foremost, charging all light vehicles produces substantially more revenue, which makes it possible to build the *complete* network by 2023, rather than only 59 percent of it by 2030. This is a huge advantage in terms of bringing congestion-reduction benefits to weary motorists throughout the region, and a major component of achieving the overall congestion-reduction goal. Second, pricing access to all but transit and emergency vehicles in these lanes provides more powerful control over lane volume and hence of the reliability of traffic flow, thereby ensuring robust toll revenue. Third, enforcement of a mixture of identical-looking free and paying autos is difficult, leading to high enforcement costs or significant losses of revenue.

In addition, Atlanta is in the fortunate position of having only 125 lanes-miles of HOV lane in place today, just 10 percent of the planned system. Thus, there is still time to make a fundamental policy decision regarding what type of managed lane approach produces the best set of benefits in relation to its costs. There is not a large constituency of people already using HOV lanes who would be disadvantaged if a large existing HOV network were converted into an Express Toll Network.

The goal of higher overall vehicle occupancy (intended to be realized via HOV lanes) can still be achieved via an Express Toll Network.

The goal of higher overall vehicle occupancy (intended to be realized via HOV lanes) can still be achieved via an Express Toll Network, for several reasons. First, a region-wide set of priced lanes offering major time savings during peak periods gives people an incentive to carpool, so as to split the toll two, three, or four ways. Second, the availability of such a network may spur a large revival of interest in company-sponsored vanpools, since these priced lanes will remain uncongested indefinitely, unlike HOV lanes which eventually fill up and lose their time-saving advantages. This long-term sustainability makes it worthwhile for companies to invest in vanpooling programs. Third, a region-wide uncongested network makes an ideal guideway for region-wide express bus service, often called Bus Rapid Transit (BRT). In fact, if a policy decision is made to *reserve* a portion of the capacity of these lanes for such bus service, and if GRTA planned much of its express bus service around use of this network, then the network would meet the definition of a Virtual Exclusive Busway network.[24] In other words, it would provide the virtual equivalent (in terms of bus performance) of a network of exclusive bus lanes.

And that leads to another possible difference between our proposal and current HOV plans. Although (like current ARC and GDOT HOV plans), our plan also calls for two managed lanes in each direction over most of the network, *both* of these lanes in our plan would be open to all eligible vehicles—buses, vans, and cars. Given that variable pricing will be used to manage traffic flow and maintain uncongested conditions, there is no need to reserve one of the two lanes for buses, as is called for in *Mobility 2030* (although GDOT reports that doing this is not their intention). Dedicating one of these lanes to buses would waste most of that second lane's capacity, since very few corridors could justify more than, say, 30 buses per hour during peak periods. An uncongested managed lane can easily handle 1,800 vehicles per hour. Hence, our proposed Express Toll Network would offer nearly double the vehicle throughput capacity of the HOV lanes proposed in *Mobility 2030*.

In addition, our proposal would not separate the toll lanes from the adjacent general-purpose lanes using concrete barriers. Experience on the 91 Express Lanes in California shows that double striping combined with plastic pylon traffic separators has been an effective separator of HOT lane and general-lane traffic. And since Atlanta does not suffer from serious snow-removal problems, plastic pylons should be quite acceptable.

Figures 9 through 13 show the proposed development of the ETL network, in four phases. The first figure shows the existing set of HOV lanes (single lane per direction), almost entirely within the Perimeter. These would be converted to ETLs as of 2008,via the addition of overhead gantries to mount the electronic toll collection and enforcement equipment and begin collecting revenue to begin the construction of Phase 1. Figure 10 shows the addition of the first phase, built in the northern portion of the freeway system where relief is needed most. Figure 11 shows Phase 2, extending the network around more of the Perimeter, adding a portion on I-20W, and adding a second lane per direction on I-75S. The next figure shows Phase 3, with major additions on the southern portion of the system, as well as adding second lanes in each direction on I-75N and I-85N within the Perimeter. The figures also indicate, via circles, accompanying interchange improvements. Finally Phase 4 fills in the remaining link of I-285S and adds ETLs on various radials farther out.

Figure 9: Converted Set of HOV Lanes

Figure 10: Phase 1 Additions to Express Toll Lane Network

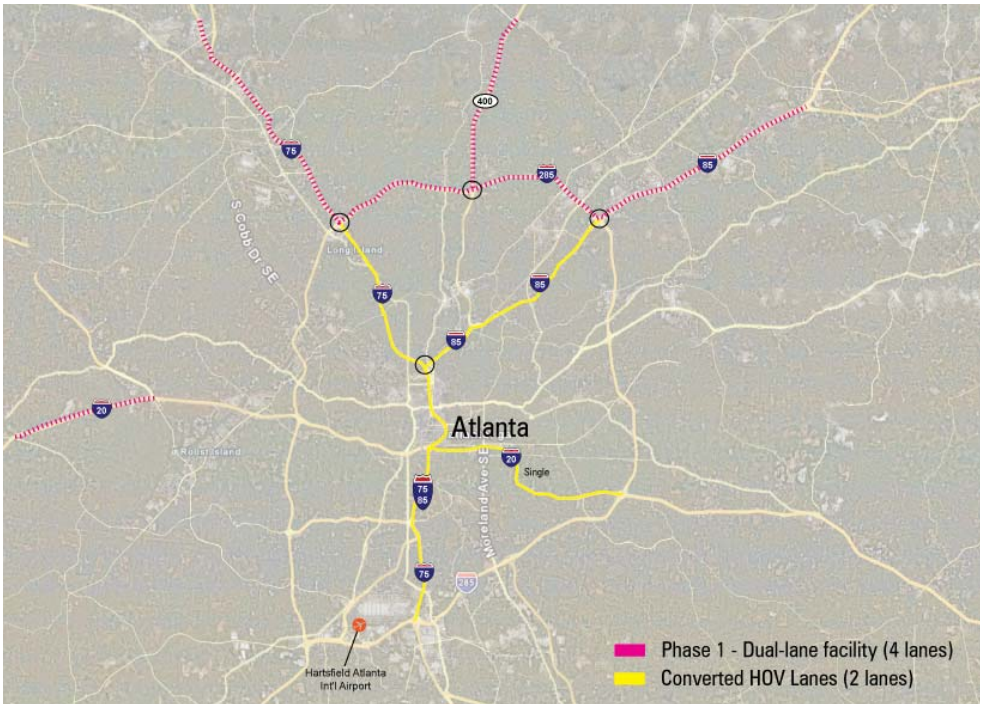


Figure 11: Phase 2

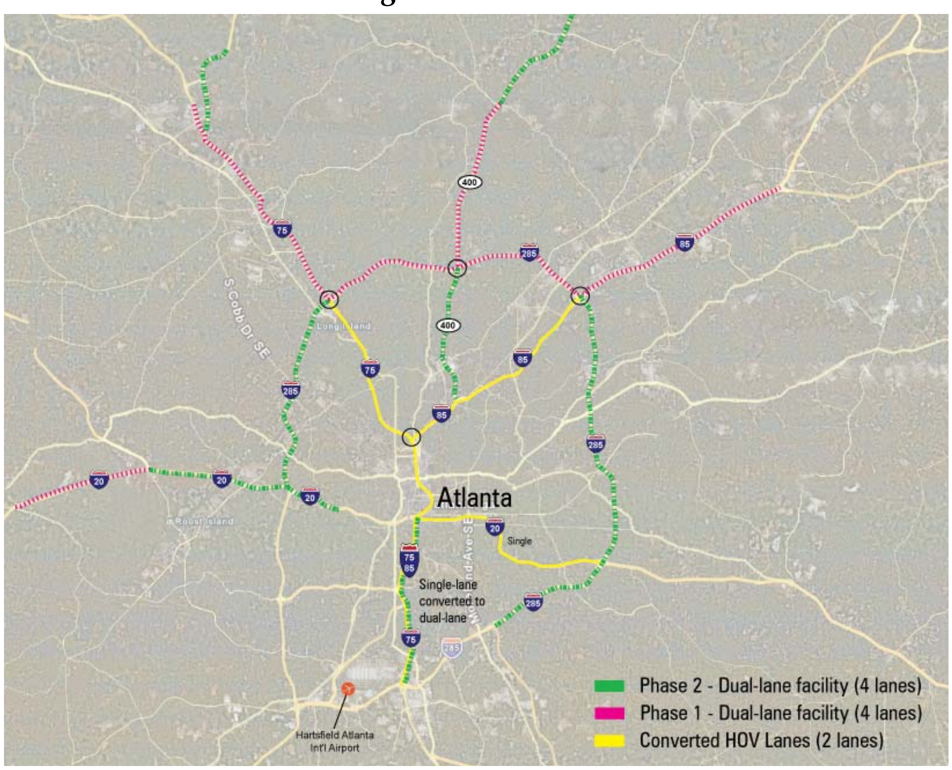


Figure 12: Phase 3

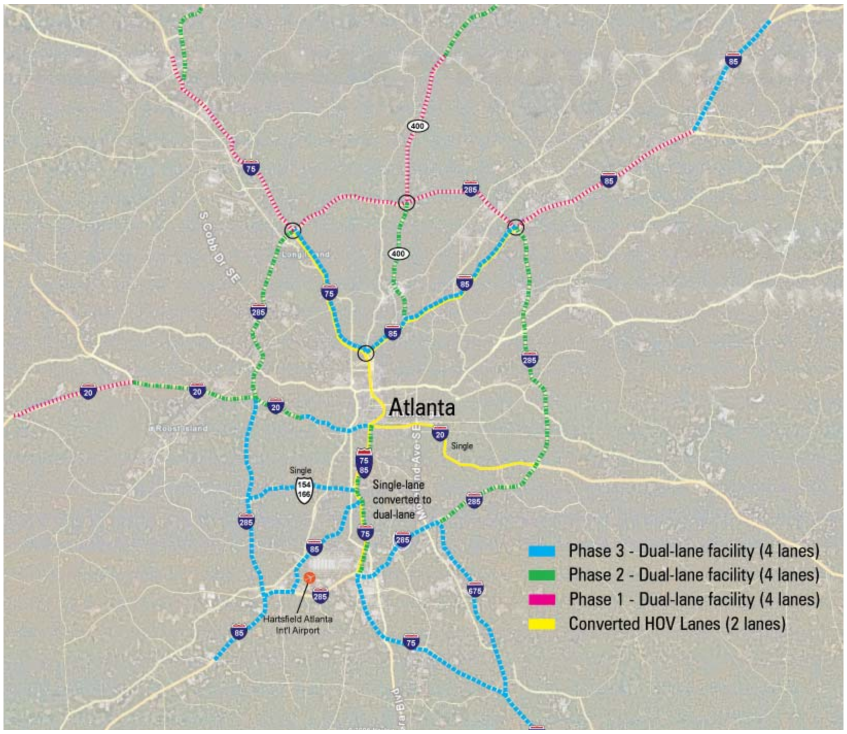
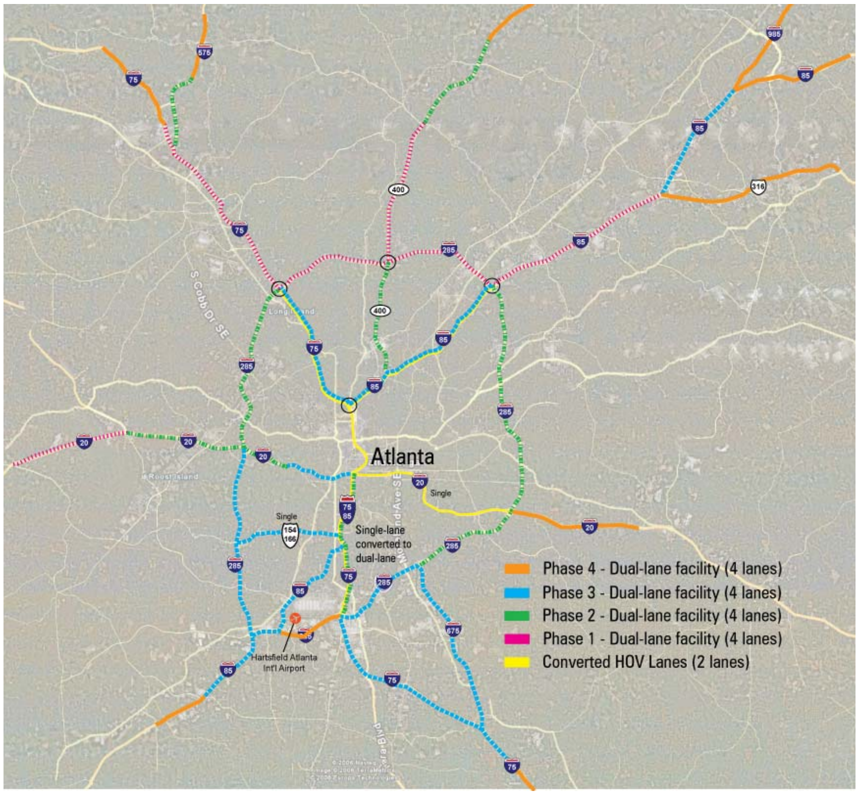


Figure 13: Phase 4



Further details are provided in the Appendix, where we estimate the costs and revenues of this network (which would be completed by 2023). Using data provided by ARC, based on GDOT plans and cost estimates, the total cost in 2003 dollars is $9.14 billion. While that is a very large sum, by operating the network as ETL instead of HOV or HOT-2, we estimate that the entire cost can be paid for out of toll revenues, with the possibility of funding left over to pay for other components of the program which are not self-supporting.

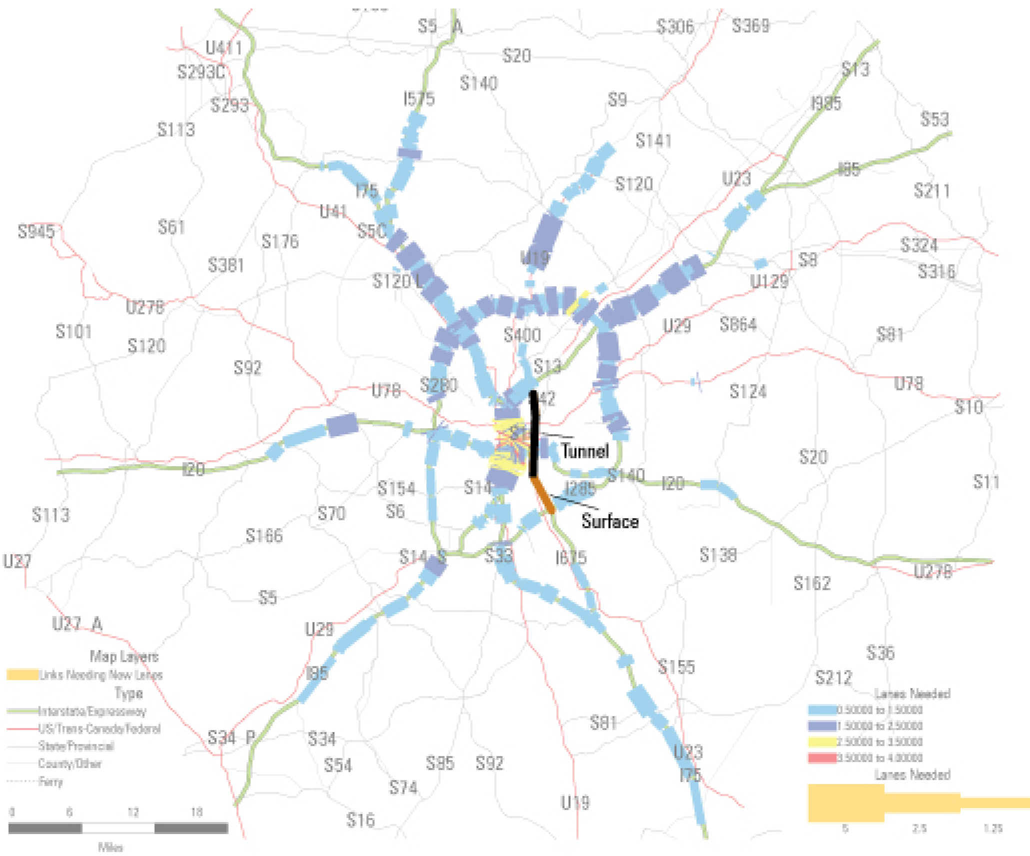
C. North-South Tunnel

As can be seen on the original map (Figure 8), the segment of the freeway system needing the greatest relief is the Downtown Connector, where I-75 and I-85 run together through downtown Atlanta. On average, six additional lanes are needed in this corridor to alleviate severe (LOS F) congestion. Yet the Mobility 2030 plan provides *no relief at all* for this corridor, for understandable reasons. Due to extremely high land-use values on either side of the freeway, there is no realistic possibility of widening it in this corridor. Double-decking it would pose major cost and constructability problems, while further concentrating traffic along this already overloaded corridor.

Our proposal is to add the needed six lanes of capacity *parallel* to the Downtown Connector, about 1.5 miles to the east. That location also has very high land values for much of its length, so the majority of the project would be built as a tunnel. It would begin at I-85N and the southern terminus of the GA-400 toll road, extending that toll road south, as a toll tunnel, to I-20. There would be one intermediate interchange, at Freedom Parkway, to provide ready access to and from downtown. After an interchange on the surface at I-20, another tunnel segment would proceed due south, to emerge just north of Constitution road, where the tollway would proceed along the railroad right of way to an interchange with I-285S and the northern terminus of I-675 (see Figure 14).

Thus, the North-South Tunnel would provide a direct link between I-675 on the south and GA-400 on the north. It would provide a north-south alternative running the full length of the Downtown Connector, with intermediate access to downtown (at Freedom Parkway) and I-20. If this route sounds logical, it's because it was proposed (as a surface toll road) in the original Atlanta Urban Area Tollways study by Wilbur Smith Associates in 1970[25], and further fleshed out in studies for the then-new Georgia State Tollway Authority (predecessor of SRTA) in 1972[26] and 1974.[27] Of the five routes proposed in those original studies, only the North Atlanta Tollway (built as GA-400) and South Atlanta Tollway (built as the non-tolled I-675) were implemented. The others were not built, for a variety of reasons including significant local opposition to having neighborhoods split by a freeway. From a traffic flow and connectivity standpoint, those routes made sense then. Given today's vastly higher traffic flow, they make even more sense today, especially the proposed north-south corridor. We believe that putting such needed links underground is the best way to provide the needed capacity while protecting Atlanta's neighborhoods.

Figure 14: Route of North South Tunnel



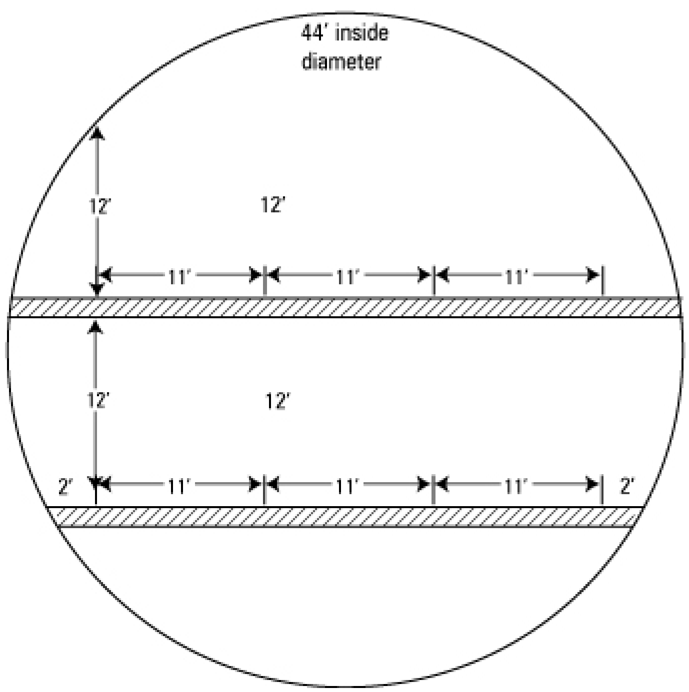
While this might sound like an extremely ambitious and costly project, there are precedents for urban toll tunnels of this magnitude. French toll road company Cofiroute is well along in construction of a comparable tunnel, bored deep beneath the Paris suburb of Versailles to complete the long-needed missing link in the Paris A-86 ring road. This tunnel, bored through solid rock using a tunnel boring machine, has an inside diameter of 34 feet. Its total length is 6.2 miles, interrupted in the middle by a semi-underground interchange with the A13 motorway. More precisely, then, the tunnel consists of segments 2.8 miles and 3.4 miles in length, totaling 6.2 miles.[28]

Because the cost of tunneling is proportional to the cross-sectional area, Cofiroute had strong incentives to minimize that cross-section, while providing for the maximum amount of capacity. It received permission from the French government to configure the tunnel for auto-size vehicles only (with a parallel tunnel nearby, to be built later, for trucks and buses). That permitted it to build the tunnel with two decks of three lanes each, with northbound traffic on one deck and southbound on the other. Overall, the cost of this autos-only tunnel project is $2.0 billion (in 2005 dollars).

A similar double-deck tunnel is in the planning stages for Brussels, the capital of Belgium. City Ring Brussels would be a 6.2-mile tunnel, with six somewhat larger lanes able to handle buses as well as cars (but not large trucks). Thus, its inside diameter is 45 feet.[29] Construction is under way in Madrid, Spain on twin three-lane tunnels 49 feet in diameter, 5.2 miles in length; they form part of the new M30 urban motorway. Similar large urban tunnel projects are under way in Brisbane, Australia; Buenos Aires, Argentina; and Kuala Lumpur, Malaysia.

Given the large size of American vehicles, and the need to accommodate express bus service as well as autos, our proposed tunnel would have an inside diameter of 44 feet, as illustrated in Figure 15. Each deck would include three 11-foot lanes and an overhead clearance height of 12 feet, sufficient to accommodate both city buses (typically 10’ 8”) and over-the-road buses (11’ 6”). Tunnels generally do not provide breakdown lanes, due to the additional cost, and we have followed that practice here. The northern tunnel (GA-400/I-85N to I-20) would be five miles long, while the southern one would be 3.1 miles, connecting to a surface toll road of 2.5 miles long to I-285S and I-675. Overall, with six lanes, that means 48.6 lane-miles of tunnel and 15 lane-miles of toll road, plus interchange work. In the Appendix, we estimate the total cost at $4.8 billion in 2005 dollars.

Figure 15: Proposed North-South Tunnel Cross Section



Although these would be very large tunnels, such size is not unprecedented. A 47-foot diameter tunnel is being bored under the Niagara River in New York, using the world’s largest tunnel boring machine.[30] Atlanta’s recently completed Chattahoochee Tunnel, though only 18 feet in diameter, is 9.5 miles long, far longer than the proposed 5-mile and 3.1-mile tunnels. Nearly all of this tunnel was excavated using tunnel boring machines, though a portion used drill and blast methods.[31]

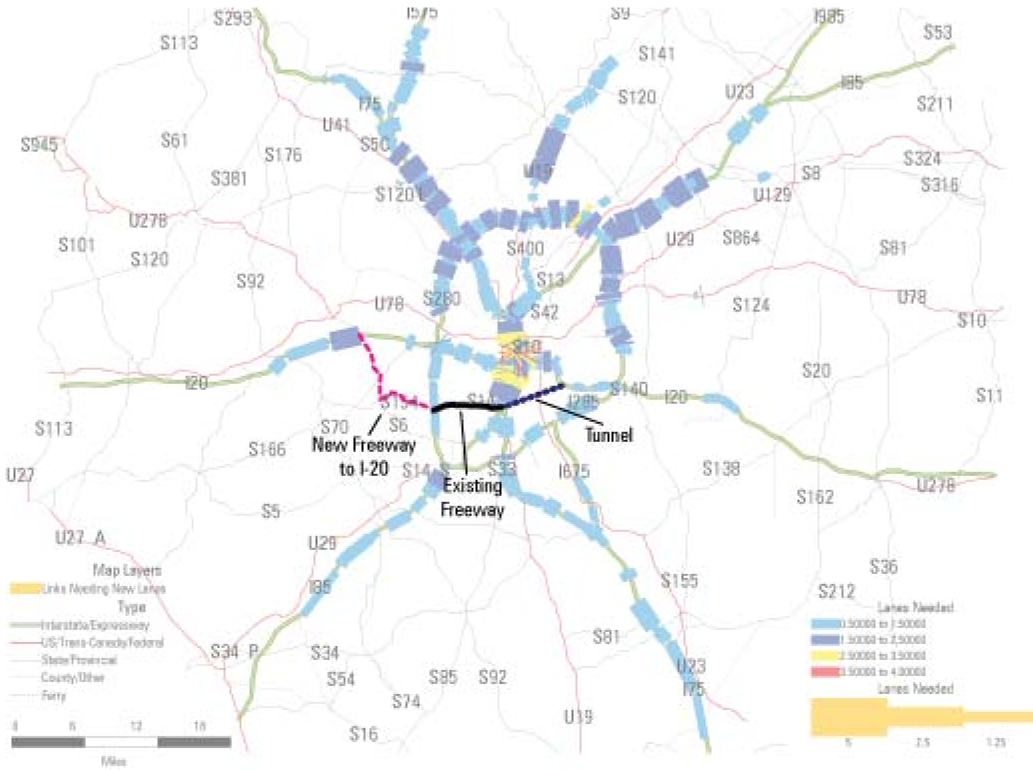
In France, Cofiroute expects to support the entire cost of building and operating the A86 tunnel out of toll revenues, on which basis it has privately financed the project under a long-term concession agreement with the government. In the Appendix, we estimate traffic and toll revenues for the proposed Atlanta tunnel, using the same kind of value-pricing assumptions used previously for the Express Toll Network. We conclude that toll revenue financing can cover about 39 percent of this project's costs, but that the balance could be paid for out of surplus revenues from the Express Toll Network. Indeed, the entire system of tolled facilities could be considered as a nearly self-supporting congestion-relief network.

D. Lakewood Tunnel and Freeway Extension

While I-20 is not as congested as most of I-285 or the Downtown Connector, over the next 25 years it would be highly desirable to relieve congestion on I-20 by means of an alternative east-west route. The original Atlanta Urban Area Tollways study called for linking the Lakewood Freeway with I-20E, proposed as the Lakewood Tollway Extension. Land-use changes since the 1970s preclude building this route as a surface freeway or toll road, but we propose that it be built as a toll tunnel of the same configuration as the North-South Tunnel. It would connect with I-20E in a simple Y interchange (i.e., travelers heading west on I-20 could choose either to continue on I-20 or shift to the Lakewood Tunnel). But in addition, there would be an underground interchange with the North-South Tunnel. (Cofiroute's A86 tunnel near Paris includes such an interchange.) Lakewood would be extended west as a freeway by upgrading Campbellton Road from I-285W to Camp Creek Parkway, and then upgrading Camp Creek between there and I-20W. Both the tunnel and the western extension would be six lanes (three each direction). Figure 16 shows how this project would fit into the overall limited-access network.

Since the need for this added capacity is less time-critical than relieving the Downtown Connector, we suggest beginning construction after the North-South Tunnel opens, in 2016. As with that project, we assume a six-year construction period, such that the Lakewood project (tunnel plus freeway) would open to traffic in 2022. The tunnel portion would be 4.7 miles long. Using the same cost per lane-mile as for the North-South Tunnel, this tunnel would cost $2.54 billion in 2005 dollars. We add $500 million for the interchanges described above, bringing the total to $3.04 billion. The extension of the Lakewood Freeway would involve 13.84 miles of six-lane capacity, essentially building a new freeway along the right of way now occupied by the two existing arterials. For a cost estimate, we used the average cost per lane-mile of all the HOV lane-additions in the current Mobility 2030 plan, $5.69 million. For the 83.1 lane-miles, that gives us $473 million, in 2005 dollars. Thus, the total project cost (tunnel, interchanges, freeway) would be $3.5 billion in 2005 dollars.

Figure 16: Lakewood Freeway Extension and Tunnel



Because we expect little congestion to exist on the freeway portion of this link, we have modeled it as operating without tolls. Drivers heading east on the new freeway would encounter heavier traffic as they reach the I-285W interchange; at that point, they could continue on the existing freeway lanes or make use of the new Express Toll lanes that are part of the Express Toll Network discussed previously. To head further east, they would have to pay a toll to use the new tunnel to get to I-20E. In the Appendix we analyze traffic and revenue on the tunnel portion, which we assume would have sufficient traffic to sustain tolls at 60 percent of those on the North-South Tunnel. Our net present value calculation finds that toll revenue would support 33 percent of the Lakewood project's construction cost.

E. Toll Truckway System

Atlanta leads the nation in looking seriously at the potential of truck-only toll (TOT) lanes to improve travel conditions on its freeways, for both truckers and ordinary motorists. In 2005 SRTA commissioned a pioneering TOT lanes study, which reviewed three scenarios that had never before been considered in transportation planning:

Alternative 1: Add TOT lanes to the most truck-intensive portions of I-285N, I-75N and S, and I-85N, in *addition* to the planned HOV lanes.

Alternative 2: In *addition* to A1, allow delivery trucks to use the HOV lanes within the Perimeter in between the morning and evening peak periods (i.e., between 10 AM and 4 PM).

Alternative 3: Build a complete network of TOT lanes on the freeway system *instead* of building HOV lanes.[32]

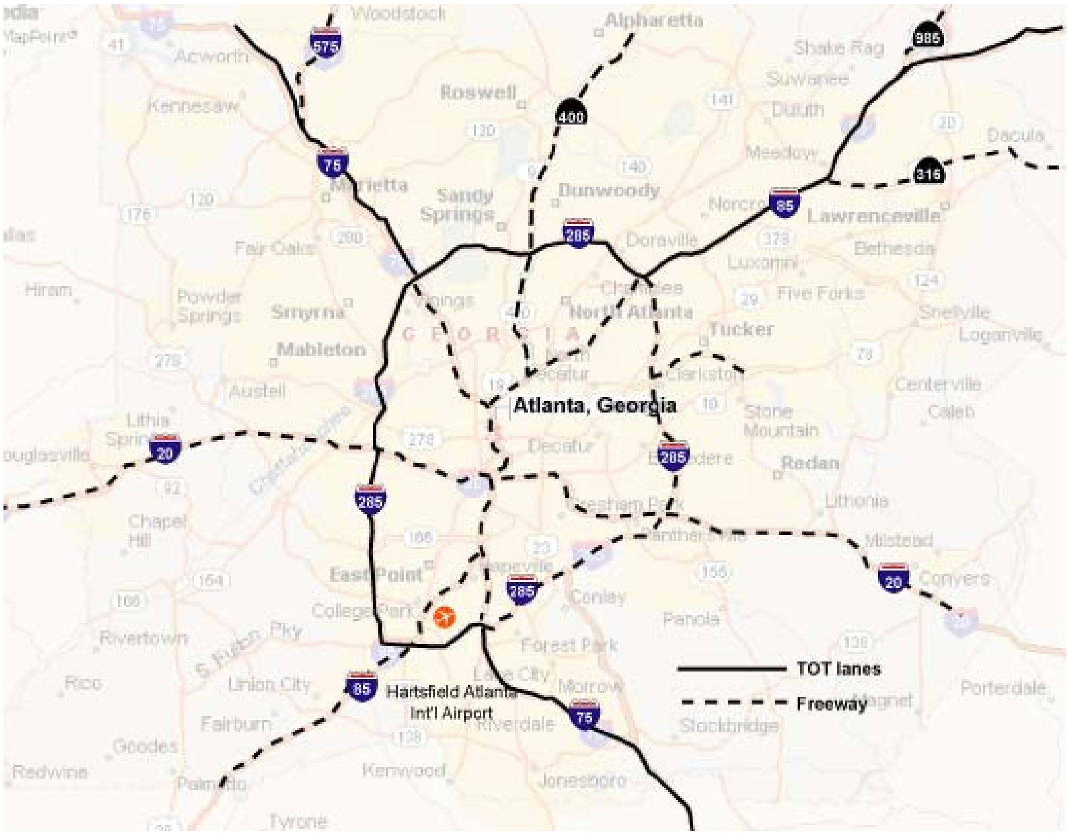
These three scenarios were simulated for 2030 traffic conditions using the ARC traffic model, and produced unexpected results. All three showed modest reductions in congestion on the regular freeway lanes, due to a significant fraction of trucks voluntarily shifting to the TOT lanes because of the major time savings (in some cases more than one hour) they could realize by doing so. Although the A1/A2 and A3 scenarios had slightly different impacts on freeway congestion, they were broadly similar, and those impacts were greater than was projected to come about from completing the planned network of HOV lanes.

Thus, while acknowledging the need for more detailed studies, some have begun to argue that TOT lanes should be added to the freeway system *instead of* HOV or HOT lanes (i.e., implement A3). The argument is that since this approach would cost about the same as adding the same number of lane-miles of HOV/HOT lanes, and those costs are already in the long-range plans (*Mobility 2030* plus the unfunded *Aspirations* plan), the greater benefits from TOT lanes would be realized at no greater investment than was already contemplated for HOV/HOT lanes. By contrast, implementing A1 would mean a major additional investment, since it would mean adding TOT lanes to a portion of the freeway system in addition to building the complete HOV/HOT network. And the way the study estimated TOT lanes revenue, those lanes would produce little more than enough revenue to pay for operating and maintenance costs, not the billions in capital costs needed for their construction.

Our proposal, by contrast, calls for adding an alternative version of A1 (toll truckways serving the most truck-intensive corridors) *in addition to* the Express Toll Network discussed previously. There are three principal reasons for pursuing this course. First, not building the Express Toll Network would mean foregoing billions of dollars in toll revenues that are sufficient to build not only those express lanes but some other needed improvements. Second, the congestion-relief benefits of the Express Toll Network are significantly greater than the planned HOV lanes or even HOT lanes as currently envisioned in SRTA and GDOT studies. Third, to provide the total amount of additional lane capacity needed to achieve the congestion-reduction goal, we need the lane-miles of a Toll Truckway System in *addition* to the lane-miles of the Express Toll Network.

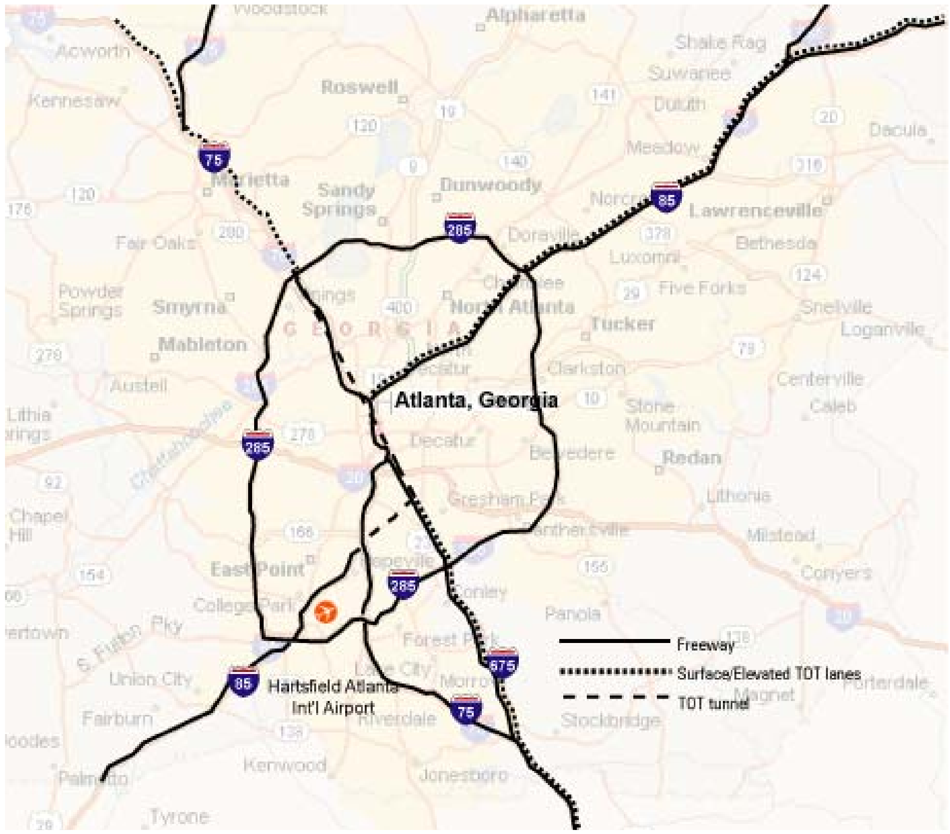
The map in Figure 17 shows the A1 alternative from SRTA's TOT lanes study. Due to the restriction that keeps heavy through trucks from operating inside the Perimeter, the route makes use of I-285N and I-285W, following the path that through-trucks on I-75 currently use to bypass downtown Atlanta. It also provides for the other principal through-truck route, linking I-75N with I-85N. During the PM peak period, despite the circuitous routing that trucks need to follow (whether on the current freeways or on the proposed TOT lanes), the time savings were estimated at 51 minutes for the I-75N to I-75S trip and 80 minutes for the I-75N to I-85N trip. The TOT lanes in this alternative total 472 lane-miles.

Figure 17: TOT Alternative Concept 1, Major Truck Corridors



Our proposal would duplicate the functional capabilities of A1, but with a shorter route making use of a tunnel beneath downtown Atlanta, as shown in Figure 18. It would avoid adding TOT lanes to the very space-constrained I-285N corridor (where it will be challenging enough to add four Express Toll lanes). A combination of at-grade and elevated truck toll lanes would be added to I-75N and I-85N outside the Perimeter, covering the same distance as plan A1, and likewise on I-75S as far north as the I-675 split. The truck lanes would then follow I-675 instead of I-75, and would parallel our proposed new tollway which extends that route northward to the proposed North-South Tunnel. At that point, the truck toll lanes would go underground into a 6.5-mile long truck-only tunnel. Just north of the I-75N/I-85N split, the truck lanes would surface, with one branch heading northeast along I-85N. The other branch would enter a new 7.7-mile tunnel heading northwest to just beyond I-285N, where the truck lanes would continue at-grade and elevated, where necessary, as proposed in the current Georgia Transportation Partners proposal. Another short (2.6 mile) tunnel would extend from I-85S (where it joins I-75S) to link up with the tunnel that goes beneath downtown.

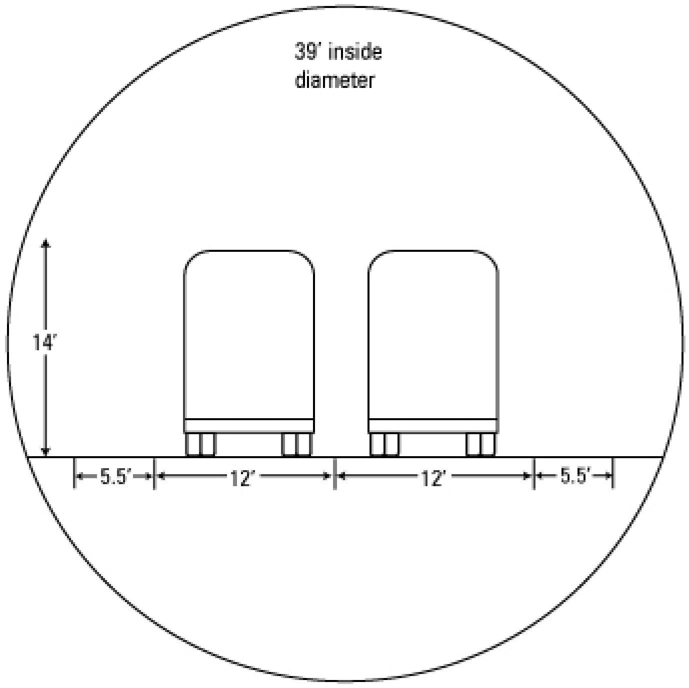
Figure 18: Proposed Atlanta Toll Truckway System



Each of these "tunnels" would actually consist of twin tubes, 39 feet in diameter and providing for two full-size, one-way lanes plus sufficient breakdown space that a disabled rig could pull to one side while still permitting two lanes of truck traffic to continue. The proposed cross-section is shown in Figure 19. This tunnel is identical in dimensions to the truck-size tunnel being built in the Paris suburbs roughly parallel with the A-86 cars-only tunnel discussed previously. The Paris truck tunnel's estimated cost, in 2005 U.S. dollars, is $66 million per lane-mile. The Toll Truckway System proposed here would consist of 368.8 lane-miles of surface/elevated lanes and 56.8 lane-miles of tunnel.

How much would this system cost? The average cost of the added HOV lanes proposed in GDOT's 2003 HOV plan was $6.98 million per lane-mile, which equates to $7.48 million per lane-mile in 2005 dollars. We assume those HOV lane additions were mostly at-grade. For elevated lanes, a four-lane segmental structure like that used for Tampa's new elevated express toll lanes would cost $13.6 million per lane-mile in 2006 dollars.[33] We estimate that a mix of elevated and surface truck lanes would average $10.4 million per lane-mile. Thus, at $10.4 million per lane-mile for the surface/elevated lanes and $66 million per lane-mile of tunnel, the total estimated cost is $7.58 billion in 2005 dollars.

Figure 19: Cross-Section of Proposed Toll Truckway Tunnels



Next we consider the question of how much of this cost can be supported from toll revenues. As was the case with the SRTA HOT lanes study, the TOT lanes study did not seek to estimate the optimal revenue-generating capacity of the TOT lanes alternatives, as would normally be done in toll road traffic and revenue studies. Rather, as explained in Appendix B of the TOT lanes study, the modeling simply used the minimum level of toll that would keep the TOT lanes from exceeding their capacity during peak periods. On one hand, this would appear to make sense, since one ground-rule for the study (with which we agree) is that use of the TOT lanes should be voluntary, and too high a toll might deter most users. Overall, with this tolling policy the modeling estimated that 50 percent of the trucks in the applicable corridors would opt to use the TOT lanes.

But on the other hand, the analysts doing any traffic and revenue study for a proposed new toll road face this same dilemma: if you set the toll rates too high, too few will choose to use the new toll road, opting instead for the free alternatives. But on the other hand, setting the tolls too low fails to collect revenues customers would be willing to spend. It seems likely that a more traditional toll road traffic and revenue study would recommend higher toll rates and estimate higher revenue than the very cautious approach used in the TOT lanes study. We did not have the resources to do such a study, but careful reading of the TOT lanes report made it possible to develop an alternative revenue estimate.

What a toll lanes alternative offers truckers is major time savings. That would be even more true of our proposed configuration, which is 11.6 route-miles shorter than the Perimeter-routed alternatives analyzed in the TOT lanes study. That study worked with the trucking industry to establish average values of time for light-duty and heavy-duty trucks, coming up with $18/hour and $35/hour, respectively (in 2005 dollars). While those numbers are far below those used by either the Federal Highway Administration or the Texas Transportation Institute, we used them for this re-estimate. Based on those hourly values, the TOT lanes study estimated the annual value of trucker time savings for A1 to be $721 million (TOT study Table 2). By contrast, the estimated annual toll revenues for A1 (TOT study Table 13) are only $89.4 million. That very large disparity suggests that pricing the TOT lanes only to deter over-crowding captures only a small portion of the value of time savings being gained by its users.

In our revenue estimates, explained in the Appendix, we made the alternative assumption that truckers would be willing to pay one-third of the value of the time savings as a toll to use the Toll Truckway System. That led to a far more robust estimated revenue stream. On the basis of that approach to setting toll levels, we estimate that toll revenue finance could pay for about 61 percent of the Toll Truckway System's cost.

Toll revenue finance could pay for about 61 percent of the Toll Truckway System's cost.

F. Arterials Expansion

We noted in Part 1 the serious deficiencies in Atlanta's arterial system, compared with other very large urban areas. And we noted that the modeling exercise to estimate the amount of capacity needed to eliminate all LOS F congestion by 2030 included the need to add 643 lane-miles of arterials and 317 lane-miles of other streets and roads. It is beyond the scope of this study to develop a plan for an expanded arterial system. What we can do here is to suggest a few key concepts that can help in such a design effort.

One key idea is to upgrade major arterials into "expressways"—roadways that have semi-limited access, with grade separations (overpasses or underpasses) at major intersections but traffic signals at other intersections. This kind of intermediate between freeway and arterial is effectively used for a number of routes in Santa Clara County, California, home of Silicon Valley. Roswell Road (SR 120), Holcombe Bridge Road (SR 140), and Peachtree Industrial Blvd. may be candidates for this kind of upgrade.

Another idea, where two major arterials intersect and heavy left-turn volume exists, is to relieve congestion by means of some form of grade separation. A number of innovative designs have been produced for such interchanges, among them the Continuous Flow Interchange, the Hybrid Interchange/Intersection (HICIS), the Echelon Interchange, and the Queue Jump.[34] Each is a variant on the theme of using two levels to simplify the complexity of intersection movements. Figures 20 and 21 illustrate two of these design concepts.

Figure 20: Hybrid Interchange/Intersection (HICIS)

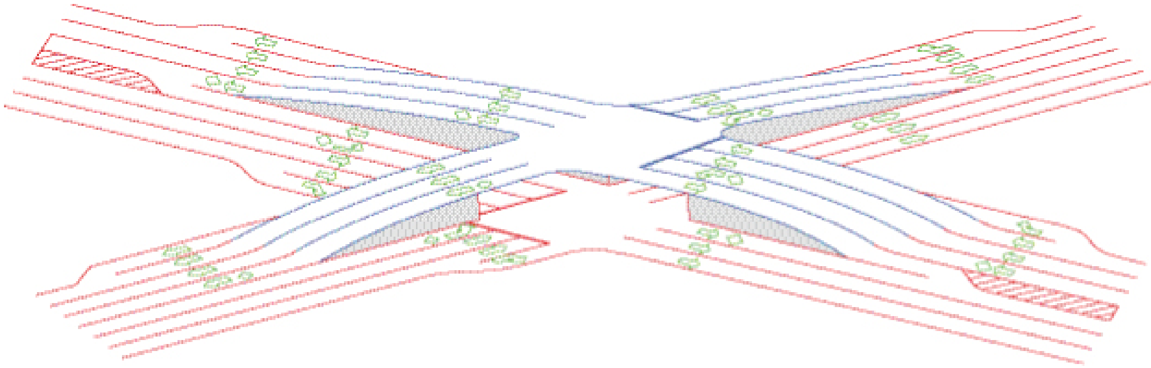
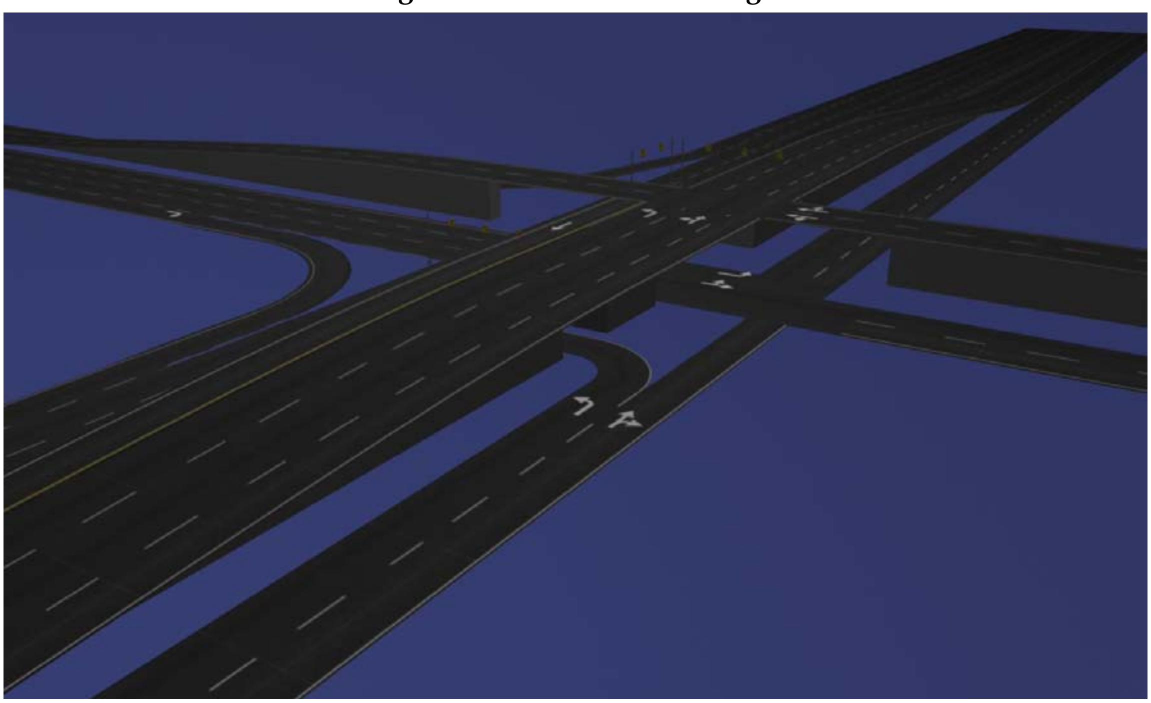


Figure 21: Echelon Interchange



G. Beyond-2030 Additions

This report has proposed an agenda that would achieve the goal set by the Governor's Congestion Mitigation Task Force of reducing traffic congestion significantly by 2030. But if this goal were to be achieved, what comes next, after 2030?

If Atlanta residents and businesses have come to understand the personal and economic value of much-improved mobility by 2030, they will want at the very least to maintain the lower level of congestion attained by that point. Doing that would require incremental additions of capacity and continued use of pricing. But at an overall travel time index of 1.35, much of the system would remain significantly congested (between LOS E and F, overall, despite LOS C on the variably priced facilities). At that point, it would be worthwhile to consider a more ambitious goal: eliminating recurrent congestion altogether, while minimizing incident-related congestion. How might this be done? Building on the base created by this report's recommendation, the next phase would require the use of new technology, additional capacity improvements, and wider use of pricing to tie the use of roads to funding of them.

Technology offers one set of tools. Adaptive cruise control (ACC), which is already available on various high-end cars, has significant potential to reduce congestion by permitting vehicles to travel more closely together, safely. These effects are seen in traffic simulation modeling with as little as 20-25 percent of the fleet equipped with ACC.[35] And ACC is merely a forerunner of more comprehensive automated highway capability, for at least the limited-access portion of the highway system. This technology holds the potential to more than double the throughput capacity of those highways so equipped.

Wider use of variable pricing is also a powerful tool for reducing or eliminating recurrent congestion. Our 2030 proposal would use variable pricing on most of the new capacity we have proposed. But once those facilities are in place and operating reliably without congestion, there may be political support for expanding pricing to currently non-priced freeway lanes. One could imagine a future in which commuters face a choice among three alternatives: premium-priced express lanes, moderately priced freeway lanes, and unpriced arterials.

Finally, even with maximum use of technology and pricing, as metro Atlanta continues to expand geographically, the region will need new limited-access roadway capacity to ensure that its developing suburbs and exurbs also have uncongested mobility. This will mean creating more of a network of limited-access routes, connecting all the higher-density nodes to one another, across the region.

We noted earlier the lack of circumferential routes linking suburbs to suburbs and the absence of a modern grid of arterials. As the metro area continues to grow, it will be important to expand the roadway network to facilitate the kinds of trips that people and goods will need to make. Several approaches should be kept in mind, as tools in the tool-box for expanding and improving the roadway network.

- Upgrade selected state highway routes to limited-access freeway or tollway status. For example, SR 5 and SR 6 on the west side would provide a more convenient north-south route for the western suburbs than I-285W, as would SR 20 for the eastern suburbs. One or more east-west routes will also be needed for the fast-growing southern suburbs.

- Consider adding elevated express toll/busway lanes above the median on major arterials. Using precast, segmented assembly, such express lanes are being added to a major commuter route in Tampa at a cost of under $14 million per lane-mile, which is quite reasonable for elevated construction.

- Consider using untraditional rights of way—such as little-used or unused rail lines, flood control channels, and power line rights of way—for express toll/busway routes. These rights of way (often 60 to 100 feet wide) are too narrow for a freeway, but could accommodate multiple lanes for cars and buses, with careful design.

This brief recap is meant to be suggestive, not exhaustive. A compendium of innovative design ideas, for both freeways/tollways and arterials, has recently been published by Reason Foundation, providing numerous examples of these kinds of approaches.[36]

Part 4

Improving System Operations

A. Freeway Operations

The Texas Transportation Institute's annual Urban Mobility Report provides summary data for each urban area on Operations Strategy measures, estimating for each one how much of a contribution it is making toward reducing the travel time index. Four basic measures are reported, two for freeways and two for arterials. The freeway measures are the extent of ramp metering and the percentage of the system under active incident management efforts. The most recent freeway data for Atlanta are shown in Table 8.

Table 8: Atlanta Freeway Operations Management

Operations Strategy	2003	2002	2001	2000
Ramp Metering				
Percent of miles of roadway	2%	2%	2%	2%
Annual delay reduction, 1000 hrs	-	-	-	-
Freeway index with strategy	1.51	1.46	1.42	1.35
Freeway index (base)	1.51	1.46	1.42	1.35
Freeway Incident Management				
a) Cameras				
Percent of miles of roadway	40%	36%	33%	20%
b) Service patrols				
Percent of miles of roadway	100%	100%	94%	86%
Annual delay reduction, 1000 hrs	8,709	7,821	6,996	5,211
Freeway index with strategy	1.47	1.43	1.39	1.33
Freeway index (base)	1.51	1.46	1.42	1.35

Source: Texas Transportation Institute

As can be seen, ramp metering was essentially non-existent as of 2003 (just five units deployed on I-75N). Yet estimates of the impact of widespread ramp metering (such as in Minneapolis/St. Paul) suggest that it can have a significant effect on recurrent congestion. For example, the Texas Transportation Institute's latest report estimates that ramp metering (which covers 90 percent of freeway miles in the Twin Cities) has saved over 4 million hours of delay per year (seven percent of all delay there). With a freeway system 44 percent larger than that of the Twin Cities, Atlanta might save 5.75 million hours of delay per year with large-scale ramp metering. Since ramp metering costs a small fraction of significant lane additions, this under-used tool clearly represents "low-hanging fruit" in reducing Atlanta's congestion. Fortunately, the Governor's Fast Forward program has an additional 115 ramp meters planned for metro Atlanta, to be added over the next three years.

Atlanta has done much better in terms of incident management. Two key elements in an effective approach are equipping the freeways with cameras, so that incidents can be identified quickly and appropriate units dispatched, and creating and operating freeway service patrols that can respond rapidly to minor incidents (breakdowns and fender-benders). On the former, Atlanta still has a ways to go, with only 45 percent of freeway miles equipped with NaviGAtor video detection cameras as of 2006 (just five percent more than the table shows for 2003). But the entire system is now covered by the HERO patrols, which the Institute credits with saving 8.7 million hours of delay in 2003, thereby reducing the freeway congestion index from 1.508 to 1.471. More recent local data show that HERO units responded to over 10,000 crashes and 63,000 motorist-assists in 2005, a 10 percent increase over 2004.[37] Since the 2002 base year, the duration of tractor-trailer incidents has declined from 81 minutes to 63 minutes, and the duration of auto incidents from 40 minutes to 34.5 minutes.[38]

To better coordinate incident response in the Atlanta metro area, dozens of state and local agencies created the Traffic Incident Management Enhancement (TIME) Task Force in 2002, whose mission is "to develop and sustain a region-wide incident management program to facilitate the safest and fastest roadway clearance." Its operational goals are to ensure that all responders are trained in traffic control procedures, to ensure that they use state-of-the-art procedures for on-scene traffic control, to ensure that they use traffic control procedures for the end of the incident queue, and to ensure that they have mutually understood equipment staging and emergency lighting procedures on-site to maximize traffic flow past the site while keeping the responders safe.

These are all worthwhile goals, and with support from the Governor's "Fast Forward" program, these efforts seem to be making steady progress. However, it is not clear how Atlanta measures up on a national scale against best practices in system operations. For several years, the Federal Highway Administration has offered state DOTs a self-assessment survey on system operations techniques and practices. As far as we could determine, GDOT has not availed itself of this resource, making it difficult for the agency or the public to know how its efforts measure up to best practices.

The underlying problem with incident management is one of institutional conflict. Public safety agencies tend to have one set or priorities while transportation agencies have different ones. Besides tending to the injured and dealing with fuel spills, public safety agencies are concerned about thoroughly investigating and documenting major accidents, which can take considerable time. Transportation agencies, by contrast, are also concerned with the huge delay costs imposed on motorists, buses, delivery trucks, and everyone else who uses the highways. In most states, including Georgia, public safety agencies are either legally or de-facto in charge at incidents, which means that minimizing delay to the traveling public does not receive priority. This appears to be less the case on certain toll roads (e.g., Florida's Turnpike and California's 91 Express Lanes), where more aggressive efforts to minimize incident clearance times seem to have taken hold.

The National Cooperative Highway Research Program has published a synthesis report on safe, quick clearance of traffic incidents.[39] An overall program should encompass the following elements:

- Quick clearance legislation;
- Hold harmless law for incident responders;
- Fatality certification law;
- Interagency agreements (open roads policy).

Georgia does well on the first two, with both a Driver Stop Law and an Authority Removal Law in place, both of which include hold-harmless provisions. Only a few states (not including Georgia) permit the certification of a fatality and removal of the body by anyone other than a medical examiner—yet such policies can make a major difference in accident clearance times. Jurisdictions with such policies include the City of Chicago and the states of Maryland, Tennessee, and Texas. Likewise, only a few states have developed enhanced interagency agreements that make quick clearance the overarching priority, commonly termed an "open roads policy." The NCHRP study identified five such states: Connecticut, Florida, Maryland, Tennessee, and Wisconsin. If congestion reduction becomes the major focus of transportation planning and programming in Atlanta, priority should be given to enactment of a fatality certification law and development of an open roads policy among GDOT and public safety agencies.

Highway construction work zones are another key source of delay, as well as a safety hot-spot. Two principal types of construction are of interest: routine resurfacing and major reconstruction projects. Both can be managed in ways that minimize the delay caused to motorists.

Routine resurfacing must be done periodically to maintain the life of the pavement, thereby preventing major reconstruction before it is really necessary. On highly congested freeways, such resurfacing operations should not be done during peak traffic periods, because the loss of lane capacity imposes too great a cost on users. But since "peak" periods in Atlanta are approaching eight hours each weekday, this means such resurfacing must be done at night and on weekends. The additional cost of night and weekend operations is far less than the delay costs that would otherwise be imposed on highway users. This is becoming GDOT practice in Atlanta. For example, the resurfacing of I-285 SE was carried out by closing one direction of the freeway on weekends; the project was completed in half the estimated time allowed.

Major reconstruction, however, inherently takes lanes out of service for a considerable period of time and hence cannot be limited to nights and weekends. In this case, to minimize total delay on major freeways, the construction work should be carried out on a round-the-clock basis (24/7), with the idea of limiting the duration of construction to as short a time as possible. This is also becoming common practice in Atlanta. When such projects are done under design-build contracts, it is common to include significant financial incentives to complete the work on or before a target date, and such projects are often completed significantly ahead of the targeted completion date.

State-of-the-art traffic control in the vicinity of construction work zones can reduce delay and improve safety. The primary impact is to reduce accidents and therefore the delays associated with clearing them.

State-of-the-art traffic control in the vicinity of construction work zones can reduce delay and improve safety.

B. Arterial Operations

Two principal operations strategies for arterials are traffic signal coordination and arterial access management. The Texas Transportation Institute data for Atlanta's use of these strategies are presented in Table 9.

Table 9: Atlanta Arterial Operations Strategies

Operations Strategy	2003	2002	2001	2000
Signal Coordination				
Percent miles of roadway	58%	58%	58%	59%
Annual delay reduction (1000 hrs)	298	343	336	397
Arterials index with strategy	1.41	1.41	1.41	1.40
Arterials index (base)	1.41	1.42	1.42	1.41
Access Management				
Percent miles of roadway	47%	46%	35%	22%
Annual delay reduction (1000 hrs)	442	549	474	407
Arterials index with strategy	1.40	1.41	1.41	1.40
Arterials index (base)	1.41	1.42	1.42	1.41

Source: Texas Transportation Institute

Atlanta did not progress much during the early years of this decade with signal coordination. In a national survey carried out by the National Traffic Operations Coalition (based on voluntary self-reporting), 11 of the 26 Atlanta-area jurisdictions with traffic signal operations responsibilities responded (neither DeKalb nor Fulton participated). The Atlanta regional score was 56 (out of 100), with participating jurisdictions ranging from 31.5 to 80.2. The average score nationwide was in the low 60s.[40]

The Regional Traffic Operations Task Force is working to coordinate traffic signal timing among jurisdictions. Since traffic flows on arterials typically cross jurisdictional lines, such efforts produce far more benefits if implemented on a regional basis. The Governor's Fast Forward program has committed $160 million to accelerate signal coordination efforts, and 16 such projects were programmed for 2005. Thus, future years should see improvements in the numbers shown in Table 9.

Access management refers to a set of techniques to increase safety and improve traffic flow on major arterials. It typically includes such measures as consolidating driveways to minimize disruptions to traffic flow, adding median turn lanes or turn restrictions, adding raised medians, and adding acceleration and deceleration lanes. Although raised medians are often a principal element in access management, under heavy traffic conditions they can increase recurrent congestion, due to the limits on storage capacity of left-turn bays. Once they become full, additional left-turning traffic spills into the through lanes, adding to delays. But because raised medians also increase safety by reducing the number of conflict points (thereby reducing accidents), they reduce incident-related congestion. When analysts crunch the numbers, they find a net decrease in congestion from the addition of raised medians, as the latter effect outweighs the former.

Because of limitations in readily available highway data, the Texas Transportation Institute uses only the extent of raised medians as its measure of access management. This may understate the extent of congestion reduction, to the extent that actual programs in urban areas may include the other features discussed above, all of which have some impact on recurrent congestion. The data in Table 9 show that Atlanta is comparable with other "very large" urban areas, which average 44 percent of their principal arterial miles with access control via raised medians.[41] In these very large urban areas, the average reduction in travel time index due to this strategy is 0.014, one-third again as large as the 0.010 that Atlanta has achieved thus far.

Part 5

Costs and Benefits of Congestion Reduction Program

Parts 3 and 4 set forth an ambitious program to eliminate serious recurrent (LOS F) congestion from Atlanta by 2030, providing new congestion-relief options for motorists, trucks, and bus rapid transit. The major capacity additions from Part 3 represent a kind of one-time catch-up, to make up for the relative lack of such expansion over the past two decades. After 2030, more modest expansion to keep the system's capacity in pace with traffic growth, or to reduce congestion even further, would be needed. Part 4 explained how a more pro-active approach to operating and managing the system would reduce the extent and impact of non-recurrent congestion. In Part 5, we add up the costs and make some estimates of the benefits of this approach to congestion reduction.

A. Costs and Revenues

Our capacity expansion approach included four major projects, costing $25.1 billion in 2005 dollars. Each of these projects would generate value-priced toll revenues, and in the Appendix we evaluated each project in net present value terms to see if it would be self-supporting. Table 10 summarizes these calculations. As previously noted, the Express Toll Network has a strongly positive NPV, which exceeds the negative NPVs of the other three projects. Overall, the entire set of projects has a negative NPV of $4.04 billion. That means toll revenues should be able to finance the large majority of the $25.1 billion cost.

One very important caveat to this assessment is the recent history of construction cost increases. Our escalation of current costs into future years used a standard 3.5 percent annual inflation factor. The producer price index for highway and street construction increased by 8.5 percent in 2004 and 12.6 percent in 2005. Should such cost increases continue, the future construction costs assumed in our analysis could be considerably higher, and projects estimated to be self-supporting from toll revenues would need additional funding from traditional highway funding sources.

Table 10: Major Project Costs and Revenues ($B)					
Project	**Cost, 2005 $**	**Base Year**	**NPV Cost**	**NPV Revenues**	**Difference**
ETL Network	$9.14	2008	$9.43	$17.02	+$7.59
N-S Tunnel	$4.88	2012	$6.21	$2.41	-$3.80
Toll Truckway	$7.58	2015	$10.70	$6.56	-$4.14
Lakewood	$3.51	2018	$5.49	$1.80	-$3.69

With that caveat, the potential exists that this $25 billion investment over the next two decades, if developed using value pricing, could be close to self-supporting. While this result may at first appear surprising, it reflects the underlying economic reality that there is a huge suppressed demand for improved mobility in Atlanta. That's what the reported basic congestion cost of $1.75 billion per year (in wasted time and fuel) means.

As a kind of reality check on this notion, we estimated the basic congestion costs in 2018 and compared that to our projected toll revenue in that year, when three of the above projects will be in their early years of operation. To do that, we escalated current cost of $1.75 billion by our assumed 3.5 percent annual inflation rate, finding that it would grow to $2.9 billion per year by 2018 simply via inflation, not counting either increases in traffic growth or additions to the system's capacity. From the spreadsheets in the Appendix, we took the 2018 gross revenues from the three systems that would be in early operation by that point. That total is $1.23 billion or 42 percent of the basic congestion cost in 2018. Since these value-priced tolls would only be paid (on any given day) by the subset of people making the most time-sensitive trips, it's plausible that the toll revenues would be between one-third and one-half of the basic congestion cost.

A second piece of good news is that developing the four major projects using value-priced tolls could free up some funds for other transportation investments. The *Mobility 2030* plan includes $4.9 billion over the next 25 years to add 688 lane-miles of HOV and busway lanes to the system. That money comes primarily from federal and state fuel tax revenues. If toll revenues covered the costs of our far more expansive system of Express Toll Lanes (which also function as virtual exclusive busways), the plan's $4.9 billion should be reprogrammed to cover the shortfalls on the other three transportation projects ($3.75 billion in present-value terms). That would potentially leave another billion dollars for other congestion-reducing investments (or, more likely, to cover some of the higher than anticipated construction costs of these largely toll-funded projects).

It is beyond the scope of this brief study to specify what the best use of any remaining dollars might be, at any level of detail. Conceptually, however, several priorities suggest themselves. One of the most important is serious upgrading of Atlanta's arterials, which as noted in Part 1 are grossly inadequate for a huge, low-density urban area. The modeling which led to the maps of needed freeway lane-additions in Part 3 also estimated that 643 lane-miles of arterials and 317 lane-miles of other street capacity were needed to reach the goal of eliminating all LOS F congestion by 2030. That's a total of 960 new lane-miles. If the average cost (including right of way acquisition) were $1 million per mile, it would require $960 million to add the needed capacity to the street and arterial system.

We also introduced the idea of adding grade separation at some of the most congested intersections of two major arterials, using designs like HICIS or Echelon. Since only a handful of such projects have been implemented, good cost figures are difficult to obtain. But if the cost of such a project is $15 million, then it would cost $150 million to implement 10 of them around the metro area.

Another productive use of freed-up funds is to accelerate the completion of system operations strategies discussed in Part 4, to the extent these are not already fully funded in *Mobility 2030*. Atlanta was found to be seriously deficient in ramp metering on the freeway system, for example, and still lacking full freeway system coverage by video cameras for rapid incident detection. Likewise, on the arterial system, traffic signal coordination and access management treatments still have a long way to go to reach 100 percent implementation.

B. Congestion-Reduction Benefits

The modeling exercise discussed previously estimated that adding 1,653 lane-miles of freeway capacity, plus 960 lane-miles of arterial and surface street capacity, would be sufficient to eliminate LOS F conditions on Atlanta's transportation system by 2030. When the ARC model was run with those additions in place, the reduction in congestion was quantified as follows:

- A small decrease (0.61 percent) in overall vehicle miles traveled (VMT);
- A 27.2 percent decrease in vehicle hours of travel (VHT) due to faster trips;
- Improvements in most travel times and speeds.

A previously noted Reason Foundation report calculated the benefits of these changes to peak-period users, assuming that all the new lanes were general-purpose lanes. Since transportation capacity is a long-lived investment, the aim was to compare the benefits over a fairly long time period (20 years) with the one-time cost of adding the capacity. Valuing the time saved at a conservative $12 per hour, and vehicle operating cost at $0.60 per mile, the study estimated the savings over 20 years to be $98.6 billion.[42] Since this national study used generic cost estimates for the added lane-miles, its estimate of the capacity-addition cost was $13.1 billion—about half of our more detailed, location-specific estimate of $25.1 billion. But even substituting our cost number, the benefit/cost ratio is a healthy 3.9.

In point of fact, however, the capacity additions proposed in this report would produce larger benefits than the basic time-savings to vehicles in general-purpose lanes estimated in that study. Our proposal adds nearly as much capacity as that analysis found needed to eliminate LOS F congestion (83 percent of the needed freeway lane-miles and 100 percent of the non-freeway lane-miles). But because the new lanes on the freeway system would nearly all be value-priced to maintain LOS C, the time savings on those lanes would be significantly larger. The ARC model is not designed to distinguish between priced and non-priced lanes, so we do not have a precise estimate. But the calculation referred to previously, showing that users of the priced lanes would pay $1.23 billion in 2018 to avoid congestion, is indicative. The total value of time savings from the system proposed here would be (1) the time saved by users of the general-purpose lanes who would no longer experience LOS F congestion, plus (2) the time saved by users of the new priced lanes, as measured by what they voluntarily pay to use those lanes.

C. Economic Benefits

The benefits of actually reducing congestion go well beyond time and fuel-cost savings to motorists and truckers. As Cox and Pisarski point out in the previously cited study, predictable highway mobility is a major consideration for manufacturing and distribution businesses. It is also a crucial factor in how large a catchment area a business has from which to draw employees (and likewise, how large a catchment area around a home each person has in which to seek a good employment fit for his or her skills). Cox and Pisarski note that as congestion is reduced:

- Effective labor markets expand, as employees can reach a much larger number of jobs in a specific period of time (such as 30 minutes); this can have a significant impact on regional economic growth, due to increased labor market productivity.
- The travel time between suppliers and commercial customers is reduced, permitting more deliveries during a work shift.
- Travel times become more reliable, particularly affecting those firms that depend on just-in-time delivery; one effect of this is to reduce inventory costs.
- Housing affordability is increased, since more affordable homes are within reach of a given workplace.
- Emergency services can get to incidents more quickly, which may reduce trauma and deaths.
- Even recreational and social interaction opportunities are increased, due to reduced travel times.

In Part 1, we noted that the National Cooperative Highway Research Program had done case studies of the impact of reduced traffic congestion on the regional economies of Chicago and Philadelphia, looking at both labor-market and logistics costs. After adjusting for inflation, these savings would today be in the $1.5 billion range for the former and $0.5 billion for the latter. We also noted the work of Prud'homme and Lee, which focused specifically on labor-market productivity. In their 2004 study, Cox and Pisarski applied the Prud'homme-Lee model to Atlanta, for each of the four alternative congestion-reduction scenarios they used in their study. Once again, interpolating between their scenarios 2 and 3, we can estimate the labor-market impact of the Reason plan.

Their scenario 2 (maintain congestion at 2001 levels, rather than letting it get dramatically worse by 2030, via the status-quo plan) would result in a 2.4 percent increase in gross personal income by

2030 ($147 billion). To repeat, this is because the larger catchment areas for both employers and potential employees allows a better matching of skill-levels with employer needs, thereby increasing the region's labor productivity. And we know that increased labor productivity results in higher incomes. Scenario 3 (50 percent congestion reduction) leads to a 3.5 percent increase, or $213 billion more gross personal income by 2030. The Reason plan, at 21 percent congestion reduction, leads to the intermediate amount of $175 billion.

By any reckoning, that would be an impressive return on the investment of $25 billion in expanded freeway capacity, plus several billion more spent on upgrading the arterials and streets.

D. Transit Benefits

All the priced-lane projects that we propose be added to the freeway system would be ideally suited to the provision of reliable, high-speed express bus service, such as that contemplated in GRTA's Regional Transportation Action Plan. That plan calls for high-speed BRT corridors on I-75N, I-75S, I-20E, I-20W, the Downtown Connector, I-85N and I-985, and I-285N and I-285E. The combination of the proposed Express Toll Network and the North-South Tunnel would provide "virtual exclusive busways" on all of these routes (with the N-S Tunnel as an alternative to the Downtown Connector).

Our plan differs significantly from what is embodied in *Mobility 2030* in several ways. First, *Mobility 2030* proposes to dedicate exclusive bus lanes on each of the above freeways (except the downtown connector), by reserving one of each pair of planned HOV lanes in each direction solely for buses. Since it is inconceivable that any of these routes could generate the need for more than 60 buses per hour even during rush hours, that means (assuming a LOS C rate of 1,800 vehicles per hour) that 97 percent of the capacity of these very costly new lanes would go unused during the very hours when congestion-relief is needed most.

By contrast, our plan would use value pricing to keep both new lanes (in each direction) flowing smoothly at LOS C during peak periods. That means both lanes would be usable by GRTA's BRT operations, which means the buses could pass the occasional slow-moving vehicle in one lane. More important, thanks to value pricing, these lanes would operate reliably and predictably at the speed limit, thereby making more credible the idea that this would actually be high-speed express service. Furthermore, in contrast with HOV lanes, which can eventually get clogged with traffic and lose their time-saving advantage, value-priced lanes are *sustainable long-term*, as long as the price is allowed to adjust as needed to keep traffic limited to LOS C conditions.

What makes an express toll lane into a "virtual exclusive busway" is a policy decision, which we recommend be made for this system of priced lanes in Atlanta. For all corridors where there is a demand for high-speed BRT service, the transit agency (presumably GRTA) and the toll lane owner-operator (presumably SRTA or a PPP partner) would contractually agree to reserve a specific portion of the capacity of those lanes for high-speed BRT service. Another portion can be reserved for vanpools, to give that very cost-effective form of mass transportation a time-saving advantage, as well. Houston is implementing this kind of policy on the new managed lanes being added to the Katy Freeway (I-10).[43]

Another benefit of implementing our plan is that a much larger network of congestion-relief lanes will be available much sooner, thanks to financing the construction with toll revenues. The fiscally constrained *Mobility 2030* would add a total of 688 lane-miles by 2030; of these, 363 lane-miles might be accessible to cars, while 325 lane-miles might be reserved for buses only. By contrast, our plan would add 1,133 lane-miles, with all of them in place by 2024, and all of them open to any car or other light vehicle (SUV, pickup truck, etc.) willing to pay the toll. Likewise, all 1,133 lane-miles would be open to buses and vanpools at no charge.

Thus, our plan offers a larger and more complete set of (virtual) exclusive busways than *Mobility 2030*, and would make them available years sooner.

E. Impact on Air Quality

Atlanta's virtual halt to the expansion of highway capacity came about in response to the EPA's late-1990s finding that the area was in "non-attainment" of air quality requirements. That led to a shift in transportation planning that focused far more on ride-sharing (HOV lanes) and transit, rather than highway expansion. The underlying premise was that adding highway capacity would increase the amount of driving (vehicle miles traveled—VMT). And since VMT is a major factor in the emission models used to determine air quality compliance, the assumption was that any significant expansion of highway capacity would conflict with achieving air quality goals.

Some readers may therefore be surprised that this report advocates a major expansion of highway capacity. Yet when the proposed addition of lane-miles was modeled using ARC's traffic assignment model, the results showed not only a major decrease in congestion (with year 2030 vehicle hours of travel—VHT—decreased by 27 percent) but also a slight decrease in VMT (0.61 percent). What seemed to be happening in the model is that the improved performance of the freeway system shifted some trips from overloaded arterials to the freeway system, thereby reducing circuitous routing and hence VMT.

The Governor's Congestion Mitigation Task Force also addressed this issue, in the process of deciding to set an aggressive congestion-reduction goal. At its final meeting on December 6, 2005, consultant Tim Lomax talked about the decision to weight the congestion-reduction factor at 70 percent in project selection. "Lomax stated that the agencies have agreed to continue work on this recommendation and incorporate it into their processes. He noted that staff analysis showed that increasing the congestion factor was not detrimental to other factors such as safety and air quality."[44]

Two other factors should also be noted regarding air quality. In addition to VMT, the other main factor driving emission models like MOBILE6 is vehicle speed. It is well-known that most tailpipe emissions are significantly lower at medium-high speeds compared with stop-and-go conditions. The large-scale addition of free-flowing priced lanes would significantly increase average peak-period speeds. Second, MOBILE6 also takes into account the impact of the latest stringent federal tailpipe emission standards. Over the next 20 years, nearly all older vehicles built prior to these most recent standards will be retired, with the vehicle fleet becoming significantly cleaner. That will also help to keep metro Atlanta in conformity with federal clean-air attainment goals.

Part 6

Conclusions and Recommendations

This report began by citing the Congestion Mitigation Task Force's call for a bold change of course in transportation planning and investment, to make reducing congestion the overriding priority in a revised long-range transportation plan. We have proposed such an approach in this case study, identifying how Atlanta could come close to achieving the congestion-reduction goal set by the Task Force report. And we have drawn on the cutting-edge experience of other states with value pricing to suggest that major congestion-relief projects could be financed largely or entirely out of value-priced toll revenues. In this concluding section, we discuss several issues that relate to implementing the kind of plan sketched out in this report.

A. Rethinking the Long-Range Transportation Plan

For Atlanta to implement this kind of change would mean a major rethink and rewrite of the current long-range transportation plan. As we noted in Part 1, that plan is premised on the idea of trying to do many "nice things" other than focusing on actually reducing traffic congestion. In particular, it lays great emphasis on trying to entice large numbers of people away from driving alone to work, by offering them carpool and transit instead. Of the $26 billion it would put into transportation infrastructure between 2005 and 2030, $10 billion would go into new transit capacity, nearly $5 billion into HOV lanes, and only $8 billion into roadway capacity.

Citizens and taxpayers need to ask how much change in travel behavior would be brought about by this, even if the strategy succeeded to the full intended extent. Table 11 shows how ARC itself forecasts travel to change during that period, if *Mobility 2030* is fully implemented.

Table 11: Commuter Mode Share Changes with Mobility 2030

Commute Mode	2005 Percent	2030 Percent	Change
Drive alone	83.0%	81.6%	-1.4
Carpool	10.3%	10.0%	-0.3
Transit	6.7%	8.4%	+1.7

Source: Atlanta Regional Commission

In other words, after the construction of one of the country's largest HOV lane systems, by 2030 a *smaller* fraction of home-to-work trips would be made as carpools than in 2005. And after expanding the transit system by $10 billion, only 1.7 percentage point more commuters would get to work on transit. And the transit numbers for *all trips* (as opposed to just the work-trips shown in this table) are even more modest. Only 3.3 percent of all Atlanta-area trips would be made using transit in 2030. While trips in private vehicles would grow from 9 million in 2005 to 13.8 million in 2030, transit trips would grow from 300,000 to 624,000—an impressive growth in numbers but a drop in the bucket compared with the growth in auto trips. And remember that this choice of travel modes would be accompanied by a huge increase in congestion, per ARC's projections, if the plan is implemented as written. This outcome is probably inevitable, if Atlanta continues to spend the majority of its transportation funds on a small portion of the expected trips.

The unviability of Atlanta's current approach to transportation and land-use was discussed several years ago by urban planner Alain Bertaud in a landmark article in the *Journal of Urban Economics*.[45] Bertaud concludes that addressing pollution and congestion in Atlanta by expanding transit and promoting increased density would be futile: "The current spatial structure of Atlanta is incompatible with a sizeable transit market share; and Atlanta's spatial structure cannot be changed significantly in the next 20 years, even if draconian land-use regulations were adopted."

The numbers in Table 6-1 illustrate that although good transit alternatives have a role to play, they have very little to do with reducing the congestion that plagues the citizens of the 20-county region. Reducing congestion means fixing the highway system, which is how the overwhelming majority of residents (and goods) will continue to travel even if the current long-range plan is implemented unchanged. Our proposal offers a technically and financially feasible way of fixing the highway system and dramatically reducing congestion in Atlanta. The next revision of the region's long-range transportation plan needs to refocus on expanding and managing the highway system so as to achieve the Task Force's congestion relief goal.

B. Support for Tolling and Value Pricing

Are the people of greater Atlanta ready to pay for congestion relief, on a voluntary basis? Survey data suggest that this is the case. First, a survey conducted for GRTA in 2002 found that traffic congestion was the region's most important problem, by a wide margin, in every county. The overall results were that 53 percent selected this as the region's top problem; crime was a distant number two at just 8 percent. And when the question focused in on rush-hour traffic as a problem for the respondent personally, the overall percentage saying "serious" or "very serious" was 61 percent.[46]

In a more recent telephone survey, conducted in support of this project by CRSPE, 79 percent of respondents said that traffic congestion is either the region's most important issue or one of the top three issues. And 77 percent thought that adding highway capacity would be "very" or "somewhat" effective in reducing congestion, higher than any other proposed alternative. When asked about possible funding sources, tolling scored 52 percent, far higher than either increased gas taxes or sales taxes (each of which garnered only 33 percent). The only funding source that got higher support was impact fees on new development (72 percent), which is more suitable to arterials and local streets than to freeways. Congestion-based tolls, which were asked about separately, were supported by 54 percent ("supportive" or "very supportive").[47]

Since 2004, local agencies such as SRTA and GDOT have been popularizing the idea of priced lanes, both for cars and for trucks. SRTA has funded pioneering studies of HOT lanes and truck-only toll (TOT) lanes, whose results have been generally well-received. And GDOT has welcomed proposals for billion-dollar scale public-private partnership projects to begin adding priced lanes to some of the most congested freeways. Our recommendations build on these promising initial moves by two of the key transportation agencies.

C. Institutional Issues

In the *2004 Blueprint 2030* report, authors Cox and Pisarski recommend that because of the large size and jurisdictional diversity of the 20-county Atlanta region, a major congestion reduction program should be administered by a state agency along the lines of the toll road authorities in other states. It should have bonding authority secured by toll revenues, be insulated from political influences, and be solely committed to developing the set of projects needed to achieve the congestion reduction goal.[48]

One possible candidate for this role is Georgia's existing State Road & Tollway Authority, SRTA. Whether to expand its role to encompass all such major priced capacity is a decision for Georgia policymakers. We do point out that because a number of the toll projects proposed in this report would not be self-supporting on a stand-alone basis, there is a good case for some sort of public agency to issue toll revenue bonds based on the toll revenues and financial strengths of the entire set of toll projects

Georgia is also just beginning to make use of public-private partnerships for tolled facilities, with initial projects in the planning stages for the SR 400 and I-75N corridors (and a third recent proposal for I-285W). The public-sector partner in these projects is the Georgia Department of Transportation (GDOT). Thus far, the form of PPP being contemplated is limited to the private sector conceptualizing the project, developing it via design-build, perhaps helping to arrange the financing (based partly on projected toll revenues), and possibly receiving an operating contract once the toll lanes are open to traffic. While this approach will bring more resources to bear sooner than would be possible with traditional gas-tax funding (thanks to toll revenue financing) and will likely develop the project more rapidly thanks to the efficiencies of the design-build process, it is only a first step toward an expanded private-sector role.

California, Texas, and Virginia all have experience with a more encompassing form of PPP: the *long-term concession*. Under this approach, the private partner takes major responsibility for financing the project, investing equity for perhaps one-quarter to one-third of the project cost and financing the rest. It takes long-term ownership responsibility, for a defined period of years (e.g., 50 years) during which it must build, operate, manage, and maintain the toll road or toll lanes, at its own risk. GDOT points out that Georgia's current Public Private Initiatives law *does* permit such long-term concession contracts. And there are good reasons for Atlanta to consider using this approach for the major toll projects proposed in this report.

The most important reason is to limit the taxpayers' risk, by shifting much of that risk to the private-sector partner. These projects all meet the definition of being "mega-projects"—multi-billion-dollar infrastructure projects. The two major risks frequently seen with such projects are cost overruns and traffic/revenue shortfalls.[49] Design-build contracts (as in GDOT's initial PPP projects) shift much of the cost-overrun risk to the private partner. But they do not shift traffic and revenue risk, nor do they ensure that the initial design is optimized for lowest life-cycle cost. A long-term concession does both.

Traffic and revenue risk is a serious issue for new toll roads. Recent reports by two of the leading bond rating agencies, Fitch and Standard & Poor's, point to a tendency of such forecasts to be overly optimistic, which puts the bondholders at risk. Several recent PPP projects of the type noted above, in which the private sector develops the project but does not take on ownership-type risks, have all experienced serious shortfalls in early-years traffic and revenue: Colorado's Northwest Parkway, South Carolina's Southern Connector, and Virginia's Pocahontas Parkway. The Pocahontas Parkway was recently rescued by means of a long-term concession agreement, under which a global toll road company has agreed to refinance the project and take on full ownership-type risks for 50 years. A similar private-sector rescue is now under way for the Northwest Parkway.

Minimizing life-cycle cost is also facilitated by a long-term concession approach. If the same enterprise that is designing and building the toll road also must operate it profitably for 50 years, it has every incentive to built it right in the first place, rather than cutting corners to get the initial cost down. Spending an extra 10-15 percent on a more durable pavement in the first instance generally pays for itself several times over in lower ongoing maintenance costs over the roadway's lifetime. But neither traditional public-sector project development nor the design-build PPP model are able to internalize this incentive effect, since operating and maintenance costs are not the responsibility of the entity designing and building the roadway.

Cost-sharing is possible under a concession agreement, for those projects that cannot be fully supported by toll revenue financing. In such cases, the public sector (e.g., GDOT) would have to make an "equity" investment for, say, 35 percent of the project cost, with the balance being financed out of toll revenues, and the responsibility to collect and manage these toll revenues falling to the concessionaire. This type of mixed financing is being done currently under the expansive PPP/tolling regime in Texas (with Texas DOT and the Texas Turnpike Authority and/or local Regional Mobility Agencies being the counterparts of GDOT and SRTA). It is also contemplated in the Federal Highway Administration's PPP agenda, which includes congressional authorization for public-sector agencies to issue up to $15 billion in tax-exempt, private activity (revenue) bonds in support of toll projects to be developed under long-term concession agreements.

The U.S. DOT's new National Strategy to Reduce Congestion could also help Atlanta in implementing megaprojects like those proposed in this report. Under this new initiative, DOT will look for a handful of urban areas that will commit to greatly expanded use of value pricing (such as a complete network of priced lanes or a toll truckway system). Those that get selected for an Urban Partnership Agreement will receive extra funding help, environmental streamlining, tolling flexibility, and other assistance with the timely implementation of such projects.

D. Conclusion

Atlanta, long known as the crossroads of the South, is also at a crossroads in terms of transportation policy. Down the status quo road of implementing the current *Mobility 2030* lies a future of dramatically worse congestion, in which the average peak-period trip is projected to take 67 percent longer than at off-hours (compared with 46 percent worse, as of now). That approach would continue the conventional wisdom that nothing much can be done about congestion, and therefore it's acceptable to expend large amounts of transportation funds on "nice things."

By contrast, the Governor's Congestion Mitigation Task Force set a goal of actually reducing congestion by 2030 to lower levels than today, under which peak-period trips would take only 35 percent longer than at off-hours. That is not zero congestion, but it would lead to a dramatically different Atlanta that is easier to get around in than today, rather than much more difficult.

We argue that Atlanta's long-term goal should be to eliminate recurring congestion and minimize incident-related congestion. The agenda proposed in this report is the first step toward this longer-term goal. The major investments in expanded highway capacity and improved operation and management of the system would achieve the 2030 goal set by the Governor's Congestion Mitigation Task Force. For the most costly part of this investment (adding capacity to the freeway system), we have shown how this can be done without bulldozing neighborhoods and without requiring large tax increases. And by offering motorists and truckers the option of paying tolls in exchange for faster and more reliable trips, the plan avoids imposing new costs on anyone.

Congestion threatens to strangle Atlanta, destroying its viability as a place to live and work, as well as its position as a major trucking and logistics center. But as Transportation Secretary Norman Mineta said recently, "Congestion is not a scientific mystery, nor is it an uncontrollable force. Congestion results from poor policy choices and a failure to separate solutions that are effective from those that are not."[50]

The policy choices recommended in this report would put Atlanta on the road to greatly increased mobility by 2030 and the elimination of congestion in the longer run.

About the Author

Robert W. Poole, Jr. is Director of Transportation Studies at the Reason Foundation in Los Angeles. He received B.S. and M.S. degrees in engineering from MIT and did additional graduate work in operations research at NYU. He worked in aerospace and for several research firms before launching Reason Foundation in 1978. His 1988 policy study, "Private Tollways: Resolving Gridlock in Southern California," directly inspired California's 1989 public/private toll roads law, which has been emulated in more than a dozen other states. He has advised the U.S., California, and Florida departments of transportation, and served 18 months as a member of California's Commission on Transportation Investment. He has also advised the last four White Houses on various transportation policy issues.

Acknowledgement

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Related Reason Foundation Studies

Peter Samuel, *Innovative Roadway Design: Making Highways More Likeable*, Policy Study No. 348, September 2006.

David T. Hartgen and M. Gregory Fields, *Building Roads to Reduce Traffic Congestion in America's Cities: How Much and at What Cost?*, Policy Study No. 346, August 2006.

Robert W. Poole, Jr. and Kevin Soucie, *Adding FAST Lanes to Milwaukee's Freeways: Congestion Relief, Improved Transit, and Help with Funding Reconstruction*, Policy Study No. 342, February 2006.

Robert W. Poole, Jr. and Ted Balaker, *Virtual Exclusive Busways: Improving Urban Transit while Relieving Congestion*, Policy Study No. 337, September 2005.

Robert W. Poole, Jr., Peter Samuel, and Brian F. Chase, *Building for the Future: Easing California's Transportation Crisis with Tolls and Public-Private Partnerships*, Policy Study No. 324, January 2005.

Robert W. Poole, Jr. and C. Kenneth Orski, *HOT Networks: A New Plan for Congestion Relief and Better Transit*, Policy Study No. 305, February 2003.

Robert W. Poole, Jr. and Kevin Soucie, *Rebuilding the Marquette Interchange Via a Public-Private Partnership*, No 304, January 2003.

Peter Samuel and Robert W. Poole, Jr., *Putting Customers in the Driver's Seat: The Case for Tolls,* No. 274, September 2000.

Robert W. Poole, Jr. and C. Kenneth Orski, *Building a Case For HOT Lanes: A New Approach to Reducing Urban Highway Congestion*, No. 257, April 1999.

Appendix: Details of Costs and Revenues of Major Proposed Projects

This appendix provides details of the assumptions and calculations used in estimating the cost and revenues of the three major projects proposed in this report to add capacity to the greater Atlanta roadway system.

A. Express Toll Network

Table A-1 defines the new express toll lane segments that would be added to the freeway system. The individual project details (lane-miles, cost, and any specific details under Notes) are nearly all taken directly from worksheets provided to us by ARC, based on the GDOT's 2003 HOV Strategic Implementation Plan. The sequencing of individual projects into Phases 1, 2, 3, and 4 is our recommendation, not GDOT's or ARC's. The overall system would add 1,132.6 lane-miles to the existing 125.3 lane-miles now configured as HOV, for a total Express Toll Lane system of 1,257.9 lane-miles.

Table A-1: Express Toll Network Segments and Phasing

Phase	Route	From/To	Lane-miles	Cost $M	Plan	Cost/ln-mi	Notes
1	I-75N	I-285 to Wade Green	48.3	$657.9	2030	$13.6	
1	I-20W	SR-6 to Bright Star	39.6	$107.2	2030	$2.7	
1	I-285N	I-75N to I-85N	52.4	$546.0	2030	$10.4	
1	SR-400	I-285 to McFarland	32.4	$247.6	2030	$7.6	
1	I-85N	I-285N to SR-316	21.4	$114.4	Asp.	$5.3	Add 2nd lanes
1	Interchange	I-285N and SR-400		$829.8	2030		
1	Interchange	I-285N and I-75N		$202.0	2030		
1	Interchange	I-285N and I-85N		$500.0	n.a.		
			194.1	$3,204.9			
2	I-575	I-75 to Sixes	22.8	$52.0	2030	$2.28	2 lanes only
2	I-20W	SR-280 to SR-6	32.4	$99.1	2030	$3.06	
2	I-285E	I-20E to I-85N	52	$487.0	2030	$9.37	
2	I-285W	I-20W to I-75N	38.4	$363.0	2030	$9.45	
2	SR-400	McFarland to SR-141	16.8	$56.2	Asp.	$3.35	
2	GA-400	I-85N to I-285N	8.4	$153.2	Asp.	$18.24	
2	I-285S	I-20E to I-675	24.4	$275.5	Asp.	$11.29	

Table A-1: Express Toll Network Segments and Phasing							
Phase	Route	From/To	Lane-miles	Cost $M	Plan	Cost/ln-mi	Notes
2	I-75S	I-20W to Aviation	15	$109.5	Asp.	$7.30	Add 2nd lanes
2	I-75S	I-85S to I-285S	16	$37.7	Asp.	$2.36	Add 2nd lanes
2	Interchange	I-75N and I-575		$47.0	2030		
2	Interchange	I-75/85 at 15th		$54.0	2030		
			226.2	$1,734.2			
3	I-85S	I-75/85 to SR-74	67.6	$259.2	2030	$3.83	
3	I-75S	Aviation to SR-155	76.8	$304.0	2030	$3.96	
3	I-85N	SR-316 to Hamilton Mill	55.2	$44.8	2030	$0.81	
3	I-85N	I-75/85 to I-285N	21.3	$112.6	Asp.	$5.29	Add 2nd lanes
3	I-20W	Bright Star to Liberty	32.4	$70.0	2030	$2.16	
3	I-20W	I-75/85 to SR-280	20.4	$343.4	Asp.	$16.83	
3	I-675	I-75S to I-285S	40	$114.9	Asp.	$2.87	
3	SR-154/166	I-285S to I-75/85	11.6	$384.8	Asp.	$33.17	2 lanes only
3	I-285S	I-675 to I-75S	23.2	$102.8	Asp.	$4.43	
3	I-285W	I-85S to I-20W	41.6	$391.8	Asp.	$9.42	
3	I-75N	I-75/85 to I-285N	15.6	$82.7	n.a.	$5.30	Add 2nd lanes
3	Interchange	I-75/85N		$750.0	n.a.		
			405.7	$2,961.0			
4	I-575	Sixes to SR-20	15	$139.0	2030	$9.27	2 lanes only
4	I-20E	Columbia to SR-162	70.4	$236.0	2030	$3.35	
4	SR-316	I-85N to Drowning Creek	52.6	$178.1	2030	$3.39	
4	I-85S	SR-74 to SR-14/US-29	40.4	$224.9	Asp.	$5.57	2 lanes only
4	I-75N	Wade Green to SR-92	17.6	$69.7	Asp.	$3.96	
4	I-85N	Hamilton Mill to SR-211	25.2	$59.6	Asp.	$2.37	
4	SR-400	SR-141 to SR-306	16.6	$85.5	Asp.	$5.15	
4	I-985	I-85N to SR-347	16	$92.3	Asp.	$5.77	
4	I-75S	SR-155 to SR-16	44.8	$118.3	Asp.	$2.64	
4	I-285S	I-75S to I-85S	8	$35.5	Asp.	$4.44	
			306.6	$1,238.9			
Overall totals:			1132.6	$9,139.0			

Under the column labeled "Plan," we have indicated whether the project is included in the adopted *Mobility 2030* plan (2030), the unfunded Aspirations plan (Asp.), or not included in either official plan (n.a.). Projects in the latter category are those that we judged critically important to the overall functionality of the network. This includes major interchange improvements at I-285N/I-85 and I-75/I-85, two of the nation's top 10 highway bottlenecks, neither of which is included in *Mobility 2030*. Also included is the addition of a second express lane in each direction on I-75N within the Perimeter. With this addition, there would provide two express lanes in each direction on the Perimeter and all the freeways within it, except the Downtown Connector. Overall, that makes the complete system two lanes in each direction except for the few cases labeled as “2 lanes only.” These are locations where traffic and congestion are less than on the rest of the system.

We adjusted GDOT’s 2003 cost figures by our assumed 3.5 percent annual inflation index. We are aware of the unusual cost increases in highway construction during the past two years, which makes it especially difficult to estimate the costs for projects (such as some of these) that would not begin until 10 or 15 years from now. If the actual cost of such projects turns out to be much higher than in these calculations, due to continued increases in the cost of construction far in excess of the Consumer Price Index, that would affect the extent to which the ETL system produces surplus revenues; indeed, it might mean that the project would no longer be self-supporting solely from toll revenues.

Considerable effort went into estimating the revenue which this proposed network might generate. Since our results came up with much higher figures than previous HOT lane studies in Atlanta, it is worth setting forth the assumptions we made and how we did the analysis.

To begin with, it is important to realize that there are two very different ways of looking at priced (or “managed”) lanes. The first is to see them as primarily HOV lanes, where pricing is used to sell whatever excess capacity may exist, and the revenue is seen as a supplement that can help out a bit with the overall costs of operating and maintaining the transportation system. In this first approach, typified by the recent Jacobs/HNTB report, “Value Pricing on the I-75 HOV/BRT Project,”[51] carpooling takes precedence over other considerations, and in corridors with high levels of carpooling, few (and sometimes no) paying vehicles are allowed entry. The fewer vehicles that are subject to pricing, the less control there is over traffic flow (since value pricing is the key to limiting access to the number of vehicles per lane per hour consistent with a specified level of reduced congestion, such as LOS C).

The second approach is to view priced lanes as a tool for managing traffic flow so as to eliminate congestion and maximize uncongested throughput during peak periods, compared with unmanaged general-purpose lanes. In this approach, the ideal is to price all vehicles, to obtain the maximum degree of traffic flow management so as to optimize throughput and guarantee a level of service such as LOS C. In this type of managed lane, although revenue maximization and throughput maximization are not identical goals, both lead toward similar pricing policies, which are dramatically different from what is used in the first approach.

From the standpoint of both reliable congestion relief and the need for transportation funding, the second approach to managed lanes is what we have adopted. The model for this type of managed lanes is the 91 Express Lanes in Orange County, California. They were originally financed, developed, and operated by a private consortium operating under a long-term concession. Although that congested freeway corridor was originally slated to have HOV lanes added to its wide median, the lack of funding to construct those lanes made the idea of a toll-funded PPP appealing to local and state transportation officials. But to be able to finance the new lanes’ $135 million cost, the company proposed operating them as express toll lanes, with no free passage for HOVs. The final compromise was that HOV-2s would pay the regular price but HOV-3s would get a 50 percent discount. Although that policy made enforcement more difficult and costly, the company agreed, and on that basis the project was financed entirely via toll revenue. It has operated successfully on that basis.

To build a revenue model for the Express Toll Network, we needed to make a number of assumptions. One of the most important is what initial toll rate would be needed during the most congested conditions (i.e., in the peak direction during peak periods). The aim is to charge a high enough rate to ensure LOS C conditions during peak periods. That translates into approximately 1,800 vehicles/lane/hour in a two-lane managed lane facility (which is what the vast majority of the proposed network would consist of). This level of performance is routinely achieved on the 91 Express Lanes in California. Since we reserve 100 spaces/lane/hour for buses and vanpools, we can allow in a maximum of 1,700 paying vehicles/lane/hour in the peak direction during peak periods.

How high must the toll rate be to limit vehicles to this number in a congested corridor? Presumably, the more intense the level of congestion, the higher the peak-period toll rate must be. For data, we can turn to the two California managed lanes projects (91 Express and I-15 Express) that have been in operation for 10 and 8 years, respectively. In a previous Reason policy paper, we obtained data from those two projects on the average peak-period, peak-direction toll level in 2005.[52] Next, we compare those peak toll levels with the intensity of congestion in those two metro areas, using data from the 2005 Urban Mobility Report from the Texas Transportation Institute.[53] In Figures A-1 and A-2, we plot those toll rates on graphs of two different measures of congestion: annual hours of delay and travel time index. We can see that because Atlanta's congestion level is in between that of San Diego and LA/Orange County, the needed peak toll rate will likely be in between, as well. Figure A-1 suggests Atlanta's peak toll would be 38 cents/mile, while A-2 suggests 35 cents/mile. To be conservative, we will use the latter figure.

That rate is what would apply only in the peak direction during peak periods. We will assume that most of the links on Atlanta's freeways have directional flow, and that demand to use express toll lanes would be significantly less in the non-peak direction. For purposes of our revenue model, we assume that the toll rate charged in the non-peak direction is one-third the peak rate, and with this lower rate, that we attract half as many vehicles per lane per hour as in the peak direction. Computing a weighted average toll rate during the peak hours, we get 27.2 cents/mile for each lane-mile of the system. This is the rate that applies in 2005, based on the level of congestion in 2005. In the model, we assume that congestion on the freeway system continues to worsen, though at a declining rate, as the various capacity additions come on line between 2012 and 2030. Thus, value-priced toll rates would have to increase each year to limit traffic in the express lanes to the allowable amount. We approximate this increase by annually adjusting the initial rate by our assumed annual CPI increase of 3.5 percent. From 2030 on, we cease this annual adjustment, on the assumption that with lower congestion on the general-purpose lanes, the 2030 price will be adequate to maintain LOS C in the express lanes.

Figure A-1: Peak-Period Toll vs. Hours of Delay

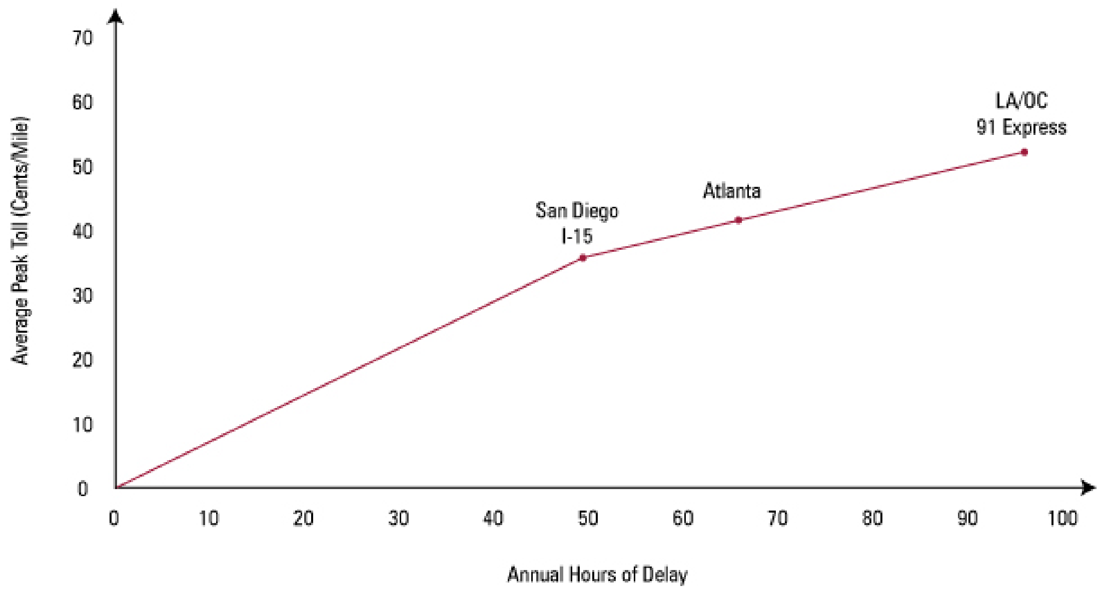
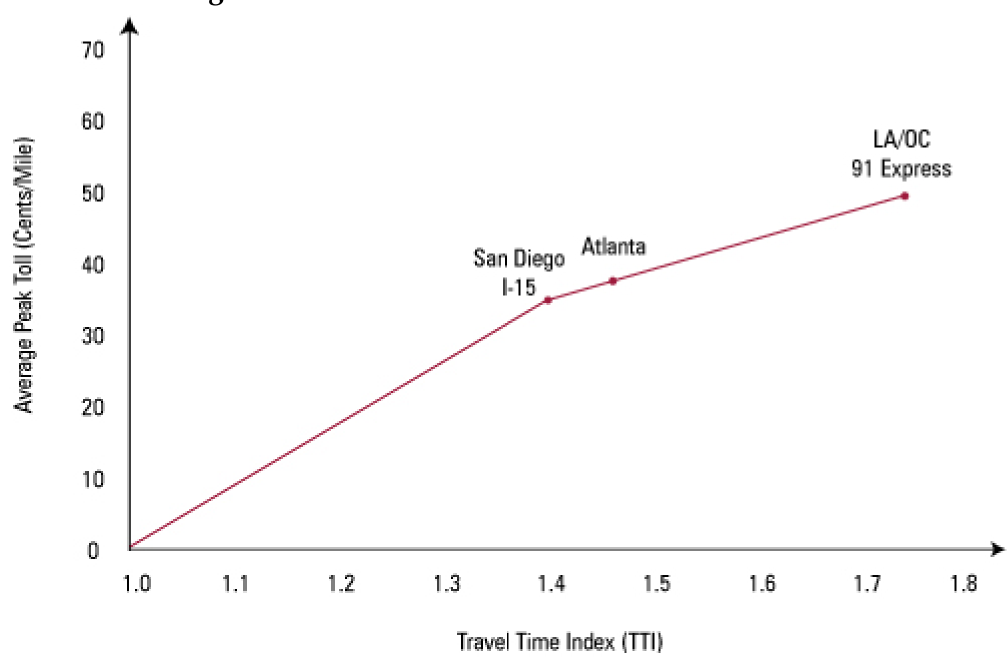


Figure A-2: Peak-Period Toll vs. Travel Time Index



We need to make several other assumptions before completing the revenue model. We define a total of eight hours per day as peak-period hours, as used by Pisarski and Lomax, citing the ARC model.[54] We assume that each of the four phases takes four years to construct and put into operation. As each phase of the network opens, we assume a "ramp-up" period of three years during which traffic in the peak direction builds to the maximum allowable rate per lane per hour.

And we assume that the existing 125.3 lane-miles of HOV lane are converted to express toll lanes beginning in 2008, the start of the period during which the Phase 1 new lanes are constructed. The resulting spreadsheet is shown in Table A-2.

Table A-2: Express Toll Network Traffic & Revenue Projection

Year	Lane-mi.	Pk veh/ ln/hr	Av peak toll	Peak rev/wkday	Annual peak rev	Ann. Non-peak Rev	Total Gross Rev	Net Revenue	NPV factor	NPV rev
2008	125.3	900	0.302	$272,452	$68,113,080	$19,752,793	$87,865,873	$79,079,286	1	$79,079,286
2009	125.3	1000	0.312	$312,749	$78,187,200	$22,674,288	$100,861,488	$90,775,339	0.9434	$85,637,455
2010	125.3	1100	0.323	$356,153	$89,038,180	$25,821,072	$114,859,252	$103,373,327	0.89	$92,002,261
2011	125.3	1200	0.334	$401,762	$100,440,480	$29,127,739	$129,568,219	$116,611,397	0.8396	$97,906,929
2012	319.4	1063	0.346	$939,797	$234,949,362	$68,135,315	$303,084,677	$272,776,210	0.7921	$216,066,036
2013	319.4	1124	0.358	$1,028,192	$257,048,010	$74,543,923	$331,591,932	$298,432,739	0.7473	$223,018,786
2014	319.4	1185	0.371	$1,123,355	$280,838,838	$81,443,263	$362,282,101	$326,053,891	0.705	$229,867,993
2015	319.4	1246	0.384	$1,222,571	$305,642,803	$88,636,413	$394,279,216	$354,851,295	0.6651	$236,011,596
2016	545.6	1133	0.397	$1,965,467	$491,366,836	$142,496,383	$633,863,219	$570,476,897	0.6274	$357,917,205
2017	545.6	1174	0.411	$2,107,873	$526,968,163	$152,820,767	$679,788,931	$611,810,038	0.5919	$362,130,361
2018	545.6	1216	0.425	$2,255,729	$563,932,160	$163,540,326	$727,472,486	$654,725,238	0.5548	$363,241,562
2019	545.6	1257	0.440	$2,413,398	$603,349,441	$174,971,338	$778,320,779	$700,488,701	0.5268	$369,017,448
2020	951.3	1137	0.456	$3,945,779	$986,444,827	$286,069,000	$1,272,513,827	$1,145,262,444	0.497	$569,195,435
2021	951.3	1180	0.472	$4,238,329	$1,059,582,293	$307,278,865	$1,366,861,158	$1,230,175,042	0.4688	$576,706,060
2022	951.3	1223	0.488	$4,546,524	$1,136,630,987	$329,622,986	$1,466,253,973	$1,319,628,576	0.4423	$583,671,719
2023	951.3	1265	0.505	$4,861,714	$1,215,428,445	$352,474,249	$1,567,902,694	$1,411,112,425	0.4173	$588,857,215
2024	1257.9	1275	0.523	$6,710,393	$1,677,598,335	$486,503,517	$2,164,101,852	$1,947,691,667	0.3936	$766,611,440
2025	1257.9	1275	0.541	$6,945,257	$1,736,314,277	$503,531,140	$2,239,845,417	$2,015,860,875	0.3714	$748,690,729
2026	1257.9	1275	0.560	$7,185,125	$1,796,281,200	$520,921,548	$2,317,202,748	$2,085,482,473	0.3503	$730,544,510
2027	1257.9	1275	0.580	$7,441,736	$1,860,434,100	$539,525,889	$2,399,959,989	$2,159,963,990	0.3305	$713,868,099
2028	1257.9	1275	0.600	$7,702,197	$1,925,549,294	$558,409,295	$2,483,958,589	$2,235,562,730	0.3118	$697,048,459
2029	1257.9	1275	0.621	$7,971,774	$1,992,943,519	$577,953,620	$2,570,897,139	$2,313,807,425	0.2942	$680,722,145
2030	1257.9	1275	0.643	$8,250,063	$2,062,515,735	$598,129,563	$2,660,645,298	$2,394,580,768	0.2775	$664,496,163
2031	1257.9	1275	0.643	$8,250,063	$2,062,515,735	$598,129,563	$2,660,645,298	$2,394,580,768	0.2618	$626,901,245
2032	1257.9	1275	0.643	$8,250,063	$2,062,515,735	$598,129,563	$2,660,645,298	$2,394,580,768	0.247	$591,461,450
2033	1257.9	1275	0.643	$8,250,063	$2,062,515,735	$598,129,563	$2,660,645,298	$2,394,580,768	0.233	$557,937,319
2034	1257.9	1275	0.643	$8,250,063	$2,062,515,735	$598,129,563	$2,660,645,298	$2,394,580,768	0.2198	$526,328,853
2035	1257.9	1275	0.643	$8,250,063	$2,062,515,735	$598,129,563	$2,660,645,298	$2,394,580,768	0.2074	$496,636,051
2036	1257.9	1275	0.643	$8,250,063	$2,062,515,735	$598,129,563	$2,660,645,298	$2,394,580,768	0.1956	$468,379,998
2037	1257.9	1275	0.643	$8,250,063	$2,062,515,735	$598,129,563	$2,660,645,298	$2,394,580,768	0.1846	$442,039,610
2038	1257.9	1275	0.643	$8,250,063	$2,062,515,735	$598,129,563	$2,660,645,298	$2,394,580,768	0.1741	$416,896,512
2039	1257.9	1275	0.643	$8,250,063	$2,062,515,735	$598,129,563	$2,660,645,298	$2,394,580,768	0.1653	$395,824,201
2040	1257.9	1275	0.643	$8,250,063	$2,062,515,735	$598,129,563	$2,660,645,298	$2,394,580,768	0.1565	$374,751,890
2041	1257.9	1275	0.643	$8,250,063	$2,062,515,735	$598,129,563	$2,660,645,298	$2,394,580,768	0.1477	$353,679,579
2042	1257.9	1275	0.643	$8,250,063	$2,062,515,735	$598,129,563	$2,660,645,298	$2,394,580,768	0.1389	$332,607,269
2043	1257.9	1275	0.643	$8,250,063	$2,062,515,735	$598,129,563	$2,660,645,298	$2,394,580,768	0.1301	$311,534,958
2044	1257.9	1275	0.643	$8,250,063	$2,062,515,735	$598,129,563	$2,660,645,298	$2,394,580,768	0.1236	$295,970,183
2045	1257.9	1275	0.643	$8,250,063	$2,062,515,735	$598,129,563	$2,660,645,298	$2,394,580,768	0.117	$280,165,950
2046	1257.9	1275	0.643	$8,250,063	$2,062,515,735	$598,129,563	$2,660,645,298	$2,394,580,768	0.1104	$264,361,717
2047	1257.9	1275	0.643	$8,250,063	$2,062,515,735	$598,129,563	$2,660,645,298	$2,394,580,768	0.1038	$248,557,484
										$17,016,343,161

The spreadsheet first calculates the revenue generated during the eight peak hours on a typical weekday. Assuming 250 weekdays per year, we then get the annual peak-period revenue. From the California experience, we can estimate non-peak (weekday plus weekend and holiday) revenue as a percentage of peak revenue, thereby giving us the sum as total gross annual revenue. Then, setting aside 10 percent of this for operating and maintenance expenses, we get the net annual revenue.

In order to estimate the extent to which the project is self-supporting, we can compare the net present value (NPV) of its toll revenue stream to the NPV of its construction cost. Using a six percent discount rate, we get a net-revenue NPV of $17.02 billion. Since the construction takes place in four phases, we first escalate the construction cost of each phase for inflation to the mid-year of the construction period for each phase (2009, 2013, 2017, and 2021, respectively). We then compute the NPV of these four cost figures, again at six percent, to the same 2008 base year used for the revenue NPV. This gives us a cost NPV of $9.43 billion. Since the NPV of revenue significantly exceeds the NPV of cost, we conclude that the project is robustly self-supporting.

B. North-South Tunnel

Because the tunnel is modeled directly after the similar six-lane, double-deck tunnel that Cofiroute is now constructing near Paris, we base our cost estimate on that project. The 2005 cost of that project is $2.0 billion for 37.2 lane-miles or $53.76 million per lane-mile. The proposed North-South Tunnel is both longer and larger in diameter. Since the cost is proportional to the cross-sectional area, the larger radius (22 feet vs. 17 feet) means the area is 1.675 times as great. Hence, the cost per lane-mile would be $90.05 million. Applying that unit cost to the 48.6 lane-miles for the North-South project gives us a tunnel cost of $4.376 billion. To this we must add the cost of 2.5 miles of six-lane tollway connecting I-675/I-285S with the southern terminus of the tunnel. We use $7 million per lane-mile for those 15 lane-miles, adding $105 million to the project cost.

The Paris tunnel includes one interchange, with the A-13 motorway. But the North-South Tunnel would require a full interchange at I-20 and a partial interchange at Freedom Parkway, in addition to expansions of the existing interchanges at GA-400/I-285N and I-675/I-285S. We estimate another $400 million for this interchange work. Altogether, that puts the project cost at $4.881 billion in 2005 dollars.

Since relief of the gridlocked Downtown Connector is the most critical congestion-reduction need, we assume that this project would receive priority in planning and funding. Hence, we assume design and environmental review in 2007-2009 followed by a six-year construction period, 2010 through 2015, with the tunnel opening in 2016. For purposes of NPV analysis, we will use a base year of 2012. Thus, the construction cost must be escalated, at 3.5 percent per year, to 2012, bringing it to $6.21 billion. We will compare this number with the NPV of net revenues as of 2012.

To estimate revenues, we must make a similar set of assumptions to those used for the Express Toll Network. We assume the same peak-period, peak-direction toll rate and the same performance target of LOS C service. In the case of this centrally located roadway, we assume that, like the Downtown Connector, the peak period traffic flow to be equally heavy in both directions. Hence, we assume an average of 1,700 paying vehicles/lane/hour for each of the six lanes during the eight peak hours of each weekday (in comparison with 1,250 for the Express Toll Network lanes). Therefore, we can use the full value of the peak-period, peak-direction toll rate. After adjusting for inflation, that gives us a starting rate of $0.511 in 2016. Because this is a completely new toll road, we assume a longer (five year) ramp-up period than we used for the Express Toll Network.

Table A-3 is the 40-year traffic and revenue model spreadsheet, which is similar in format to that used for the Express Toll Network. Because the operating and maintenance costs of a tunnel are higher than those of a surface road, we assume 15 percent of gross revenue is needed for those costs, leaving net revenue at 85 percent of gross. Using standard six percent NPV factors, we see that the NPV of net revenue, as of 2012, is $2.413 billion. That is approximately 39 percent of the 2012 NPV of construction costs. Thus, on a stand-alone basis, this project would not be self-supporting. However, considered as part of the overall priced network, the balance of its costs could be covered by surplus revenue from the Express Toll Network lanes.

Table A-3: North-South Tunnel Traffic & Revenue Projection

Year	Peak/lane/hr	Av Pk Toll	Pk Rev/Day	Peak Rev/Yr	Off-peak Rev	Annual Rev	Net Rev.	NPV factor	NPV, 2012
2016	1,000	0.511	$259,997	$64,999,200	$18,849,768	$83,848,968	$71,271,623	0.7921	$56,454,252
2017	1,200	0.529	$322,986	$80,746,560	$23,416,502	$104,163,062	$88,538,603	0.7473	$66,164,898
2018	1,400	0.547	$389,639	$97,409,760	$28,248,830	$125,658,590	$106,809,802	0.705	$75,300,910
2019	1,550	0.566	$446,370	$111,592,560	$32,361,842	$143,954,402	$122,361,242	0.6651	$81,382,462
2020	1,700	0.586	$506,867	$126,716,640	$36,747,826	$163,464,466	$138,944,796	0.6274	$87,173,965
2021	1,700	0.607	$525,031	$131,257,680	$38,064,727	$169,322,407	$143,924,046	0.5919	$85,188,643
2022	1,700	0.628	$543,195	$135,798,720	$39,381,629	$175,180,349	$148,903,296	0.5584	$83,147,601
2023	1,700	0.65	$562,224	$140,556,000	$40,761,240	$181,317,240	$154,119,654	0.5268	$81,190,234
2024	1,700	0.673	$582,118	$145,529,520	$42,203,561	$187,733,081	$159,573,119	0.497	$79,307,840
2025	1,700	0.696	$602,012	$150,503,040	$43,645,882	$194,148,922	$165,026,583	0.4688	$77,364,462
2026	1,700	0.721	$623,636	$155,909,040	$45,213,622	$201,122,662	$170,954,262	0.4423	$75,613,070
2027	1,700	0.746	$645,260	$161,315,040	$46,781,362	$208,096,402	$176,881,941	0.4173	$73,812,834
2028	1,700	0.772	$667,749	$166,937,280	$48,411,811	$215,349,091	$183,046,728	0.3936	$72,047,192
2029	1,700	0.799	$691,103	$172,775,760	$50,104,970	$222,880,730	$189,448,621	0.3714	$70,361,218
2030	1,700	0.827	$715,322	$178,830,480	$51,860,839	$230,691,319	$196,087,621	0.3503	$68,689,494
2031	1,700	0.856	$740,406	$185,101,440	$53,679,418	$238,780,858	$202,963,729	0.3305	$67,079,512
2032	1,700	0.886	$766,355	$191,588,640	$55,560,706	$247,149,346	$210,076,944	0.3118	$65,501,991
2033	1,700	0.917	$793,168	$198,292,080	$57,504,703	$255,796,783	$217,427,266	0.2942	$63,967,102
2034	1,700	0.949	$820,847	$205,211,760	$59,511,410	$264,723,170	$225,014,695	0.2775	$62,441,578
2035	1,700	0.982	$849,391	$212,347,680	$61,580,827	$273,928,507	$232,839,231	0.2618	$60,957,311
2036	1,700	1.017	$879,664	$219,916,080	$63,775,663	$283,691,743	$241,137,982	0.247	$59,561,081
2037	1,700	1.052	$909,938	$227,484,480	$65,970,499	$293,454,979	$249,436,732	0.233	$58,118,759
2038	1,700	1.089	$941,941	$235,485,360	$68,290,754	$303,776,114	$258,209,697	0.2198	$56,754,491
2039	1,700	1.127	$974,810	$243,702,480	$70,673,719	$314,376,199	$267,219,769	0.2074	$55,421,380
2040	1,700	1.167	$1,009,408	$252,352,080	$73,182,103	$325,534,183	$276,704,056	0.1956	$54,123,313
2041	1,700	1.208	$1,044,872	$261,217,920	$75,753,197	$336,971,117	$286,425,449	0.1846	$52,874,138
2042	1,700	1.25	$1,081,200	$270,300,000	$78,387,000	$348,687,000	$296,383,950	0.1741	$51,600,446

Table A-3: North-South Tunnel Traffic & Revenue Projection

Year	Peak/lane/hr	Av Pk Toll	Pk Rev/Day	Peak Rev/Yr	Off-peak Rev	Annual Rev	Net Rev.	NPV factor	NPV, 2012
2043	1,700	1.294	$1,119,258	$279,814,560	$81,146,222	$360,960,782	$306,816,665	0.1653	$50,716,795
2044	1,700	1.339	$1,158,181	$289,545,360	$83,968,154	$373,513,514	$317,486,487	0.1565	$49,686,635
2045	1,700	1.386	$1,198,835	$299,708,640	$86,915,506	$386,624,146	$328,630,524	0.1477	$48,538,728
2046	1,700	1.434	$1,240,353	$310,088,160	$89,925,566	$400,013,726	$340,011,667	0.1389	$47,227,621
2047	1,700	1.484	$1,283,601	$320,900,160	$93,061,046	$413,961,206	$351,867,025	0.1301	$45,777,900
2048	1,700	1.536	$1,328,579	$332,144,640	$96,321,946	$428,466,586	$364,196,598	0.1235	$44,978,280
2049	1,700	1.59	$1,375,286	$343,821,600	$99,708,264	$443,529,864	$377,000,384	0.1169	$44,071,345
2050	1,700	1.645	$1,422,859	$355,714,800	$103,157,292	$458,872,092	$390,041,278	0.1104	$43,060,557
2051	1,700	1.703	$1,473,027	$368,256,720	$106,794,449	$475,051,169	$403,793,493	0.1038	$41,913,765
2052	1,700	1.763	$1,524,924	$381,231,120	$110,557,025	$491,788,145	$418,019,923	0.0972	$40,631,537
2053	1,700	1.824	$1,577,687	$394,421,760	$114,382,310	$508,804,070	$432,483,460	0.0923	$39,918,223
2054	1,700	1.888	$1,633,044	$408,261,120	$118,395,725	$526,656,845	$447,658,318	0.0874	$39,125,337
2055	1,700	1.954	$1,690,132	$422,532,960	$122,534,558	$545,067,518	$463,307,391	0.0776	$35,952,654
									$2,413,199,553

C. Lakewood Tunnel and Freeway Extension

While the proposed extensions of the Lakewood Freeway east and west provide important new east-west connectivity, and an alternative to congested I-20, the projected congestion on I-20 is considerably less than on the Downtown Connector. Therefore, it would not be realistic to charge the same value-priced toll rates on the Lakewood Tunnel as on the North-South Tunnel. Lacking the resources to do any kind of study of demand for this link, we make the arbitrary assumption that the peak-period rate needed to ensure uncongested traffic flow is 60 percent of the level needed on the Downtown Connector. Otherwise, the model is the same. In this case, because the project is built after completion of the North-South Tunnel (during the years 2016-2021), the first year of toll collection is 2022. For NPV calculations, we use a year midway in the construction period, 2018. Thus, in Table A-3, we find that the NPV of net toll revenues is $1.8 billion.

Table A-4: Lakewood Tunnel Revenue Projection

Year	Peak/lane/hr	Av Pk Toll	Pk Rev/Day	Peak Rev/Yr	Off-peak Rev	Annual Rev	Net Rev.	NPV factor	NPV, 2018
2022	1,000	0.377	$191,818	$47,954,400	$13,906,776	$61,861,176	$52,582,000	0.7921	$41,650,202
2023	1,200	0.39	$238,118	$59,529,600	$17,263,584	$76,793,184	$65,274,206	0.7473	$48,779,414
2024	1,400	0.404	$287,777	$71,944,320	$20,863,853	$92,808,173	$78,886,947	0.705	$55,615,298
2025	1,550	0.418	$329,652	$82,412,880	$23,899,735	$106,312,615	$90,365,723	0.6651	$60,102,242
2026	1,700	0.433	$374,528	$93,631,920	$27,153,257	$120,785,177	$102,667,400	0.6274	$64,413,527
2027	1,700	0.448	$387,502	$96,875,520	$28,093,901	$124,969,421	$106,224,008	0.5919	$62,873,990
2028	1,700	0.463	$400,476	$100,119,120	$29,034,545	$129,153,665	$109,780,615	0.5584	$61,301,495
2029	1,700	0.479	$414,316	$103,578,960	$30,037,898	$133,616,858	$113,574,330	0.5268	$59,830,957
2030	1,700	0.496	$429,020	$107,255,040	$31,103,962	$138,359,002	$117,605,151	0.497	$58,449,760
3031	1,700	0.514	$444,589	$111,147,360	$32,232,734	$143,380,094	$121,873,080	0.4688	$57,134,100
2032	1,700	0.532	$460,159	$115,039,680	$33,361,507	$148,401,187	$126,141,009	0.4423	$55,792,168
2033	1,700	0.55	$475,728	$118,932,000	$34,490,280	$153,422,280	$130,408,938	0.4173	$54,419,650

Table A-4: Lakewood Tunnel Revenue Projection

Year	Peak/ lane/hr	Av Pk Toll	Pk Rev/Day	Peak Rev/Yr	Off-peak Rev	Annual Rev	Net Rev.	NPV factor	NPV, 2018
2034	1,700	0.569	$492,162	$123,040,560	$35,681,762	$158,722,322	$134,913,974	0.3936	$53,102,140
2035	1,700	0.589	$509,461	$127,365,360	$36,935,954	$164,301,314	$139,656,117	0.3714	$51,868,282
2036	1,700	0.61	$527,626	$131,906,400	$38,252,856	$170,159,256	$144,635,368	0.3503	$50,665,769
2037	1,700	0.631	$545,790	$136,447,440	$39,569,758	$176,017,198	$149,614,618	0.3305	$49,447,631
2038	1,700	0.653	$564,819	$141,204,720	$40,949,369	$182,154,089	$154,830,975	0.3118	$48,276,298
2039	1,700	0.676	$584,713	$146,178,240	$42,391,690	$188,569,930	$160,284,440	0.2942	$47,155,682
2040	1,700	0.7	$605,472	$151,368,000	$43,896,720	$195,264,720	$165,975,012	0.2775	$46,058,066
2041	1,700	0.725	$627,096	$156,774,000	$45,464,460	$202,238,460	$171,902,691	0.2618	$45,004,125
2042	1,700	0.75	$648,720	$162,180,000	$47,032,200	$209,212,200	$177,830,370	0.247	$43,924,101
2043	1,700	0.776	$671,209	$167,802,240	$48,662,650	$216,464,890	$183,995,156	0.233	$42,870,871
2044	1,700	0.803	$694,563	$173,640,720	$50,355,809	$223,996,529	$190,397,049	0.2198	$41,849,271
2045	1,700	0.832	$719,647	$179,911,680	$52,174,387	$232,086,067	$197,273,157	0.2074	$40,914,453
2046	1,700	0.86	$743,866	$185,966,400	$53,930,256	$239,896,656	$203,912,158	0.1956	$39,885,218
2047	1,700	0.89	$769,814	$192,453,600	$55,811,544	$248,265,144	$211,025,372	0.1846	$38,955,284
2048	1,700	0.922	$797,493	$199,373,280	$57,818,251	$257,191,531	$218,612,802	0.1741	$38,060,489
2049	1,700	0.954	$825,172	$206,292,960	$59,824,958	$266,117,918	$226,200,231	0.1653	$37,390,898
2050	1,700	0.987	$853,716	$213,428,880	$61,894,375	$275,323,255	$234,024,767	0.1565	$36,624,876
2051	1,700	1.022	$883,989	$220,997,280	$64,089,211	$285,086,491	$242,323,518	0.1477	$35,791,184
2052	1,700	1.058	$915,128	$228,781,920	$66,346,757	$295,128,677	$250,859,375	0.1389	$34,844,367
2053	1,700	1.094	$946,266	$236,566,560	$68,604,302	$305,170,862	$259,395,233	0.1301	$33,747,320
2054	1,700	1.133	$980,000	$244,999,920	$71,049,977	$316,049,897	$268,642,412	0.1235	$33,177,338
2055	1,700	1.172	$1,013,733	$253,433,280	$73,495,651	$326,928,931	$277,889,592	0.1169	$32,485,293
2056	1,700	1.213	$1,049,196	$262,299,120	$76,066,745	$338,365,865	$287,610,985	0.1104	$31,752,253
2057	1,700	1.256	$1,086,390	$271,597,440	$78,763,258	$350,360,698	$297,806,593	0.1038	$30,912,324
2058	1,700	1.3	$1,124,448	$281,112,000	$81,522,480	$362,634,480	$308,239,308	0.0972	$29,960,861
2059	1,700	1.345	$1,163,371	$290,842,800	$84,344,412	$375,187,212	$318,909,130	0.0923	$29,435,313
2060	1,700	1.393	$1,204,889	$301,222,320	$87,354,473	$388,576,793	$330,290,274	0.0874	$28,867,370
2061	1,700	1.441	$1,246,407	$311,601,840	$90,364,534	$401,966,374	$341,671,418	0.0776	$26,513,702
									$1,779,903,583

Escalating the $3.512 billion 2005 construction cost to 2018, at our 3.5 percent annual CPI increase, leads to a 2018 cost of $5.493 billion. Thus, the NPV of net toll revenues is 33 percent of the project's cost. Thus, the Lakewood project would not be self-supporting from toll revenues, which is not too surprising given that we have assumed tolls would be charged on only 28.2 lane-miles out of the total 111.2 lane-miles.

D. Toll Truckway System

For the toll truckway system, we carried out a net present value analysis similar to that used for the other two projects. We assumed the system would take six years to construct (2012 through 2017) and would begin revenue service in 2018. For the NPV analysis, we used 2015 as the base year, which required escalating the construction cost by our assumed 3.5 percent annual CPI to $10.7 billion in 2015.

For the revenue projection, as discussed in Part 4, we assumed that it would be possible to charge tolls equivalent to one-third of the value of time saved by truckers using the Toll Truckway. Although this might seem to be an aggressive assumption, it is based on the very conservative 2005 values of time ($18/hour for light-duty and $35/hour for heavy-duty trucks) used in the TOT lanes study. Other studies use much higher rates. For example, the Texas Transportation Institute uses a 2005 weighted average (two-axle and five-axle) hourly truck cost of $77 in 2005 dollars. That number is based on two independent studies of North American truck operations, one by Transport Canada and the other for the Federal Highway Administration.[55]

Using its much lower per-hour rate, the TOT study estimated the annual value of time saved at $721 million. One-third of that is $240 million, so we used that as the revenue that could be generated if the Truckway system were in operation in 2005. We then adjusted that number by the annual 3.5 percent CPI to get the starting-year (2018) revenue estimate of $423.3 million gross revenue. Even though most of the Truckway is not in tunnels, the operating and maintenance cost of truck-only facilities will be higher than that of regular lanes, so we used 15 percent for such expenses. That provided the annual net revenue figures in Table A-5. The NPV of net revenue, baselined to 2015, is then $6.556 billion, which is 61.3 percent of the 2015 cost.

Table A-5: Toll Truckway System Revenue Projection

Year	Gross Revenue	Net Revenue	NPV Factor	NPV Revenue
2015	0	0	1	$0.0
2016	0	0	0.9434	$0.0
2017	0	0	0.89	$0.0
2018	$375.4	$319.1	0.8396	$267.9
2019	$388.5	$330.2	0.7921	$261.6
2020	$402.1	$341.8	0.7473	$255.4
2021	$416.2	$353.8	0.705	$249.4
2022	$430.7	$366.1	0.6651	$243.5
2023	$445.8	$378.9	0.6274	$237.7
2024	$461.4	$392.2	0.5919	$232.1
2025	$477.5	$405.9	0.5584	$226.6
2026	$494.3	$420.2	0.5268	$221.3
2027	$511.6	$434.9	0.497	$216.1
2028	$529.5	$450.1	0.4688	$211.0
2029	$548.0	$465.8	0.4423	$206.0
2030	$567.2	$482.1	0.4173	$201.2
2031	$587.0	$499.0	0.3936	$196.4
2032	$607.6	$516.5	0.3714	$191.8
2033	$628.8	$534.5	0.3503	$187.2
2034	$650.8	$553.2	0.3305	$182.8
2035	$673.6	$572.6	0.3118	$178.5
2036	$697.2	$592.6	0.2942	$174.3
2037	$721.6	$613.4	0.2775	$170.2
2038	$746.9	$634.9	0.2618	$166.2
2038	$773.0	$657.1	0.247	$162.3
2040	$800.1	$680.1	0.233	$158.5

Table A-5: Toll Truckway System Revenue Projection				
Year	Gross Revenue	Net Revenue	NPV Factor	NPV Revenue
2041	$828.1	$703.9	0.2198	$154.7
2042	$857.1	$728.5	0.2074	$151.1
2043	$887.0	$754.0	0.1956	$147.5
2044	$918.1	$780.4	0.1846	$144.1
2045	$950.2	$807.7	0.1741	$140.6
2046	$983.5	$836.0	0.1653	$138.2
2047	$1,017.9	$865.2	0.1565	$135.4
2048	$1,053.5	$895.5	0.1477	$132.3
2049	$1,090.4	$926.8	0.1389	$128.7
2050	$1,128.6	$959.3	0.1301	$124.8
2051	$1,168.1	$992.9	0.1236	$122.7
2052	$1,208.9	$1,027.6	0.117	$120.2
2053	$1,251.3	$1,063.6	0.1104	$117.4
				$6,556.0

This revenue projection is admittedly less detailed than those used for the Express Toll Network and the North-South Tunnel. The TOT Lanes study provides neither the assumed toll rates, traffic levels, nor growth rates that its authors used, making it difficult to model alternative assumptions directly. Based on previous Reason Foundation work on toll truckways,[56] we think these figures for revenues based on the value of time savings are in the right ballpark.

Endnotes

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1 If 'year of construction' estimates are used, nominal costs would be higher. We estimate that about $692 billion (in 'year of construction' dollars) would be needed.

2 David Schrank and Tim Lomax, *The 2005 Urban Mobility Report*, College Station: Texas Transportation Institute, May 2005.

3 Congestion Mitigation Task Force, "Final Report & Recommendations," Atlanta: ARC, GDOT, GRTA, SRTA, December 2005.

4 A project summary will be found at www.reason.org/mobility.

5 Wendell Cox and Alan E. Pisarski, *Blueprint 2030: Affordable Mobility and Access for All of Atlanta and Georgia*, June 21, 2004 (http://ciprg.com/ul/gbt/atl-report-20040621.pdf).

6 The Road Information Program, "Metropolitan Atlanta: Breaking the Gridlock," Atlanta: Georgians for Better Transportation, 2000.

7 Email to the author from Tim Lomas of Texas Transportation Institute, June 27, 2006.

8 Jack Wells, Chief Economist, U.S. Department of Transportation, "The Role of Transportation in the U.S. Economy," presentation to the National Surface Transportation Policy and Revenue Study Commission, June 26, 2006.

9 Parsons Brinckerhoff, *Truck Only Toll Facilities: Potential for Implementation in the Atlanta Region*, Atlanta: State Road & Tollway Authority, July 18, 2005.

10 Glen Weisbrod, et al., *Economic Implications of Congestion*, NHCRP Report 463, Washington, DC: Federal Highway Administration, 2001.

11 Remy Prud'homme and Chang-Woon Lee, "Size, Sprawl, Speed and the Efficiency of Cities," *Urban Studies* 36, No. 11 (October 1999), pp. 1849-1858.

12 Cox and Pisarski, op cit.

13 "Texas Metropolitan Mobility Plan—Breaking the Gridlock," Austin: Texas Transportation Commission, Oct. 26, 2004.

14 Parsons Brinckerhoff, et al, "Urban Areas Congestion Analysis," Olympia: Washington State Department of Transportation, March 2006.

15 Carol H. Walters, Scott A. Cooner, and Stephen E. Ranft, "Reconsidering Freeway Bottlenecks: Case Studies of Bottleneck Removal in Texas," Transportation Research Record #1925, 2005 (www.national-academies.org/trb/bookstore).

16 Cambridge Systematics, Inc., "Unclogging America's Arteries: Effective Relief for Highway Bottlenecks, 1999-2004" Washington, DC: American Highway Users Alliance, February 2004.

[17] Cambridge Systematics, Inc, "Initial Assessment of Freight Bottlenecks on Highways," Washington, DC: Federal Highway Administration, 2006, (www.fhwa.dot.gov/policy/otps/bottlenecks/bottlenecks.pdf).

[18] Chao Chen and Pravin Varaiya, "The Freeway Congestion Paradox," *Access* (University of California Transportation Center), No. 20, Spring 2002, p. 40.

[19] Steve Hemminger, Metropolitan Transportation Commission, presentation at International Bridge, Tunnel & Turnpike Association conference in Santa Monica, CA, March 21, 2006.

[20] Doug MacDonald, "Highway Congestion: What Is to Be Done?" (www.wsdot.wa.gov/secretary).

[21] Lockwood, op. cit, p. 18.

[22] David T. Hartgen and M. Gregory Fields, "Building Roads to Reduce Traffic Congestion in America's Cities: How Much and at What Cost?" Policy Study No. 346, Los Angeles: Reason Foundation, August 2006, Table 25.

[23] Parsons Brinckerhoff, "High Occupancy Toll Lanes: Potential for Implementation in the Atlanta Region," Atlanta: Georgia State Road and Tollway Authority, April 1, 2005.

[24] Robert W. Poole, Jr. and Ted Balaker, "Virtual Exclusive Busways: Improving Urban Transit while Relieving Congestion," Policy Study No. 337, Los Angeles: Reason Foundation, September 2005.

[25] Wilbur Smith Associates, "Preliminary Traffic and Revenue Study, Atlanta Urban Area Toll Roads, Atlanta: State Highway Department of Georgia, May 1970

[26] Wilbur Smith Associates, "Traffic and Revenues: Proposed Atlanta Urban Area Toll Roads," Atlanta: Georgia State Department of Transportation and Georgia State Tollway Authority, July 1972.

[27] Wilbur Smith Associates, "Traffic and Revenues: Supplemental Study, Traffic and Revenues, Alternate Tollway Systems, Proposed Atlanta Urban Area Tollways," Atlanta: Georgia State Department of Transportation and Georgia State Tollway Authority, April 1974.

[28] Details may be found at www.a86ouest.com.

[29] Details at www.ita-ailes.org/cms/fileadmin/filemounts/general/pdf/ItaAssociation/ProductandPublication/ConfPapersExCo/project-ITA2.pdf.

[30] Details at www.popsci.com/popsci/technology/generaltechnology/0e1877530caf9010vgnvcm1000004eecbccdrcrd.html

[31] www.kiewit.com/project/pro_12000010.html.

[32] Parsons Brinckerhoff, "Truck Only Toll Facilities: Potential for Implementation in the Atlanta Region," Atlanta: State Road & Tollway Authority, July 18, 2005.

[33] Braden R. Sneath (CFO, Tampa-Hillsborough County Expressway Authority), email memo to Robert Poole, Aug. 17, 2006.

[34] Peter Samuel, "Innovative Roadway Design," Policy Study No. 341, Los Angeles: Reason Foundation, September 2006, Part 4.

[35] "Adapting to Road Conditions," *The Economist*, July 3, 2004.

[36] Samuel, op cit.

[37] PB Faradyne, "Metro Atlanta Traffic Incident Management Strategic Vision," Atlanta: GDOT and GRTA, May 12, 2006 (Powerpoint presentation).

[38] "2005 Transportation Metropolitan Atlanta Performance Report," Atlanta: Georgia Regional Transportation Authority, May 2006 draft. (www.grta.org/DRAFT_2005_Transportation_MAP_Report.pdf)

[39] National Cooperative Highway Research Program, *Safe and Quick Clearance of Traffic Incidents*, Synthesis 318, Washington, DC: Transportation Research Board, 2003. (http://trb.org/publications/nchrp/nchrp_syn_318.pdf).

[40] "National Traffic Signal Report Card," Atlanta: Regional Traffic Operations Task Force, presentation made March 17, 2005.

[41] David Schrank and Tim Lomax, "2005 Urban Mobility Report: Six Congestion Reduction Strategies and Their Effects on Mobility," College Station, TX: Texas Transportation Institue (n.d.), available online at http://mobility.tamu.edu.

[42] David T. Hartgen and M. Gregory Fields, op cit.

[43] Robert W. Poole, Jr. and Ted Balaker, op cit.

[44] Congestion Mitigation Task Force, 12/6/05 Meeting Summary, Appendix 2, page 2-30.

[45] Alain Bertaud, "Clearing the Air in Atlanta: Transit and Smart Growth or Conventional Economics?" *Journal of Urban Economics*, Vol. 54, 2003, p. 379.

[46] Ayres, McHenry & Associates, "Survey of Metropolitan Atlanta Residents Regarding Transit Awareness," March 23-30, 2002 (www.grta.org/rtap/pdf_files/GRTA_Presentation.pdf).

[47] Chris Swenson, et al;, "Public Perceptions of Traffic Congestion and Transportation Funding Options," Cape Coral, FL: CRSPE, Inc., July 2006.

[48] Cox and Pisarski, op cit.

[49] Bent Flyvbjerg, et al, *Megaprojects and Risk*, Cambridge (U.K.): Cambridge University Press, 2003.

[50] Norman Mineta, speech before the National Retail Federation, Washington, DC, May 16, 2006.

[51] Jacobs/HNTB, "Value Pricing on the I-75 HOV/BRT Project," Atlanta: State Road and Tollway Authority, February 2006.

[52] Robert W. Poole, Jr. and Kevin Soucie, "Adding FAST Lanes to Milwaukee's Freeways," Policy Study No. 342, Los Angeles: Reason Foundation, February 2006.

[53] Shrank and Lomax, 2005 Urban Mobility Report

[54] Congestion Mitigation Task Force, "Final Report & Recommendations," Atlanta: ARC, GDOT, GRTA, and SRTA, December 2005, Appendix 9, p. 9-3.

[55] Transportation Technical Services, Inc., "An Evaluation of Expenses per Ton-Mile, Expenses per Mile, and Expenses per Ton for Major Commercial Carriers in Numerous Segments of For-Hire Trucking," Washington, DC: Federal Highway Administration, 2000.

[56] Peter Samuel, Robert W. Poole, Jr., and Jose Holguin-Veras, "Toll Truckways: A New Path Toward Safer and More Efficient Freight Transportation," Policy Study No. 294, Los Angeles: Reason Foundation, June 2002; and Robert W. Poole, Jr., Peter Samuel, and Brian F. Chase, "Building for the Future: Easing California's Transportation Crisis with Tolls and Public-Private Partnerships," (see Part 3, section D), Policy Study No. 324, Los Angeles: Reason Foundation, January 2005.

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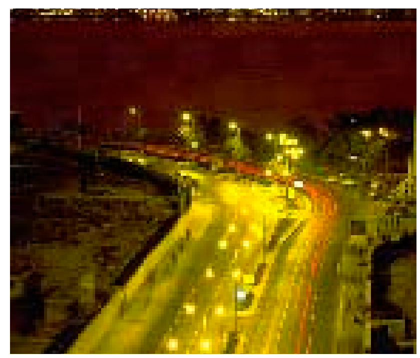
The Mobility Project Advisory Board provides overall program guidance, suggestions on research, and feedback on studies. It does not necessarily endorse the conclusions of individual studies.











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