POLICY report

Goldwater Institute

No. 223 | April 30, 2008

More Roads to Travel: *A Path to Transportation Solutions in Arizona*

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EXECUTIVE SUMMARY

Arizona has a transportation problem. The average Phoenix commuter spends some 38 hours a year stuck in traffic, and one in Tucson spends an average 42 hours. Overall, traffic congestion costs Arizonans at least $2 billion annually in lost time and wasted fuel. The state must take action on a number of fronts to ensure that transportation problems do not damage Arizona's economy and quality of life.

Create a new transportation funding mechanism – toll roads. Arizona should actively pursue a toll road policy, which would make it possible to build needed roads now, rather than decades from now. A toll road in San Diego only 10 miles long will allow many commuters to shorten their drives by 20 minutes, allowing many to have dinner with their families for the first time in years.

Build more roads. The state desperately needs an east-west alternative to I-10, bypassing Phoenix and Tucson, and could have such a road sooner if toll financing were used. Other construction recommendations are discussed in the report.

Consider tolls or congestion pricing to reduce traffic at peak hours. Fully half of the people on the roads at peak times are not commuting to work and could be encouraged to travel at a different time with toll incentives.

Minimize expensive, inflexible mass transit and legalize flexible, private mass transit. Phoenix isn't dense or centralized enough to be a good candidate for mass transit. Many countries have private systems using small vans and buses to transport riders on very flexible schedules and routes. Arizona should legalize this approach.

Amend Arizona's constitution so that the Arizona Department of Transportation can avoid having to purchase state land. Currently, it is illegal for the Arizona State Land Department to turn property over to any state agency for any purpose. ADOT must buy the land, with proceeds going to public schools. Requiring the state to buy land from itself often makes building new roads cost-prohibitive.

Implement known techniques to improve traffic flow These include signal synchronization, building grade separations, converting streets to one-way, and adopting restrictions on truck lanes. "Smart" road technology, such as dynamic signage, can help. The effectiveness of High Occupancy Vehicle (HOV) versus general-purpose lanes should be evaluated.

To improve transportation, policymakers should embrace a variety of approaches that harness, rather than direct, market forces and the personal preferences of Arizonans.

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Introduction

A driver in a congested community is trapped in a maze, one that's already difficult to negotiate and that is made all the more difficult because it changes. No matter where the driver turns, the situation never gets better on any consistent basis. What is more, the daily commuter has to repeat his frustrating time- and gas-wasting foray into traffic congestion day after day.

The average Phoenix commuter loses 38 hours and 24 gallons of fuel per year trapped in traffic.

Phoenix is the 23rd most congested urban area of 85 areas rated by the Texas Transportation Institute (TTI). The average Phoenix commuter loses 38 hours and 24 gallons of fuel per year trapped in traffic. Phoenix also has the second- and 12th-worst interchange-related truck bottlenecks in the United States.[1] And congestion along Arizona's interstates and other highways is only projected to get worse.

Tucson hardly fares better. In the 28th most congested area, the average Tucson commuter loses 42 hours and wastes 26 gallons of fuel per year. Tucson ranks fourth worst in its size-class of cities.[2] This should explain the apparent contradiction that Tucson is less congested than Phoenix, but its commuters spend more time in traffic.

There is much that policymakers can do to improve transportation and alleviate congestion. Indeed, there is a great deal of activity promising to relieve congestion. Many communities have bus services; it seems that road construction is everywhere; and large cities are installing or expanding light-rail. While individually we may not be able to give up our cars, it seems that there are alternatives for others to do so, especially given how much we have subsidized rides on bus or rail transit.

But traditional finance and planning methods are not working. Despite the passage of Proposition 400 in Maricopa County, which continued a half-cent sales tax specifically for road construction and improvments, it is estimated that where there is $6 billion in projected road construction needs, there is only $2.4 billion in likely funding over the next 20 years.[3] The gasoline tax has become a less effective method for financing roadways, for a number of reasons that will be discussed later in this paper.

Unfortunately, many Arizona communities are focused on highly subsidized mass transit, such as light-rail and bus services, as well as carpooling, hoping to encourage these types of travel with HOV lanes. Many think that the way to relieve congestion on I-10 between Phoenix and Tucson is with commuter rail. But none of these proposed solutions takes into account the way most people want to travel.

Meanwhile, congestion only gets worse. Few urban communities have seen a reversal of this misfortune. To solve the traffic problem, we must first understand its causes.

Arizona's Growing Urban Population

Arizona has only one-half mile of roadway per square mile of surface area. Only seven states are more sparsely paved.[4] At the same time, 16 states have a lower statewide population density, implying that Arizona has a relative scarcity of roads.[5] On the other hand, only 15 percent of Arizona's landmass is under private ownership, with the balance being owned by the federal government, Native American reservations, and the state.

Because the bulk of the state's population is relegated to a tiny portion of the total landmass, Arizona is a heavily urbanized state. In fact, it is more urbanized than the state of New York. Consequently, Arizona's transportation issues are almost entirely urban in nature.

A detailed discussion of Arizona's road ownership pattern is included in Appendix B for those who would like a more complete overview of the state's system. To summarize, Arizona is unusual in its relatively high degree of federal road ownership and its relatively low degree of municipal and county road ownership.

From 2000 to 2006, Arizona's population grew by 20.2 percent. Only Nevada grew at a faster rate. Arizona is projected to be the 10th most populous state by 2030, rising from its current rank of 16th and adding 4.5 million people, increasing its current population of about 6.2 million by two-thirds in less than 25 years.[6]

The population in the greater Phoenix area is expected to increase by 1.5 million by 2020, a 42 percent increase from 2005. Communities in the West Valley are projected to contribute three times more of this population increase than communities in the East Valley.[7]

Pima County's incorporated cities are expected to grow in population by more than one-half million people, an 85 percent increase, from 2005 to 2030. Tucson alone is expected to grow by almost 400,000 people.

The State's Inadequate Response to Growth

Over a five-year period (2000 to 2005), Arizona's centerline highway miles and lane miles increased by a mere 8 percent, while the annual number of vehicle miles traveled increased by 20 percent.[8] The response of Arizona's road authorities to population and travel growth has clearly been insufficient. Most of the growth in vehicle miles traveled has occurred in the urban areas where the population growth has occurred.

Arizona's transportation issues are almost entirely urban in nature.

Road policy in the Phoenix, Tucson, and Flagstaff areas has not kept pace with the volume of traffic, as can be seen in Figures 1, 2, and 3. To illustrate relative trends in estimated time delays (where available), road miles, and vehicle miles traveled (a measure of traffic volume), each of these variables is indexed for each city (see Appendix A). Tucson and Phoenix data is indexed to 1994. Data available for Flagstaff are indexed to 1996. An index value of 1.25 in vehicle miles traveled in Tucson in 1999, for example, means vehicle miles traveled in 1999 were 25

percent higher than in 1994. These figures show how much time delays have grown in Phoenix and Tucson from 1994 through 2005, as growth in road capacity has lagged behind growth in vehicle miles traveled.[9]

Right now, 72 percent of peak-period (6-9 a.m. and 4-7 p.m.) travel in Phoenix and 57 percent of peak-period travel in Tucson is congested, leaving substantial numbers of Arizonans sitting in traffic on a daily basis.[10] Population estimates and projections predict that the problem could reach crisis proportions unless more workable solutions are implemented.

From 1994 through 2005, the number of lane miles in Phoenix increased by 37 percent. At the same time, the number of daily vehicle-miles traveled (traffic volume) increased by 69 percent. Consequently, delay time increased by a whopping 138 percent.

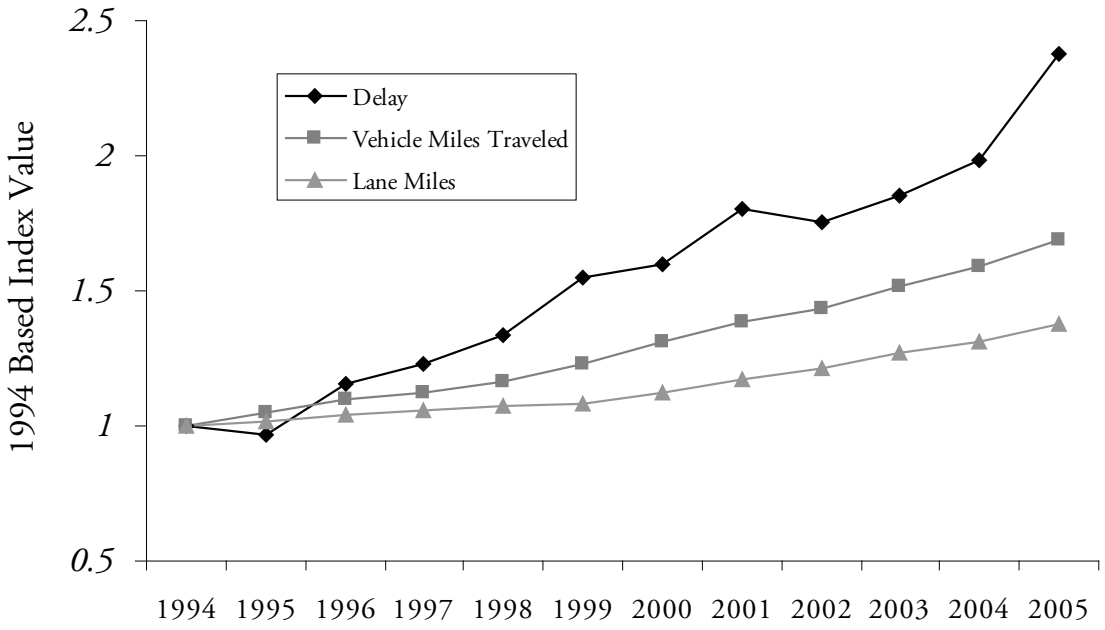
The total congestion cost for Phoenix is estimated at $1.7 billion per year.

According to the TTI, Phoenix is the 23rd most congested urban area of the 85 areas rated. The TTI finds that the average Phoenix commuter loses 38 hours per year—almost an entire workweek—trapped in traffic. Time spent sitting in traffic wastes 24 gallons of fuel per year per commuter, with all the resulting pollution. The total congestion cost for Phoenix is estimated at $1.7 billion per year.[11]

Phoenix has the second- and 12th-worst interchange-related truck bottlenecks in the United States: the I-10/State Route (SR) 51/Loop 202 interchange, causing 22,805 hours of delay per year, and the I-10/I-17 interchange, causing 16,310 hours of delay per year.[12]

The Phoenix metropolitan area's emphasis in recent years has been on the East Valley, an area of high housing

Figure 1: Phoenix Capacity, Travel & Delay



demand, and the north/south corridors in and around Phoenix. Loop 101 on the west side only recently opened. The rest of Loop 101, SR 51, and Loop 202, which is still under construction in the East Valley, are not old. Despite their recent construction, these corridors are already heavily congested during rush hours.

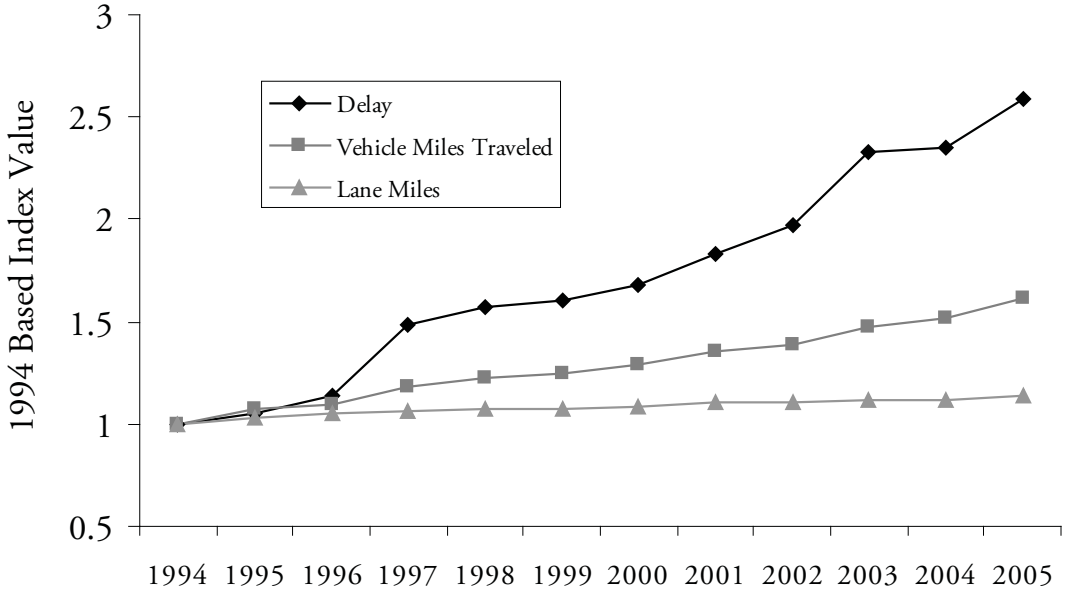
There are a number of limited-access freeway north/south corridors in Phoenix, including two sections of Loop 101, I-17, and SR 51, as well as a portion of I-10. Conspicuously present, because of the absence of any alternative, is the single east/west limited-access freeway through much of Phoenix, I-10. Admittedly, a portion of Loop 101, on the north side of Phoenix, has an east/west orientation, relieving I-10 of some of the traffic that would otherwise merge onto its already congested portions. Nevertheless, those living west of downtown Phoenix with east/west-oriented commutes have fewer limited-access options than those with north/south commutes.

As Figure 2 shows, in Tucson between 1994 and 2005, lane miles increased a paltry 14 percent compared with the 61 percent increase in traffic volume. Delay time increased an astounding but not surprising 158 percent.

Tucson is the 28th most congested area in TTI's analysis. The average congested Tucson commute of 25 minutes is slightly shorter than the congested Phoenix commute average of 26 minutes. However, when there is delay, the average Tucson commuter loses 42 hours and wastes 26 gallons of fuel per year. Tucson ranks fourth worst on the travel time index in its size-class of cities.[13] The total congestion

Tucson is the 28th most congested area in TTI's analysis.

Figure 2: Tucson Capacity, Travel & Delay



cost for Tucson is estimated at $338 million per year.[14]

While Phoenix appears to have a knack for building behind demand, at least it is building. Tucson seems to be limiting itself to expanding the number of lanes on I-10 through the city. Conspicuously absent are entirely new roads, at least of the limited-access freeway variety, in or around Tucson.

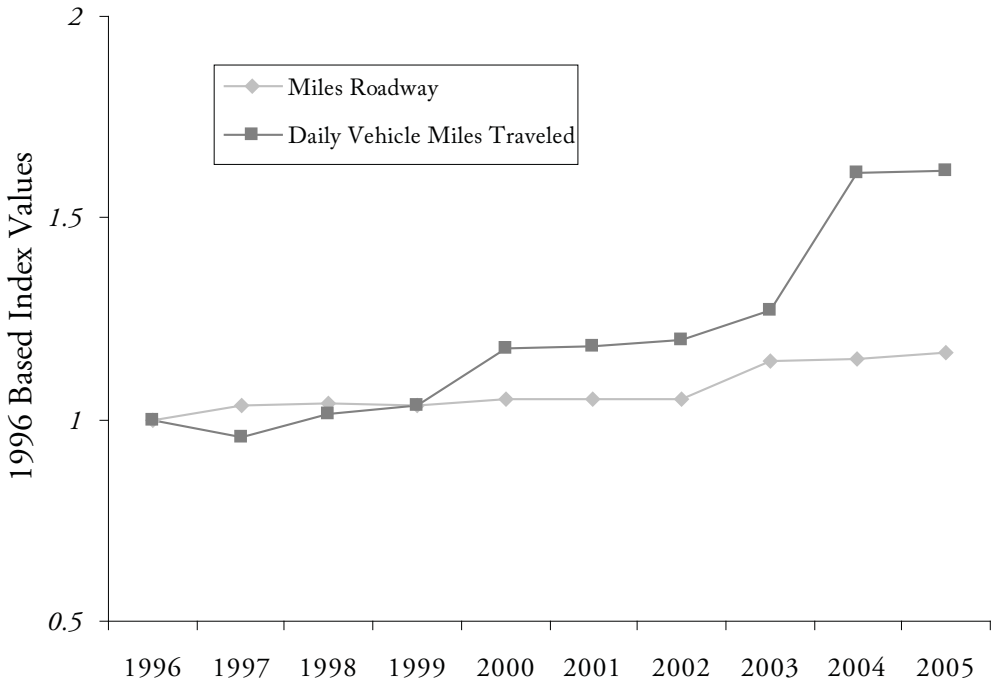
Delay time is not available for Flagstaff. Nevertheless, while traffic volume increased 61 percent, road mileage increased only 16 percent.[15] Thus, delay time likely increased similarly to that in Tucson. There seem to be fewer complaints about congestion in Flagstaff, since Flagstaff did not start out as congested as Tucson was in 1994. That leaves room for more growth in congestion before it becomes intolerable enough for many to complain.

Much of the traffic on Arizona's rural interstates is truck traffic passing through the state.

Arizona's rural interstates and some highways are increasingly congested, as well. The I-17 and I-19 routes, both contained entirely within the state, serve as north/south routes. I-17 is very busy and is especially congested north of Phoenix's Loop 101. I-19 is congested several miles to the south of Tucson. The others—I-8, I-10, and I-40—are east/west routes. They serve as freight conduits between Southern California and the rest of the nation; therefore, much of the traffic on Arizona's rural interstates is truck traffic passing through the state.[16]

The I-10 corridor passes through the now highly congested Tucson and Phoenix urban areas. The I-8 corridor passes through Yuma and terminates at I-10 between Phoenix and Tucson. The I-40 corridor passes through Flagstaff, where traffic is increasing. Highway 60 west of Tonto National Forest passes through Mesa and

Figure 3: Flagstaff Capacity, Travel & Delay



Tempe and northwest through Phoenix to Wickenburg, where Highway 93 extends to I-40. All of these routes will see increasing congestion as the state grows.

Road congestion is very costly. The national economy loses 4.2 billion man-hours per year, or 38 hours per commuter. Likewise, congestion costs the national economy 2.9 billion gallons of gasoline per year. In dollar terms, these costs add up to $78.2 billion per year.[17] It is estimated that it costs trucking companies $8 billion per year just to contend with traffic bottlenecks and the uncertainties they cause.[18]

Time and fuel costs are not all Americans lose as a result of congestion. In their book *The Road More Traveled*, Ted Balaker and Sam Staley make a persuasive argument that much more is lost. Their case reaches into the narrowed personal opportunities Americans suffer as they limit their physical universe to avoid the aggravations of traffic congestion.[19]

All of this time delay, whether a result of being stuck in traffic or having to reschedule, has economic costs. Congestion can cause a local economy to lose jobs by driving up costs for producers who then choose other locales. Just-in-time delivery is a necessity in today's competitive environment. It ensures that a company does not have to maintain costly inventories and allows for swift adjustment to changing technological environments. Congestion interferes with production planning and makes timely deliveries difficult. Companies also have trouble recruiting and keeping quality employees who are forced to spend wasted hours each day in traffic delays.[20]

Looking Forward: Bad Goes to Worse

With growth in both Phoenix and Tucson, as well as continued economic growth in the rest of the country, the I-10 corridor between the two cities will become increasingly congested. Already, even a minor accident between the two cities can cause traffic to back up for miles.

Assuming no additional capacity is added, the year 2020 brings some sobering predictions:

- The capacity of Highways 60 and 93 will be exceeded from Surprise to I-40 and east of the 202 loop to Globe.
- Much of I-10 on either side and through Tucson will be over capacity.
- Sections of I-17 south of the Prescott turnoff will be over capacity.
- North of Prescott, all of Highway 89 to I-40 is expected to be over capacity.
- Nearly every limited-access highway in the Phoenix area will be over capacity.[21]

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Planned Road Expansion Inadequate

Most of the needed transportation improvements in the state are along the I-10 corridor and involve the Phoenix and Tucson metropolitan areas. The I-17 corridor will also need expansion to save drivers from congestion within and north of Phoenix to the Prescott exit. The I-10 corridor between Phoenix and Tucson through Pinal County is under the charge of

the Arizona Department of Transportation (ADOT). Transportation solutions in the metropolitan areas themselves are largely the ken of the respective regional authorities: in the Phoenix area, this is the Maricopa Association of Governments (MAG); in Tucson, it is the Pima Association of Governments (PAG).

Most of the needed transportation improvements in the state are along the I-10 corridor and involve the Phoenix and Tucson metropolitan areas.

MAG's plans would extend Loop 202 from its current southern I-10 intersection west, passing south of South Mountain and then turning north to intersect I-10 again at 55th Avenue. Loop 303 running north/south 10 miles west of Loop 101 would be improved and completed (already under construction) eastward to I-17 from Surprise. Loop 303 would essentially extend south of I-10 and then turn east, parallel of I-10 and designated as 801, intersecting 202 south of I-10 near 55th Avenue. Lanes would be added to major freeways along with major arterial improvements, as well. While MAG is planning to devote the lion's share of its anticipated resources to road expansion from 2008 to 2028, fully one-third of the anticipated MAG half-cent sales tax revenues—$6 billion—is devoted to public transit. If all of MAG's plans were implemented immediately, they would probably solve most of our congestion problems for now. However, by the time the planned construction is completed, current plans will likely be obsolete. In fact, MAG's own plan clearly states that if its plans are fully implemented, by 2028 total congested lane miles will increase by 47 percent.[22]

PAG's plans are far less ambitious. It calls for increasing the number of lane miles of roadway in Tucson and its immediate suburbs. However, few new centerline miles[23] of roadway would be added. In fact, if one compares the anticipated 2030 congestion map of Tucson with no road improvements with a similar map with currently planned improvements, there is surprisingly little difference. Through-traffic on I-10 and I-19 would continue in heavy congestion.[24]

Here are some suggested priorities in road expansion:

- The state desperately needs an east-west alternative to I-10, bypassing Phoenix and Tucson. This is an ideal candidate for a toll road.

- Phoenix needs the planned but unfunded Loop 202 extension around South Mountain right away. That loop should intersect I-10 further west than currently planned (at the Loop 101 instead of 55th Avenue).

- I-17 should be expanded from Phoenix to the Prescott exit.

- Tucson needs a bypass but has none in the plans.

- Highways 60 and 93 should be expanded from Surprise to I-40 and east of the 202 loop to Globe.

- Highway 89 north of Prescott to I-40 needs to be widened.

Misplaced Emphasis on Transit

Transit's total contribution to commuting trips nationally is small and shrinking. From 1960 to 2000, federal

transit subsidies nearly tripled, and all government subsidies to transit increased by 700 percent. Meanwhile, the share of work trips by way of transit fell from over 12 percent to less than 5 percent.[25] Only about 1.5 percent of trips taken by Americans are on transit. Even as the United States added 63 million workers from 1960 to 2000, the number using transit fell by 2 million.[26] One thing is certain: Mass transit is not the solution to transportation woes.

Economists Clifford Winston of the Brookings Institution and Vikram Maheshri of the University of California, Berkeley, investigated the net social benefits of transit, even taking into account congestion relief and pollution mitigation. They found that only San Francisco's BART (Bay Area Rapid Transit) system provided net social value. Not even New York's legendary subway hit the mark. No doubt, much of what reduced the net benefits is that, on average, transit revenues only cover about 40 percent of operating costs and none of the initial investment.[27]

Local transportation authorities seem to be dominated by individuals who are not concerned with giving people what they want—the means to independence, a personal home, and some elbow room. Instead, the thinking is that urban sprawl is a problem and that people have to be forced to live in denser communities and leave their cars. Consequently, there is little desire among some planners to solve congestion problems. In fact, the idea is that congestion is exactly what might persuade people to leave their cars and get on transit.[28]

Population density must exceed 4,000 persons per square mile for transit to gain a significant share of commute trips. Accordingly, New York City would seem an ideal transit city. But it takes transit riders in New York nearly twice as long to get to work as it takes drivers.[29] Only New York's subway carries as many people as a single lane of freeway.[30] In Phoenix, the travel time disparity is likely to be even worse, where the light-rail currently under construction is at grade and moves along streets. In fact, light-rail in Phoenix is likely to increase congestion because the traffic-light synchronization that prevails to some degree now will be interrupted by the rail. This is even indicated in the environmental impact statement for the project.[31]

Although significant sections of the Phoenix metro area exceed 4,000 persons per square mile, and MAG expects these high-density areas to expand over the next 25 years, Phoenix lacks a truly defined downtown, which renders mass transit relatively ineffective.[32] Mass transit's fixed routes are not particularly good at merging the weblike pattern people's commutes would trace out were they to be mapped. Phoenix's overall density is also only 2,933 persons per square mile, making the emphasis on transit particularly befuddling.[33]

Some argue that transit is needed for the poor. However, few of the arguments for Phoenix's light-rail system center on the poor. A big emphasis is "transit-oriented development" and the positive effect light-rail can have on property values.[34] An increase in property values, though not a bad thing, hardly encourages the poor to locate along light-rail routes. Besides, there is good evidence that the poor need cars.

Only about 1.5 percent of trips taken by Americans are on transit. Even as the United States added 63 million workers from 1960 to 2000, the number using transit fell by 2 million.

Personal automobiles provide the flexibility needed to search for and change jobs, a necessity for moving into higher income levels in today's dynamic economy.[35]

Ultimately, there is no evidence that mass transit spurs development that otherwise would not occur. No doubt, development occurs differently with transit, and the mix of developers and residents changes in the presence of transit. However, arguing that transit is a necessary condition for certain levels of development is a little like saying people would not have sports equipment and outdoor recreation goods were it not for retail giant Cabela's tax abatements.[36] Government transit is potentially one more example of government picking winners and losers in the economic game.

The answer to congestion is threefold—expanding supply, managing supply, and managing demand.

Some $898 million in contracts have already been awarded for the Phoenix area's light-rail.[37] At $12 million per lane mile of road, this is enough to build 19 miles of four-lane, limited-access highway, enough to provide relief to east/west commuters on I-10 and more than enough to widen I-17 north of Loop 101. Admittedly, much of this money is federal and dedicated to mass transit. Six billion dollars of purely local money is slated for transit in Phoenix over the next 20 years as required by Proposition 400. This funding is enough to build a four-lane highway from Phoenix to Tucson, and more than enough to build a highway to bypass Phoenix entirely from Buckeye to I-8, running south of the Gila River reservation.[38]

Federal funding policy encourages cities to invest in transit by providing a good deal of the funding for it. In fact, 31 percent of total funding for the light-rail in Phoenix over the next 28 years is expected to come from the federal government; only 22 percent is expected to come from fares.[39] Nevertheless, using transit as a way to claim federal money is hardly a good excuse for wasting billions of dollars in local funds.

One other issue with respect to transit bears noting. An ADOT-sponsored study that looked at 20 potential congestion-reducing alternatives evaluated them on the basis of their respective potential impacts on pollution mitigation. Two of the five alternatives with the least effect on pollution were the two fixed rail transit alternatives. They were also by far the two costliest ways to reduce pollution.[40]

Solutions for Arizona

The answer to congestion is threefold—expanding supply, managing supply, and managing demand. First, we need to get more pavement on the ground to expand road lane mileage, which involves locating and constructing roads to get the most movement per dollar. Second, we need to manage the new and existing road supply efficiently, which involves optimizing the user's ability to use a road. Third, we need demand management, which involves giving preference to those who have the most immediate need to use a road, and spreading road use over time to reduce congestion.

The solutions recommended below

do not neatly fall into only one of these categories. Therefore, they are not organized in this way. However, these categories do allow an evaluation of each recommendation in terms of the type of impact it might have. It is also important for solutions to road congestion to be considered comprehensively in practice. That is, one solution can affect another. For example, signal synchronization can be affected negatively by a new limited-access road's intersection. Similarly, if more traffic is handled by existing streets, signal synchronization can affect drivers' demand for a toll road.

Solution 1: Road Expansion

Most people like the flexibility and independence a personal automobile can afford them. An automobile provides the flexibility to leave work and take care of a sick child. It opens up more possibilities for places to work and live and gives readier access to leisure activities. People exhibit how much they value auto services through their willingness to pay for them through the prices they pay for gasoline, vehicle purchases, and upkeep.

Mass media often deride Americans for their "love affair" with the automobile. But Americans are not alone in their affection. As the Chinese gain wealth, they increasingly purchase cars.[41] Europeans, especially in nations formerly of the Soviet Union, have more and more turned to the automobile as a favored transportation mode.[42] So have Russians, who have increasingly embraced markets and the wealth that is produced with them.[43] Automobile ownership is a result of wealth and the options that people desire as a result of their wealth.

Where it is cost-effective to do so, roads of every type in Phoenix should be widened. While north/south limited-access corridors are congested, at least they are relatively numerous. Their effectiveness is limited, however, by the congestion on I-10. West of I-17, I-10 is the only limited-access east-west corridor, except for Loop 101 far to the north. Given expected future growth in the West Valley, east/west capacity is badly needed.

Judging by current congestion levels on I-10 and expectations that most limited-access freeways through the city will see traffic over capacity by 2010, Phoenix needs the planned but unfunded Loop 202 extension around South Mountain right away.[44] That loop should also intersect I-10 farther west than currently planned (at the Loop 101 interchange instead of 55th Avenue).

Phoenix needs the planned but unfunded Loop 202 extension around South Mountain right away.

Road alignments currently featured in the MAG plan need to be reconsidered for optimum effect on road congestion, especially in light of the I-10 corridor's already congested condition and the fact that truck freight traffic is growing twice as fast as car traffic.[45] The planned 801 parallel to I-10 should already be under construction, as well, especially if Loop 202 is not better aligned. Tucson needs a bypass, but there are currently no firm plans to build one.

Benefit of Roads: Congestion Relief

With a growing population and economy, Arizona's roads are increasingly in demand and becoming more crowded. With more roads, all roads become less crowded. In fact this is exactly what the

TTI study of 85 urban areas finds. The TTI data show that the greater the difference between growth in traffic and the growth in road lane mileage, the greater the growth in congestion. In other words, communities that increase their road mileage as quickly as traffic grows will see congestion remain roughly the same.[46]

The greater the difference between growth in traffic and the growth in road lane mileage, the greater the growth in congestion.

Alternatives to building roads focus on higher-density development, with the goal of encouraging people to walk or use bicycles and public transit. But Arizonans have demonstrated that they prefer not to ride bicycles in the heat or in the rain. Employers seem unlikely to install showers for those who would do so. Transit modes usually take longer, are much less convenient, and do not allow the flexibility to take care of unexpected events that occur during a workday, such as a child getting sick in school.

Addressing Issues of the Environment and Eminent Domain

Any time roads are constructed, issues arise regarding the environment and eminent domain, as well as community disruption. Sometimes these serious issues are interjected to disguise ulterior motives, but this is not to say that they are not important. In fact, they are so important that they make road placement and design an issue of utmost importance. Roads must be placed, designed, and managed to carry maximum traffic loads as efficiently as possible. In so doing, the fewest roads are needed, and issues with eminent domain, the environment, and community are minimized.

The continuation of Loop 202 around the south of South Mountain is a case in point. The routing of this section has been in place since 1988, and development has taken root along Loop 202's southern leg in the Ahwatukee area. But there has emerged some resistance to the long-planned project that includes destroying 250 homes. A possible rerouting immediately south would encroach on the Gila River Indian Reservation, which has so far denied such access. Added to this mix of issues is the tiny community of Laveen, which has planned for the 1988 alignment all along as a development tool and will certainly oppose a rerouting that would move the new 202 extension's intersection with I-10 west to Loop 101 (which makes the most sense from a traffic-flow perspective).[47]

Roads generally represent a public use of property. This fact seems quite straightforward, since roads are open to all users and are owned in common through state and local governments. Therefore, the exercise of eminent domain seems appropriate, given that private property owners are compensated and that there will be a general benefit from the new road. This straightforward reasoning gets murky when roads are created for any reason or purpose other than to get traffic moving as efficiently as possible, with full costs accounted for, including the cost of acquiring property. When a road is routed with a specific community's or property owner's economic ambitions in mind to the detriment of traffic flow, the public benefits are accrued to a select few and, therefore, eminent domain may not be appropriate. In the long run, roads must simply be planned to have the greatest impact on congestion.

Benefit of Roads: Improved Air Quality

In the nation as a whole, although driving is increasing by one to three percent each year, average vehicle emissions are dropping by ten percent per year due to improvements in vehicles and fuel formulations. Overall, the nation's air is getting cleaner.[48] Phoenix and Tucson are not exceptions.

The U.S. Environmental Protection Agency (EPA) monitors six principal air pollutants: carbon monoxide, nitrogen dioxide, sulfur dioxide, lead, ozone, and particulate matter. Several monitoring stations serve to gather data, and their locations change. No overall "average" pollution level is computed for a region, so trends and excess pollution determinations have to be examined by looking at the various data points over time. (These data points are available for Phoenix and Tucson at the "Where You Live" link, http://www.epa.gov/airtrends/index.html.)

The air quality for Phoenix and Tucson has improved in every category except ozone, which is partly driven by sunlight but which nonetheless remains below federal standards. In Phoenix, carbon monoxide is at half or less than half the national standards. Nitrogen dioxide is at similarly low levels. Sulfur dioxide is at perhaps a tenth of allowable concentrations. Lead is nearly nonexistent in the air. Ozone approaches the national standard in Phoenix. For now, Tucson is not even close to exceeding air quality standards, probably at least partly due to its location and wind patterns.[49]

Phoenix fails to meet only one of the EPA's air quality standards—particulate matter, which refers to small particles that can get past the defenses of the lungs and might never be expelled, causing long-term reduction in lung function. There are actually two particulate matter (PM) categories, based on the size of the particulates: PM 2.5 includes particles 2.5 microns and smaller; PM 10 includes particles larger than 2.5 microns but smaller than 10. Phoenix fails only in the PM 10 category, which implies that much, if not most, of Phoenix's air quality problem is very fine dust.

If our air is so clean, then what is the infamous "brown cloud?" There are two simple explanations—first, the dust mentioned above, and second, the fact that our flat landscape makes it possible for us to look out very far into the distance. Sometimes, the winds in the Sonoran Desert howl. Much of the time, they are very nearly nonexistent. With no wind, the fumes produced by cars and the dust stirred up by everyday life pile up in the low atmosphere of Phoenix.

Overall, the nation's air is getting cleaner. Phoenix and Tucson are not exceptions.

Nevertheless, even with the brown cloud, air quality has improved. If we could only look out a couple of miles into the distance, we would not see a thing. But it looks worse when people can see 20 miles out.

The progress in air quality could be reversed, though, if traffic congestion increases at such a pace that emissions improvements are overcome. Phoenix constantly skirts with exceeding ozone concentration standards. Ozone is a

highly corrosive substance that is very dangerous and should be taken seriously. It forms naturally in the upper and lower atmospheres when sunlight acts as a catalyst to break oxygen molecules into atoms that then react with other oxygen molecules to form ozone. The presence of high concentrations of nitrogen dioxide and carbon monoxide contributes to how much ozone is formed in the lower atmosphere. To add to this issue, the EPA continuously threatens to tighten air quality standards.

The worst possible situation is to have automobiles idling in place as a result of traffic congestion (admittedly less of a problem with increasing use of hybrids). For the sake of cleaner air, traffic needs to move with as little interference as possible. That means policies should seek to get traffic moving and get commuters to their destinations, with keys off, as quickly as possible. An uncongested 15-minute trip that takes 45-minutes because of congestion needlessly contributes to pollution.

The funding system for financing roads and road improvements is broken.

Another way to reduce pollution would be to reroute truck and automobile through-traffic off I-10 and around Phoenix and Tucson. While a Loop 202 extension around South Mountain would help Phoenix, a more comprehensive solution would be the creation of a new road that would bypass both Phoenix and Tucson. In fact, ADOT has already presented preliminary findings from a study for such a bypass.[50]

Another policy for mitigating the pollution problem is to get unnecessary traffic off the road during rush hours, the most highly congested and potentially polluted parts of a day. Simply building more roads will not accomplish this goal. Careful consideration must be given to how use of new roads might be allocated. Mechanisms should ideally be in place to discourage unnecessary trips during congested periods.

Cost of Roads: Funding Mechanisms Must Keep Pace

More roads (or lane miles) mean less congestion, more economic development, less pollution per mile traveled, and less wasted time. But roads cost money, and there is not enough of it. The funding system for financing roads and road improvements is broken, according to U.S. Transportation Secretary Mary Peters. Problems include congressional earmarks that use transportation funds for pet projects with little or no productivity.[51] But even if nonproductive earmarks were eliminated, problems with how roads are currently funded would continue.

Inflation has degraded road-dedicated fuel taxes. The federal government provides a substantial amount of every state's road funding. In recent years, federal fuel tax revenues have declined, even in absolute terms at times. The total real purchasing power of the federal fuel tax reached its zenith in 1977 and has declined ever since, despite several increases in tax rates.[52]

The current federal tax on gasoline is 18.4 cents per gallon. The current Arizona tax on gasoline is 18 cents per gallon. The current total 36.4 cents per gallon tax would have to rise by 14 cents just to reach the same per-gallon purchasing power as

the early 1990s, the last time the state and local components were increased, consistent with the Consumer Price Index. The tax would have to increase even more to adjust for cost increases in steel, concrete, and petroleum-based asphalt in recent years.[53] Improving vehicle gas mileage adds to the inflation problems. Drivers pay less in tax on a per-mile basis now than in the past because, on average, less fuel is used over a given distance.

Politically, the likelihood of taxes increasing to account for these changes is very nearly zero, as it should be. Gasoline taxes are a very indirect way to pay for roads. They result in some drivers subsidizing others. One of the biggest beneficiaries of this subsidy is the trucking industry, whose weighty trucks require much thicker pavements and much more road maintenance than would otherwise be necessary. Even more indirect are sales taxes for transportation like those extended by Proposition 400 in Maricopa County. Resources are most rationally demanded and consumed when individuals pay most directly for them, but hidden dedicated taxes hardly qualify as direct payment.

Another challenge is the fact that drivers passing through Arizona can do so without buying fuel here—in essence, paying nothing to use our roads. Arizona is about 350 miles wide. It can easily be traversed by a motor home without having to refuel; many smaller vehicles can achieve the same feat. Therefore, some traffic passing through Arizona can easily avoid the state's fuel tax. Automobile owners can also avoid fuel taxes by purchasing more fuel-efficient cars, even though doing so has little or no effect on the amount of roadway required. This illustrates how limiting and irrational a fuel tax can be as a source of funds.

The money must be found. In Phoenix, there are $6 billion in projected needs but only $2.4 billion in likely funding over the next 20 years.[54] The need is now. Unless Arizonans want to see economic growth choked by congested roads, we must find new funding mechanisms and a way to accelerate construction.

Solution 2: Market Forces and Toll Roads

One very powerful approach to transportation would be to let market forces work. It is arguable that people have never had a chance to truly reveal their preferences regarding transportation modes, commute times, and community characteristics in light of the true costs of the various choices. Despite the gasoline tax, roads are provided effectively for free, distorting transportation choices. Transit is even more heavily subsidized than roads. Zoning laws have prevented communities from developing in a more highly mixed-use pattern, as well.

The total real purchasing power of the federal fuel tax reached its zenith in 1977 and has declined ever since, despite several increases in tax rates.

Consequently, we do not truly know if people would trade off lower density where they live for longer commutes. We do not know how many would prefer greater density and shorter commute times to lower density and longer commute times. We do not know the degree to which people would trade off car size and house size if roads and transit were market priced to cover the true costs of these transportation modes. The true costs in a market context,

however, would probably be significantly different from the costs we see today in a government context.

For example, David T. Hartgen, a professor of transportation studies at the University of North Carolina at Charlotte and a former highway official, estimated that the amount of spending on new roadway required to end gridlock—the worst form of congestion—in most major urban areas nationally would be $413 billion, about 38 percent of already planned spending (which is not entirely funded).[55]

This estimate is based on an engineering analysis that would get the biggest congestion relief for the transportation dollar invested, something modern transportation planning is unlikely to accomplish. Planned spending and "needs based" studies produced by road agencies frequently misplace priorities and often do not represent true attempts to solve road congestion problems.[56]

Users of roadways use the roads as if they were free, when they are actually quite costly and getting costlier by the day.

Market mechanisms should not be used in an attempt to manipulate people into different choices, however. Instead, market mechanisms should be introduced where they have not previously been relied on so that people will make more efficient and beneficial choices for themselves and society at large.

Tolls Manage Demand

Thus far, the proposals discussed have largely addressed the issue of supply. Now we turn to the demand side of the equation. Arizona, especially in the Phoenix and Tucson areas, needs more roads, especially those of the high-speed, limited-access variety. But development patterns and peoples' choices of transportation mode have a way of filling up new roads. At the same time, there is a great deal of justifiable resistance to tax increases for the sake of building more roads. Oftentimes, roads are misplaced or badly configured for optimum performance. Finally, users of roadways use the roads as if they were free, when they are actually quite costly and getting costlier by the day. Toll roads can be at least a partial solution to all of these problems.

Half the people on the nation's highways during rush hour are not bound for work. A quarter of these drivers are retired.[57] There are many hours during the day when roads are not particularly congested, the same roads on which traffic comes to a standstill during rush hour. Building free roads to allow free-flow conditions during rush hour would be a little like "building the church for Easter Sunday." It is arguably wasteful to build for free-flowing conditions during rush hours on a road that would otherwise have sparse traffic.

Construction all by itself is therefore not the complete answer. A recent economic study by noted Brookings Institution transportation economists Clifford Winston and Ashley Langer showed that one dollar of highway spending in a given year only reduces congestion costs 11 cents. The conclusion these experts drew was that road pricing is needed to cost-effectively reduce congestion.[58] Congestion is a supply problem but also a demand problem. The problem is that everybody wants to use the roads at the same time. Many have no choice in when they use a road, but there are many others who could

reschedule their driving activities.

Any time something is priced too low, people waste valuable time waiting in line to get it, what has been characterized as the "Leninist concept of time rationing."[59] If phone companies did not drop the price of usage on nights and weekends, most everybody would talk during the week while the sun is up, clogging the system, while the lines would fall virtually silent otherwise. By applying the concept of congestion pricing—charging more during peak-use periods than during traditionally low-use periods—demand can be controlled and valuable commodities can be more effectively and efficiently managed. This is a common market-based pricing approach.

Even if road taxes completely fund a road, this funding scheme separates the driver using the road from the act of paying for it. The fact that the road is actually a commodity and that it costs something to use it might never even enter the driver's mind. Consequently, people who are not working help clog the road during rush hour, driving to activities that could be accomplished during a different part of the day.

The only way to make users take account of a valuable asset that can be congested is to price the asset in some way. For roads, that means tolls. By varying tolls over the course of a day, those who need to use a road to get to work at 8 a.m. are allowed to do so quickly, while others are discouraged from using the road during rush hour by a relatively high toll. During other parts of the day when demand is lower, tolls can be reduced significantly.

Here is an example of how tolls can help. It can be frustrating to drive on a busy interstate during rush hour surrounded by heavy freight trucks. Tolls can redirect truck traffic in two ways. First, congestion pricing can result in careful planning by freight truck drivers to avoid rush hour traffic and higher tolls. Tolls can help recover the full costs of providing the heavy-duty roads trucks require—a cost currently being borne by all drivers.[60] Tolls might even redirect some freight to railroads, potentially increasing overall economic well-being.

Road demand management through tolls can have a positive impact on air quality, as well. An ADOT study calculated that, after signal synchronization, congestion pricing would have the greatest impact on pollutant reduction in Phoenix. Since congestion pricing is not designed to discourage individual travel, it is not as cost-effective in reducing pollution on a per-ton basis as some other pollution-reducing measures such as telecommuting half-time, bus service using natural gas, or even vanpooling.[61]

The only way to make users take account of a valuable asset that can be congested is to price the asset in some way.

Tolling might have a positive impact on air quality because it can encourage people to use alternative means of travel by choice rather than by force. Carpooling might increase, and transit could become more attractive, as well.

Some object to the idea of tolls because they remember when tolls meant tollbooths, which were inconvenient and even dangerous, especially on a high-speed, limited-access highway. Modern technology has changed this. Small

transponders can now be easily mounted to vehicles, which are then detected by roadside electronic checkpoints when the vehicles pass by, charging the owner of the vehicle for use of the road. Owners can be billed, or they can maintain a balance in a personal account from which the toll is deducted. Photo enforcement is used to bill others who use the road. Of course, if billed, a road customer is charged more than if he or she had a balance.

Another objection to tolls is that they are a form of "double taxation." The reasoning is that we already paid for roads with gasoline and sales taxes; therefore, we should not have to pay for them again with a toll. The problem with this reasoning is, of course, that current sources of revenue do not come near paying for the full costs of roads. Fuel taxes per gallon are effectively falling. Inflation has ensured that we have all enjoyed a continuous gasoline tax rate reduction for 16 years. Total revenues might be rising, but compared with the costs of construction and maintenance, and factoring in needs of the rising population and traffic volume, they are not as high as people sometimes think. Cars have become more fuel-efficient, which means that people are able to drive farther for each cent of fuel tax paid.

Many states and nations are getting private enterprise involved.

Tolls Manage Supply, Too

Tolls also allow private companies to get more integrally involved in the provision of roads. Many states and nations are getting private enterprise involved through what are generically termed "long-term concession agreements," or simply "concessions." In essence, these are long-term leases. Public ownership is maintained, but companies pay substantial sums for the right to administer and receive the tolls on existing toll roads. They also agree to fund substantial portions of new toll roads for the same right. Oftentimes, these leases last decades. The companies act with the full knowledge that they are obligated to maintain the roads to exacting standards. Furthermore, if the company must build the road, it must build it to high standards.

Australia has taken the lead recently on private concession agreements, using tolls and concessions to finance new roads and real congestion solutions in Brisbane, Sydney, and Melbourne. India has recently moved in the same direction, with the national government agreeing in 2005 to use toll concessions to upgrade nearly 2,500 miles of national highway. France has seen suburban development similar to that in the United States and has pioneered long-term concessions for roads.[62] There, the Millau Viaduct, the tallest bridge in the world with the height of its cable support towers, is privately financed on a 75-year concession. The concessions model has also been developed and used in Argentina, Brazil, Britain, Canada, Chile, Germany, Greece, Ireland, Italy, Norway, Portugal, and Spain.[63]

In the United States, concessions have been used with Michigan's Detroit-Windsor Tunnel. California's highly successful SR 91 toll lanes were built as a concession and were proposed by a private company. Alabama's Foley Beach Expressway bridge has been leased by a private company. The Indiana toll road and Chicago's Skyway toll road have both been leased by private

companies. In Texas, a company signed a $1.3 billion lease, substantially financing the construction of a 40-mile toll road, for the right to collect the tolls. There are other concession proposals under consideration in Alaska, Colorado, Florida, Georgia, Illinois, Indiana, Missouri, Nevada, New Jersey, Ohio, Oregon, Pennsylvania, Texas, Utah, and Virginia.[64] Twenty-one states have passed legislation allowing for privatization of transportation assets.[65]

Concessions are desirable for several reasons. First, they allow access to large sources of private capital, and tolls are the key to that access. Goldman Sachs recently raised $6.5 billion for its new infrastructure fund.[66] U.S. Transportation Secretary Mary Peters says that $400 billion are available from all over the globe for transportation infrastructure investment in this country.[67] Tolls are the financial reward for private involvement and innovation. Roads are big investments that make sense from a private investor perspective when the result is a long-term revenue stream.

Second, because private companies are interested in maximizing revenues over the life of an asset, they have an interest in serving customers' needs. That is, a toll-collecting company will ensure that a new road is located where people actually want to travel and where it draws the most traffic, thereby targeting the investment where it is most needed and where it serves the purpose of moving traffic most effectively.[68]

Third, private companies are also interested in minimizing costs over the life of an asset. Consequently, private companies have a strong incentive to construct a road using high-quality techniques and materials to minimize maintenance costs over the life of the asset. A private company will not waste money on needless frills along the roadway but will make sure that the road asset will last the entire life of the lease.

Fourth, as financial partners, private companies bear some of the risk of big projects. One reason big projects repeatedly see cost overruns is that there is a lack of accountability in purely public projects. In fact, when companies are contracted to build large projects that involve finding new solutions, unless they have a financial stake in the success of the project, they have an incentive to underbid and come back for more funding later. Government has little choice but to ante up additional funds when they are requested because government officials do not want to leave a project a half-finished eyesore. Companies are more likely to be realistic and efficient when they bear the risk of costly errors.[69]

Twenty-one states have passed legislation allowing for privatization of transportation assets.

Fifth, private companies bring more talent to the road industry, and the profit motive provides incentives to innovate. In France, a 30-year impasse over how to close the A86 Paris ring road in the area of Versailles was settled when a private company proposed a concession to tunnel under the palace. Virginia has seen success with a private proposal to partially toll lanes that had been intended as HOV lanes but were not being built. When completed, this new capacity will be in place 30 years earlier than traditional funding would have allowed. Companies with special knowledge of how to get things done are encouraged to get involved and share their talent in an area that needs it.

Finally, congestion tolling is more accepted when it is practiced by private companies.[70] Private companies are less likely to be assailed over issues of fairness. We are used to being charged different prices at the movie theater depending on whether we go during the day or on Friday night. Airlines do not catch grief for charging more for a flight leaving Sunday than one leaving Monday.

Private companies have also shown interest in high-occupancy toll (HOT) lanes. High-occupancy vehicles (usually more than three or four passengers in a vehicle) travel the lanes for free; others pay to use the lanes. An ADOT study considered the cost-effectiveness of five alternatives for facilitating traffic on freeways through Phoenix. It found that, by far, the most cost-effective alternative was a HOT lane; the costliest alternative, by far, was light-rail.[71]

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Potential Toll Projects: New Centerline Miles

State policymakers are currently studying a possible bypass of Phoenix and Tucson as an alternative to I-10. It would be about 250 miles long, branching from I-10 west of Buckeye and joining the interstate again near Wilcox. The bypass would likely remove most of the through truck traffic making its way to and from California through the Phoenix and Tucson environs, with all the benefits of reduced congestion and pollution that come from reduced traffic. This wonderful idea could not come soon enough.

There is just one problem with the I-10 bypass, though: It might take 20 to 50 years to build. Even with this long-term time horizon, there is no funding identified for the currently estimated $6 billion to $8 billion needed to finance the road.[72]

A bypass of Phoenix and Tucson is a prime candidate for a long-term road concession agreement. The road would be entirely new, so there would not be the complaints that the tolls are "double taxation." It would also be open to any number of efficiency innovations that private companies could bring with them. Although the general alignment of the highway is and should be determined by state authorities, final consideration of alignment and which segments would be most feasible should be determined in cooperation with private vendors.

A brand-new highway through undeveloped territory could allow for innovative ways to provide travelers the services they need. For example, within the road's right-of-way, vendors could bid for long-term contracts to provide food, gasoline, and other goods and services.

The state might even consider eliminating or greatly reducing its fuel tax along the route, especially in more remote areas where surrounding residents cannot use the fuel concessions to avoid the tax. This would attract more traffic to the bypass, including trucks that might otherwise pass through the state without stopping. Arizona law already contains a provision for fuel tax rebates when a person uses a toll road.[73]

A long-term concession for new center-line miles is ideal for an I-10 bypass, but this is not the only possible candidate. There are

studies underway for I-17 alternatives, as well. Solutions are badly needed for I-17 north of Loop 101. Private companies should be solicited for proposals to bring solutions to that bottleneck, too.

The planned Loop 202 extension around South Mountain should also be concession tolled. This would allow for more immediate construction, and if a private company is allowed (as it should be) to finalize the plans, taking financial realities into account, their input on the road's alignment might make it more functional. With a private concession, the Gila River reservation might even be convinced that there is a financial benefit for them, thereby allowing an alignment that does not require as much disruption of already developed areas.

Potential Toll Projects: New Lane Miles

Even if a good deal of traffic is pulled off I-10, SR 51, and the loops in the Phoenix metro area—and even if the same were to occur in Tucson along I-10—congestion would still be a problem. These are all free roads, and they are going to remain free roads. That means there will be no incentive for people to spread trips out where they can—and there will always be a crowded rush hour.

Tolls and long-term concessions could help along preexisting corridors, as well. As mentioned above, for many years a loop around Paris, France, remained unfinished because Versailles, the palace of past kings and a historical treasure, stood in the way. Unbidden by the French government, a private company suggested a way to complete the circle, financed through a long-term concession. The tunnel under Versailles is now under construction.

In Houston, I-10 has been congested for years. Along its Texas-size median, new lanes are being constructed for bus and general vehicle traffic. Transit buses will travel with no tolls. Everyone else will pay, and the tolls will vary so that a bus trip will always be rapid. In this way, preexisting transit might become more cost-effective.

Houston's example could serve well for Phoenix, at least in some areas. It might well be that a vendor would be willing to construct new free lanes in exchange for the right to operate some existing lanes as tollways. Such lanes could be managed as HOT lanes—HOV lanes on which vehicles with fewer than a set number of occupants are charged a toll. (California's SR 91 is an example, as mentioned earlier.)

A long-term concession for new center-line miles is ideal for an I-10 bypass, but this is not the only possible candidate.

When I-10 was constructed through Phoenix, its placement in a tunnel restricted it from being widened. Could there possibly be a cost-effective solution to this problem? Maybe not, but there might perhaps be someone or a group of people with the imagination to devise a solution if an incentive, such as the prospect of profit, were present.

Solution 3: Privatize Transit

Privatized transit is flexible transit, whether it be conducted in a person's car or a taxi. The biggest problem with fixed-route transit is the unrealistic belief that people will inconvenience themselves to ride it. People have to gather from all over

the weblike pattern of a community and assemble at a loading point. Then they crowd themselves onto the conveyance with a bunch of strangers according to the system's schedule. The conveyance itself is often stark and uncomfortable. Then the users are left to their own devices to spread themselves out in a weblike pattern to their respective workplaces. No wonder so many people drive cars.

Far more convenient would be a legalized system of private transit, wherein individuals and companies could use vans and small buses to pick up riders. Instead of big buses on fixed routes and fixed schedules, inconveniencing riders and drivers alike, these small buses could be called on any time and virtually anywhere. They could pick people up at their houses and drop them off near or at their workplace. Like carpools, they could have regular groups of riders.

The biggest problem with fixed-route transit is the unrealistic belief that people will inconvenience themselves to ride it.

Vendors would have an incentive to keep their buses in shape to attract customers. Some might cater to certain clienteles. This type of service is available in many cities in the world and is known by many different names. In the United States, the service was common when affordable cars first appeared, but monopoly franchises running city trolley services lobbied to have this type of service made illegal.

Cities would have to establish ground rules, and they would probably need to provide some basic infrastructure for a private bus industry to thrive. They have every incentive to do so, because such privatized systems will help make public transit viable. If light-rail transit is ever to succeed as a true mass transportation system, it has to get people from stations to destinations more distant than most are willing to walk. Of course, with a private system of transit, the reasons for a fixed transit system could be largely satisfied. Unfortunately, cost-effective transit solutions do not have a history of acceptance by planners.

Solution 4: Stop Requiring the Arizona Department of Transportation to Purchase State Land

Currently, proceeds of state land sales are entirely dedicated to certain education funds. Therefore, it is illegal for the Arizona State Land Department to turn property over to other state agencies for any public purpose other than, perhaps, to build a public school or university. This is true even if the transfer would increase the value of surrounding state property. In essence, Arizona's schools and universities collectively own state lands, rather than the people of Arizona. Thus, ADOT (owned by the people) must use its scarce dollars to pay for land owned by the schools (owned by the people).

Minimally, the State Land Department should be authorized, with a change in the state constitution, to cede lands to other state agencies when the land will be put to public use for the indefinite future. Nothing comes closer to meeting this criterion than roads. A new road through an area also increases land values, so schools and universities would profit from this arrangement anyway.

Solution 5: Establish Performance Measures with Accountability

Any potential solution should be evaluated on the basis of cost-effectiveness. For example, how many tons of pollutants and how much congestion can be removed for a given amount of money? Given two otherwise equal options, the one that should prevail is the one that most reduces delay time per dollar spent. A similar strategy should be followed for pollution mitigation. The tough part is when a couple of million-dollar strategies have mixed results, with one better for congestion and the other better for pollution. That creates a quandary, but at least with objective metrics, we all know where we stand.

Transportation agencies, decision makers within them, and the companies they contract with should all be evaluated on performance criteria. These criteria cannot be something highly subjective and immeasurable on the order of "quality of life improvement." Instead, metrics such as accident rates, traffic signal delay time, delay time in general, and TTI's travel time index should be used to determine bonus payments or whether companies keep their contracts. Policymakers, even those who are elected, sharpen their focus when sound performance measures are put in place.

Solution 6: Synchronize Traffic Signals

The nation earns a C-minus in traffic signal timing operations and a D on general signal operations that include maintenance, management, and signal operation.[74] Individual city results are not available.

Phoenix's grid system lends itself to timing the traffic lights. In fact, the city currently has a traffic management center with an annual operating budget of $3.4 million and six employees.[75] Nevertheless, following the posted light-timed speed is not necessarily consistent with actual light timing on streets like Thomas. I-17 and Grand (Highway 60) create problems, too. These two thoroughfares make it particularly difficult to maintain timed lighting on the east/west streets. North/south streets' synchronization suffers where these streets intersect Grand, as well.

Synchronization affects more than just congestion time. An ADOT research report showed that, compared with several other options, signal synchronization would have the greatest total impact on pollution reduction in Phoenix. The research did not measure effects in Tucson due to lack of data.[76]

Signal synchronization would have the greatest total impact on pollution reduction in Phoenix.

Because Phoenix's large grid streets are arranged in one-mile blocks, they must be two-way streets. Two-way streets' traffic lights can be timed, but this can be tricky, especially if a left-turn signal is installed at some of the controlled intersections. Timing lights in one direction, however, is virtually a trivial exercise, although timing lights on east/west streets does not necessarily bode well for timing on north/south streets.

Phoenix should consider designating selected north/south streets whose lights will always be timed optimally for northbound traffic. Others would have their lights timed optimally for southbound traffic. Alternatively, optimal timing could vary by time of day. Rather than have

multidirectional middle lanes, as on 7th Street, that are confusing and result in accidents, northbound optimized streets could be marked with more northbound lanes, and vice versa. Of course, the same strategy could be used on east/west grid streets. This strategy would avoid confusion and accidents. Light timing would be easy to achieve and maintain. With signs and announcements, commuters would adjust their trips accordingly.

In Tucson, there are plans to optimize signal timing. Signal timing is a relatively inexpensive solution to traffic congestion, with big payoffs in time savings and pollution abatement. A well-managed city would make signal timing one of its highest priorities, especially considering the big return on investment.

Traffic volume on a one-way street can be up to 50 percent higher than on the same street in a two-way configuration.

Solution 7: Build Grade Separations

With the BNSF (Burlington Northern Santa Fe) railroad track running parallel to it and its orientation diagonal to compass headings, Highway 60 (Grand) presents a problem for traffic flow anywhere it is not grade separated, which is along most of its length through Phoenix. If the city makes a greater effort to time lights along certain main grid streets, it should devote resources to grade separating those streets from both Grand and the railroad. Almost $6 billion over the next 20 years would be far better spent on grade separations than on light-rail.

Tucson has plans to grade-separate many of its streets from the railroad that runs through the city. It too, however, has plans for an enlarged government transit system and should redirect these resources to more effective transportation solutions.

Solution 8: Convert Streets to One-Way

Traffic volume on a one-way street can be up to 50 percent higher than on the same street in a two-way configuration. Accidents and travel times often drop by 10 to 50 percent. Slowdowns and stops are reduced, and the need for left-turn lanes is eliminated. Average speed increases, but top speeds do not.[77]

One-way streets do pose their own challenges and can be confusing to anyone new to an area. Nevertheless, the advantages would seem to outweigh the costs where streets can be practicably made one-way. In Phoenix, the only streets that are good candidates for one-way designation are downtown and many of them already are one-way. The main grid streets are not good candidates because of their one-mile distances from each other and the long loops that would be required should someone miss a turn. Tucson, on the other hand, as well as other communities in the state, has more opportunities.

Unfortunately, many planners and other activists prefer two-way streets. They argue that one-way streets are less pedestrian friendly. Traffic that is stop-and-go gives pedestrians more opportunities to cross a street, they claim. However, one-way streets are still traffic-controlled at intersections and require pedestrians to look only in one direction when they cross. Cities with one-way streets should keep them and expand them where possible.

Solution 9: Implement Smart Road Technology

At its simplest, smart road technology merely involves installing electronic signage that updates drivers regarding upcoming road conditions. Such signs are already in use in Phoenix. This practice presumes there are viable alternative routes that drivers could take, once they are informed of delays in front of them. To some extent, this function is also already accomplished with radio-broadcast traffic reports. However, implemented properly, dynamic highway signage could be updated in an even more timely manner than is achieved through radio broadcasts, although there are always limits on real-time information.

Dynamic signage can include large billboard-sized signs that inform drivers of time to a major intersection, accidents, and upcoming or ongoing construction. It can also include small indicators mounted on overpasses that inform drivers that a lane is closed ahead. These systems allow drivers to anticipate traffic conditions, benefiting themselves as well as other drivers around them.

One potential use of signage could be to require the railroad to post, in advance, when it intends to block streets like McDowell during rush hours. It seems reasonable that commuters should be informed at least 24 hours in advance of such blockages. This would allow commuters to plan a different route. In addition, this does not restrict the railroad from using the right-of-way that it rightfully owns.

Solution 10: Adopt Truck Lane Restrictions

Along limited-access highways with three or more lanes, trucks can be restricted to the two right lanes with some safety and traffic-flow benefits.[78] This strategy has been implemented in Florida, South Carolina, Tennessee, and Texas. Especially through Phoenix, this is a policy that would have the potential to move traffic more quickly, especially during rush hours.

Solution 11: Build Only General-Purpose Lanes

A 2002 study conducted by Cambridge Systematics for the Minnesota Department of Transportation yielded some interesting results regarding HOV lanes. The Minnesota legislature had requested a study to determine the effects of opening existing HOV lanes to general-purpose traffic along I-394 in the Minneapolis-St. Paul area. To conduct the study, the intention had been to open the HOV lanes to general traffic and study the results. The U.S. Department of Transportation's Federal Highway Administration (FHWA) stepped in, however, and threatened to pull federal transportation funds from the state if such action was taken, apparently even for the purposes of a short-term experiment.

A 2002 study conducted for the Minnesota Department of Transportation yielded some interesting results regarding HOV lanes.

Nevertheless, a study was conducted using modeling techniques, actual field data, and statistics from corridors with HOV lanes throughout the nation. The findings follow.

- HOV lanes allow carpoolers and bus riders to have faster commutes.

- HOV lanes carry about 50 percent more commuters than general-purpose lanes do.

- At most, 25 percent of HOV lane users would switch to driving alone if the HOV designation were removed.

- Converting the HOV lanes to general-purpose lanes would increase throughput, both per person and per vehicle. In other words, traffic movement would improve.[79]

One has to wonder what was so dangerous, from the federal perspective, in allowing the actual field experiment to occur. It is also interesting to note that congestion along the corridors is expected to increase markedly in the future, making it obvious that HOV lanes are not about relieving congestion. Finally, despite the fact that the study estimated net benefits from converting HOV lanes to general-purpose lanes, it was still recommended that HOV lanes be maintained.

Responses to the state's traffic problems must reflect the reality that people prefer the flexibility and autonomy provided by cars.

HOV lanes, which are being added to Loop 101 in Phoenix, represent a social policy rather than a transportation policy. The best way to get traffic moving would be to add general-purpose lanes, and the best way to get these funded and constructed in an efficient manner would be through the use of tolls.

Conclusion

Arizona's traffic is bad and getting worse. The costs of congestion are enormous. Arizona needs transportation solutions now. The state must act quickly to get more pavement on the ground and to revamp how roads are financed.

There is no magic bullet. Too often, policymakers promise more than they can ever possibly deliver, or the latest fad is promoted as an easy solution. Real solutions involve new ways of thinking. Many of the solutions offered above are new to Arizona, but they have been tried elsewhere throughout the world and are solving real transportation problems right now.

Responses to the state's traffic problems must reflect the reality that people prefer the flexibility and autonomy provided by cars. Efforts at social engineering and expensive transportation fads should be avoided.

Market forces have a role to play. They can help stimulate investment and manage demand. Arizona drivers—indeed, drivers everywhere—seldom take into account the real costs of the commute decisions they make. Potential problem-solvers in the private sector need incentives to bring their potential solutions forward.

Economic development is good, and traffic is an inescapable byproduct. Increased traffic is not the problem, but unrealistic responses to traffic cause problems. Everybody can win if human ingenuity is fully harnessed and market incentives are allowed to work.

Let's put Arizona on the map as the nation's leader in traffic solutions.

APPENDIX A

The following table shows how the indexes used to construct Figures 1, 2, and 3 were derived. The values in each column in the top half of the table were divided by the earliest available value in the column (1994 for Phoenix and Tucson; 1996 for Flagstaff). The results yield the index numbers in the bottom half of the table, graphed in Figures 1, 2, and 3.

	Tucson			Phoenix			Flagstaff	
	Reported Actuals			Reported Actuals			Reported Actuals	
Year	Delay	VMT	Lane Miles	Delay	VMT	Lane Miles	Daily VMT	Miles
1994	6583	9090	1685	34403	37000	5780		
1995	6951	9725	1740	33292	38800	5890		
1996	7467	9920	1765	39707	40565	6010	1,001	263
1997	9765	10760	1785	42367	41425	6130	959	272
1998	10347	11090	1800	45878	43030	6200	1,016	274
1999	10558	11365	1810	53403	45595	6275	1,036	272
2000	11026	11775	1835	55077	48525	6485	1,178	276
2001	12075	12360	1855	62148	51325	6760	1,181	277
2002	12986	12620	1855	60212	53065	7030	1,199	277
2003	15340	13390	1880	63754	56035	7325	1,273	301
2004	15501	13745	1890	68260	58780	7580	1,612	302
2005	17011	14640	1920	81727	62475	7940	1,619	306
	Index Values			Index Values			Index Values	
Year	Delay	VMT	Lane Miles	Delay	VMT	Lane Miles	Daily VMT	Miles
1994	1.00	1.00	1.00	1.00	1.00	1.00		
1995	1.06	1.07	1.03	0.97	1.05	1.02		
1996	1.13	1.09	1.05	1.15	1.10	1.04	1.00	1.00
1997	1.48	1.18	1.06	1.23	1.12	1.06	0.96	1.03
1998	1.57	1.22	1.07	1.33	1.16	1.07	1.01	1.04
1999	1.60	1.25	1.07	1.55	1.23	1.09	1.03	1.03
2000	1.67	1.30	1.09	1.60	1.31	1.12	1.18	1.05
2001	1.83	1.36	1.10	1.81	1.39	1.17	1.18	1.05
2002	1.97	1.39	1.10	1.75	1.43	1.22	1.20	1.05
2003	2.33	1.47	1.12	1.85	1.51	1.27	1.27	1.14
2004	2.35	1.51	1.12	1.98	1.59	1.31	1.61	1.15
2005	2.58	1.61	1.14	2.38	1.69	1.37	1.62	1.16

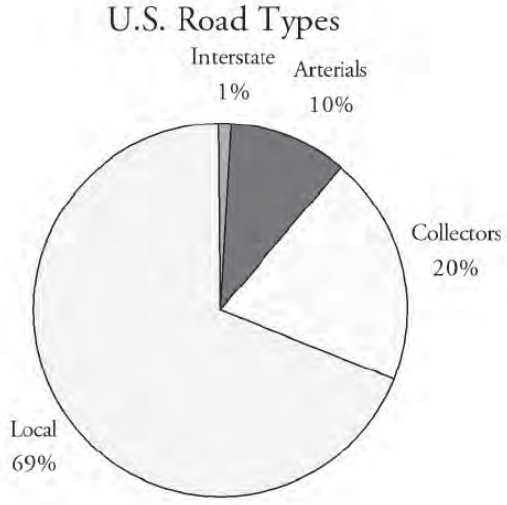
Sources: Texas Transportation Institute, http://mobility.tamu.edu/ums/congestion_data/tables/phoenix.pdf and http://mobility.tamu.edu/ums/congestion_data/tables/tucson.pdf, and
Federal Highway Administration, Highway Statistics, http://www.fhwa.dot.gov/policy/ohpi/hss/hsspubs.htm

APPENDIX B

Arizona is geographically the sixth-largest state in the United States but only 17th in population. It has approximately 59,789 miles of roadway. Of these, 1,169 miles (1.9 percent of the total) are interstate; 5,876 miles (9.8 percent) are arterial roads; and 8,163 miles (18.3 percent) are collector roads. The bulk of road miles in any state are in local roads. On average in the United States, 69 percent of public road miles are local. Arizona has 44,581 miles (74.5 percent) of these.[80]

Compared with the other states, Arizona has a slightly higher-than-average percentage of interstate and local roads. It has a significantly lower-than-average percentage of collector roads.

Take a look at a collection of state road maps, and it becomes obvious that Arizona has relatively few miles of roadway relative to its land area.

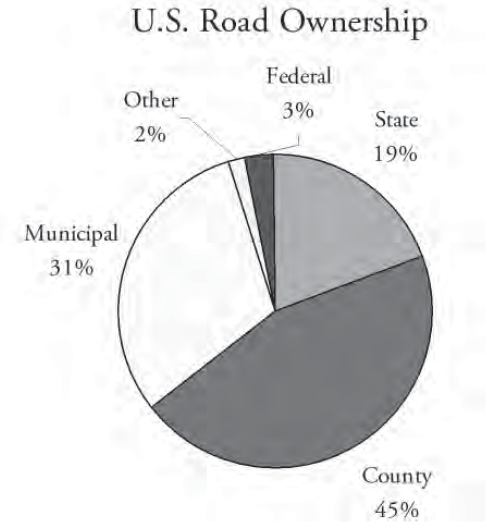


Source: Bureau of Transportation Statistics, State Transportation Statistics, December 2006.

In terms of road ownership, nearly 22 percent of Arizona's roads are federally owned, much higher than the national average of 3 percent. About 11.4 percent of Arizona's road mileage is state-owned, compared with the national average of 19.5 percent. Counties in Arizona own about 31.6 percent of the state's road mileage, far short of the nation's average of 44.6 percent.[81]

As a consequence of the state's land ownership patterns and the fact that federally funded water projects allow for dense development, more than 88 percent of Arizona's population is urban, making Arizona more urbanized than New York State.[82] Consequently, Arizona's transportation problems are mostly urban.

The skewing of road ownership and type in Arizona is a product of two key elements. First, Arizona's natural geography discourages settlement in many areas. There would naturally be fewer small settlements in Arizona – the basis for an extensive collector road system like Texas' farm and ranch road system. Second, only about 15



Source: Bureau of Transportation Statistics, State Transportation Statistics, December 2006.

percent of the state's landmass is privately owned. Twenty-four percent is occupied by Native American reservations, roughly 13 percent is state owned, and nearly 50 percent is federally owned.[83]

Government ownership of more than 60 percent of the state's landmass would be less of a problem if the government's land were contiguous. The reality is that the tribal reservations, federal lands, and state lands are spread out in large and small irregularly shaped patches throughout the state. Reservations border the Phoenix metro area on the east and south, geographically constricting development and forcing greater density.

Another unnatural stricture is the land grant system. Much of the state's property is still in the railroad land grant checkerboard pattern, creating access problems and discouraging its sale. Some is even entangled with federal lands. As a result of the abuse of railroad land grants, the Arizona constitution's limits on the disposition of state lands are quite strict. The state cannot even grant itself property for public use. This has undoubtedly delayed development in some areas of the state.

NOTES ON TERMINOLOGY

An *arterial road* is a highway, or in urban areas a road, that moves traffic from one distinct area to another. Arterial roads generally have speed limits greater than those of neighborhood roads.

A *collector road* is one that moves traffic to arterials, often connecting neighborhoods and sections of neighborhoods. In rural areas, most country roads would be considered collectors because of their light traffic.

Local roads are neighborhood roads and are mostly urban.

NOTES

1. Cambridge Systematics (in association with Battelle Memorial Institute), An Initial Assessment of Freight Bottlenecks on Highways, Federal Highway Administration, October 2005, pp. 5-10, http://www.fhwa.dot.gov/policy/otps/bottlenecks/bottlenecks.pdf.

2. David Shrank and Tim Lomax, The 2007 Urban Mobility Report, Texas Transportation Institute, Texas A&M University, September 2007, pp. 32-35, http://tti.tamu.edu/documents/mobility_report_2007_wappx.pdf.

3. Michael Clancy, "$6 Bil Needed to Build, Maintain Phoenix Roads," Arizona Republic, October 12, 2007.

4. Calculated using total states' total surface area and U.S. Department of Transportation, Research and Innovative Technology Administration, Bureau of Transportation Statistics, State Transportation Statistics, 2006, Table 1-2, "Public Road Length, Miles by Ownership: 2005," December 2006, p. A-2, http://www.bts.gov/publications/state_transportation_statistics/state_transportation_statistics_2006/pdf/entire.pdf.

5. U.S. Census Bureau, The 2008 Statistical Abstract of the United States, Table 13, "State Population—Rank, Percent Change, and Population Density: 1980 to 2006," p. 18, http://www.census.gov/compendia/statab/2008edition.html.

6. U.S. Census Bureau, The 2007 Statistical Abstract, Tables 12-14, pp. 17-19, http://www.census.gov/prod/2007pubs/08abstract/pop.pdf.

7. Maricopa Association of Governments, Regional Transportation Plan: 2007 Update, Phoenix, July 2007, p. 3-4, and author's calculations.

8. Bureau of Transportation Statistics, State Transportation Statistics, 2006, Table 1-1, "Public Road Length, Miles by Functional System: 2005," p. A-1, http://www.bts.gov/publications/state_transportation_statistics/state_transportation_statistics_2006/pdf/entire.pdf; U.S. Department of Transportation, Research and Innovative Technology Administration, Bureau of Transportation Statistics, Arizona Transportation Profile, 2002, Table 1-1, "Arizona Public Road Length, Miles by Functional System: 1995-2000," p. A-1, http://www.bts.gov/publications/state_transportation_statistics/arizona/index.html; U.S. Department of Transportation, Federal Highway Administration, Table HM-48, "Federal-Aid Highway Lane—Length," in Highway Statistics 2000 and Highway Statistics 2005, http://www.fhwa.dot.gov/policy/ohpi/hss/hsspubs.htm.

9. Data presented similarly to figures in John Semmens, The Cost of Traffic Congestion in Arizona's Metropolitan Regions, Arizona Transportation Research Center, unpublished manuscript, April 2007.

10. Shrank and Lomax, The 2007 Urban Mobility Report, p. A-23.

11. Ibid, pp. 32-35.

12. Cambridge Systematics (in association with Battelle Memorial Institute), An Initial Assessment of Freight Bottlenecks on Highways, Federal Highway Administration, October 2005, p. 5-10, http://www.fhwa.dot.gov/policy/otps/bottlenecks/bottlenecks.pdf.

13. Austin, Texas, ranks as the worst among cities roughly Tucson's size.

14. Shrank and Lomax, The 2007 Urban Mobility Report, pp. 32-35.

15. Road volume and travel are measured differently for Flagstaff, using daily vehicle miles traveled instead of total miles for the year. Nonetheless, the measures are analogous to those for Tucson and Phoenix.

16. See U.S. Department of Transportation, Federal Highway Administration, "Freight Analysis Framework: North American Interchange on Transportation Statistics," http://ops.fhwa.dot.gov/freight/presentations/na_interchange.htm, for a series of maps showing truck and rail movement volumes graphically.

17. Shrank and Lomax, The 2007 Urban Mobility Report, p. 3.

18. Ibid, p. 27.

19. Ted Balaker and Sam Staley, The Road More Traveled: Why the Congestion Crisis Matters More Than You Think, and What We Can Do About It, New York: Rowman & Littlefield Publishers, 2006, pp. xiii-xix.

20. Ibid, pp. 28-29.

21. Wilbur Smith Associates, The National I-10 Freight Corridor Study—Final Report: Summary of Findings, Strategies, and Solutions, Houston, Texas, May 6, 2003, pp. 3-12, http://www.i10freightstudy.org/assets/Final%20Report.pdf. See Federal Highway Administration, "Freight Analysis Framework," for maps illustrating expectations.

22. Maricopa Association of Governments, Regional Transportation Plan: 2007 Update, pp. 7-8, 8-1 through 9-11, 20-8.

23. A centerline mile is a mile of right-of-way. A lane mile is a mile of a single lane. A mile of road with six lanes is one centerline mile and six lane miles.

24. Pima Association of Governments, "Regional Transportation Plan Projects," pp. 14 and 49. See also http://www.pagnet.org/documents/RTP/RTP2030/Adopted2030RTPProjectListsAmended.pdf.

25. Adrian Moore, Reason Foundation, "Private Transportation and Competition," testimony before U.S. House Subcommittee on Energy Policy, Natural Resources and Regulatory Affairs Committee on Government Reform, May 18, 2004, http://www.reason.org/commentaries/moore_20040518.shtml.

26. Balaker and Staley, The Road More Traveled, p. 45.

27. Robert W. Poole, Jr., "Urban Transit Derailed," commentary, Georgia Public Policy Foundation, August 24, 2007, http://www.gppf.org/article.asp?RT=&p=pub/Transportation/Transit/railbenefits070817.htm.

28. Balaker and Staley, The Road More Traveled, pp. 77-100.

29. Ibid, pp. 44 and 47.

30. Randal O'Toole, The Best Laid Plans: How Government Planning Harms Your Quality of Life, Your Pocketbook, and Your Future, Washington, D.C.: Cato Institute, 2007, p. 251.

31. Federal Transit Administration and Regional Public Transportation Authority, Final Environmental Impact Statement for the Central Phoenix/East Valley Corridor: Phoenix, Tempe, Mesa Arizona, November 2002, p. S-18. Table S-9 shows a 1.23 percent increase in vehicle hours of travel, meaning that light-rail will increase the amount of time drivers spend in their cars.

32. Maricopa Association of

Governments, Regional Transportation Plan: 2007 Update, p. 3-7.

33. Federal Highway Administration, Highway Statistics 2005, Table HM-72, "Urbanized Areas – 2005: Selected Characteristics," updated October 2006, http://www.fhwa.dot.gov/policy/ohim/hs05/htm/hm72.htm.

34. See Valley Metro Rail, "Transit-Oriented Development," http://www.valleymetro.org/METRO_light_rail/About_Light_Rail/Transit_Oriented_Development/index.htm.

35. Margy Waller, "High Cost or High Opportunity Cost? Transportation and Family Economic Success," Center on Children and Families Working Paper, Brookings Institution, http://www.brookings.edu/views/papers/20051128waller.pdf.

36. Cabela's has a state strategy to seek favorable government treatment in the name of economic development. See Good Jobs First, "Case Study of Cabela's Inc.," http://www.goodjobsfirst.org/corporate_subsidy/cabela.cfm.

37. Valley Metro Rail, "Contract History," http://www.valleymetro.org/METRO_light_rail/Contracts_&_Purchasing/CONTRACT%20HISTORY%20072307%20posting.pdf.

38. Arizona Department of Transportation, I-10 Phoenix-Tucson Bypass Study: Preliminary Findings, presentation to Arizona State Transportation Board, November 5, 2007, http://www.azdot.gov/Board/PDF/Transportation_Board_Study_Session_Presentation_110507.pdf.

39. Maricopa Association of Governments, Regional Transportation Plan: 2007 Update, p. 10-12.

40. Matthew Rowell, Rederic Buonincontri, and John Semmens, The Cost Effectiveness and Magnitude of Potential Impact of Various Congestion Management Measures, Arizona Department of Transportation, FHWA-AZ-97-453, March 1997, pp. 40-41.

41. Luke T. Johnson, "China's Auto Mania: World Carfree Day in Beijing? Are You Kidding?" The Tyee, October 10, 2007, http://thetyee.ca/News/2007/10/10/ChinaAutoMad/.

42. Agence France-Presse, "Car Use Soars in Europe as Road Deaths Fall," Space Mart, September 19, 2006, http://www.spacemart.com/reports/Car_Use_Soars_In_Europe_As_Road_Deaths_Fall_999.html.

43. "Hyundai Plans to Build $400 Million Plant in Russia," Manufacturing.Net, December 17, 2007, http://www.manufacturing.net/article.aspx?id=153384.

44. See Federal Highway Administration, "Freight Analysis Framework," for map illustrating exceeded capacities.

45. "I-10 Bypass May Be a Part of S. Arizona Future," editorial, Arizona Daily Star, November 6, 2007.

46. Shrank and Lomax, The 2007 Urban Mobility Report, pp. B-23 through B-26.

47. For background, see J. Craig Anderson, "Gila River Tribe Stands Firmly against Loop 202: Official Rebuts Reports Reservation Will Have Freeway," The Tribune (Mesa), November 20, 2006, http://www.redorbit.com/news/business/737190/gila_river_tribe_stands_firmly_against_loop_202_official_rebuts/index.html#, and Mel Meléndez, "Rerouting Loop 202 Could Stifle Laveen Development," Arizona Republic, Valley & State online print edition, August 21, 2005, http://

www.azcentral.com/arizonarepublic/local/articles/0821loop21.html#.

48. Balaker and Staley, The Road More Traveled, p. 55.

49. See U.S. Environment Protection Agency, "Air Trends," http://www.epa.gov/airtrends/index.html.

50. Arizona Department of Transportation, I-10 Phoenix-Tucson Bypass Study.

51. Luige del Puerto, "Transportation Chief: Road Funding System Is 'Broken,'" Arizona Capitol Times, September 14, 2007.

52. Based on calculations using the Consumer Price Index and data from Jonathan Williams and Scott A. Hodge, "State and Federal Treasuries 'Profit' More from Gasoline Sales Than U.S. Oil Industry," Fiscal Facts, Tax Foundation, October 26, 2005, http://www.taxfoundation.org/publications/show/1139.html.

53. Debra K. Davenport, Auditor General, Arizona Department of Transportation-Highway Maintenance, Performance Audit, Report No. 07-03, June 2007, p. 27.

54. Clancy, "$6 Bil Needed to Build, Maintain Phoenix Roads

55. Balaker and Staley, The Road More Traveled, pp. 10-11.

56. John Semmens, "De-Socializing the Roads," in Gabriel Roth, ed., Street Smart: Competition, Entrepreneurship, and the Future of Roads, Oakland, Calif.: Independent Institute, 2006, pp. 25-42.

57. Luige del Puerto, "Transportation Chief: Road Funding System Is 'Broken.'"

58. Clifford Winston and Ashley Langer, "The Effect of Government Highway Spending on Road Users' Congestion Costs," AEI-Brookings Joint Center for Regulatory Studies Working Paper 06-11, May 2006.

59. Joseph M. Giglio, Mobility: America's Transportation Mess and How to Fix It, Washington, D.C.: Hudson Institute, 2005, p. 6.

60. Freight trucks are effectively subsidized by about 10 percent when current freight industry road taxes are compared to costs incurred due to freight. See U.S. Department of Transportation, Federal Highway Administration, 1997 Federal Highway Cost Allocation Study: Summary Report, August 1997, http://www.fhwa.dot.gov/policy/hcas/summary/.

61. Rowell, Buonincontri, and Semmens, The Cost Effectiveness and Magnitude of Potential Impact of Various Congestion Management Measures.

62. Balaker and Staley, The Road More Traveled, pp. 103-122.

63. Robert Poole, Reason Foundation, "Public-Private Partnerships for Toll Highways: States Increasingly Turning to Toll Finance, PPPs to Begin Filling the Transportation Funding Gap," testimony to Congress, February 13, 2007, http://www.reason.org/commentaries/poole_20070213.shtml.

64. Leigh Ferrara, "Who's Buying Your Commute? A State-by-State Tally of Highway Privatization Projects in the Works," Mother Jones, January 1, 2007, http://www.motherjones.com/news/feature/2007/01/highwaymen_states.html.

65. Alexis Perrotta, Proceed with Caution: Ground Rules for a Public Private Partnership in New Jersey, Trenton, N.J.: Regional Plan Association, January 8, 2007, pp. 2-3.

66. Perrotta, Proceed with Caution.

67. U.S. Dept. of Transportation, "Over $400 Billion Available Today for Road, Bridge and Transit Projects U.S. Secretary of Transportation Mary E. Peters Announces," Press Release DOT 43-08, Wednesday, March 26, 2008, http://www.dot.gov/affairs/dot4308.htm.

68. For example, a private company would probably not plan the western Loop 202 extension to intersect I-10 at 55th Avenue. It does not interface well with Loop 101, and it may lead to increased congestion along I-10 between 55th Avenue and Loop 101.

69. Bent Flyvbjerg, with Nils Bruzelius and Werner Rothengatter, Megaprojects and Risk: An Anatomy of Ambition, Cambridge, UK: Cambridge University Press, 2003.

70. Peter Samuel, The Role of Tolls in Financing 21st Century Highways, Los Angeles: Reason Foundation, Policy Study 359, May 2007, http://www.reason.org/ps359.pdf.

71. Brennan Kidd, Multimodal Optimization of Urban Freeway Corridors, Arizona Department of Transportation, FHWA-AZ-06-582, November 2006.

72. "I-10 Bypass May Be a Part of S. Arizona Future," Arizona Daily Star, November 6, 2007.

73. Title 28, Chapter 22, Arizona Statutes, Subsection 28-7749. "Tax Refund or Credit," http://www.azleg.state.az.us/FormatDocument.asp?inDoc=/ars/28/07749.htm&Title=28&DocType=ARS.

74. National Transportation Operations Coalition, National Traffic Signal Report Card: Executive Summary, 2007, http://www.ite.org/reportcard/NTSRC%20Exec%20Summary%20final.pdf.

75. Ron Doubek, traffic signal engineer, City of Phoenix, telephone interview, January 2, 2008.

76. Rowell, Buonincontri, and Semmens, The Cost Effectiveness and Magnitude of Potential Impact of Various Congestion Management Measures, pp. 40-41.

77. Balaker and Staley, The Road More Traveled, pp. 157-158.

78. Texas Department of Transportation, "State Approves More Interstate 35 Truck Lane Restrictions," news release, March 5, 2007

79. Cambridge Systematics (with URS), Twin Cities HOV Study: Executive Summary, prepared for the Minnesota Department of Transportation, February 2002, http://www.dot.state.mn.us/information/hov/pdfs/hov_execsum.pdf.

80. Bureau of Transportation Statistics, State Transportation Statistics, 2006, Table 1-1, "Public Road Length, Miles by Functional System: 2005."

81. Bureau of Transportation Statistics, Table 1-2, "Public Road Length, Miles by Ownership: 2005."

82. U.S. Census Bureau, The 2007 Statistical Abstract: The National Data Book, Table 33, p. 36

83. See National Atlas of the United States of America, "Arizona," http://nationalatlas.gov/printable/images/pdf/fedlands/az.pdf, for a map of the state's federal and reservation lands.

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