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AUDIT OF THE

MARICOPA ASSOCIATION OF GOVERNMENT'S (MAG)

TRANSPORTATION PROGRAM 2025

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CONTENTS

EXECUTIVE SUMMARY

Arizona law requires the Maricopa Association of Governments (MAG) to develop a regional transportation plan every five years describing how funds will be spent on highways, transit, and other transportation facilities.[1] The law also requires the state auditor general to audit each plan's performance. The law specifically requires the auditor to look at light rail service levels, costs, ridership, and farebox revenues, as well as the effects of the plan on congestion and mobility.[2] The last audit was published in 2021 so the next audit should be under way. Here are issues that the auditor general should consider.

First, Phoenix's light-rail system has failed by almost every measure. Transit ridership was rapidly growing before the first light-rail line opened at the end of 2008. The opening of the light rail halted this growth. Bus plus rail ridership in 2019 was 7 percent lower than in 2009 despite a 39 percent increase in light-rail route miles. Much of this drop was due to cutbacks in bus service to cover light-rail costs.

Transit ridership is low because light rail reaches just three of ten major economic centers in the Phoenix urban area that have 40,000 or more jobs, plus one of seven minor centers with 10,000 to 25,000 jobs. MAG light-rail plans call for it to reach only one more center but the one with the fewest jobs. Transit carries more than 3 percent of commuters only to downtown and the university; less than 1.3 percent of workers in the remaining economic centers take transit to work, not that light rail would help as Phoenix light rail is so slow that it wouldn't attract many commuters out of their cars.

The rate of growth of traffic congestion doubled after the opening of Phoenix's first light-rail line. Regional mobility has dropped, as the share of the region's jobs reachable by people in a fixed amount of time has declined whether people are driving, taking transit, or riding bicycles.

Phoenix's transit system is such a failure that 88 percent of workers who live in households without cars didn't ride transit to work in 2023. Rather than respond to the pandemic-induced shifts in travel that appear to have permanently depressed transit ridership by some 40 percent, MAG continues to plan more light-rail lines.

If MAG is too focused on light rail to see that its transit plans aren't working, its approach to bicycling and walking is more of an unaimed scattershot. MAG has been spending hundreds of millions of dollars on "active transportation," yet its goals are unclear and it has made no attempt to ensure that its spending is cost-effective.

For example, MAG's 2025-2030 transportation improvement plan calls for spending about a fifth of the region's active transportation funds on a 3rd Street pedestrian bridge across the Rio Salado. On one hand, this is practically a bridge to nowhere. On the other hand, the Central Avenue bridge, just three blocks away, already has wide sidewalks.

Meanwhile, urban Maricopa County saw record numbers of bicycle and pedestrian fatalities in 2022 and only a few less in 2023. MAG has done little to reduce those fatalities, and some of its projects, such as putting bike lanes on arterial streets, may increase them. MAG should make safety the primary goal of its active transportation program and spend that program's funds on cost-effective safety projects, not bridges to nowhere.

This paper concludes with recommendations for reforming the region's transit system and questions the state auditor general should ask when looking at MAG's transportation plans and programs.

MAG'S TRANSPORTATION VISION HAS FAILED

In the past 25 years, the Maricopa Association of Governments has spent or overseen the expenditure of nearly $4 billion on planning, designing, engineering, and constructing light rail. It has also spent or overseen hundreds of millions of dollars on bicycle and pedestrian facilities.

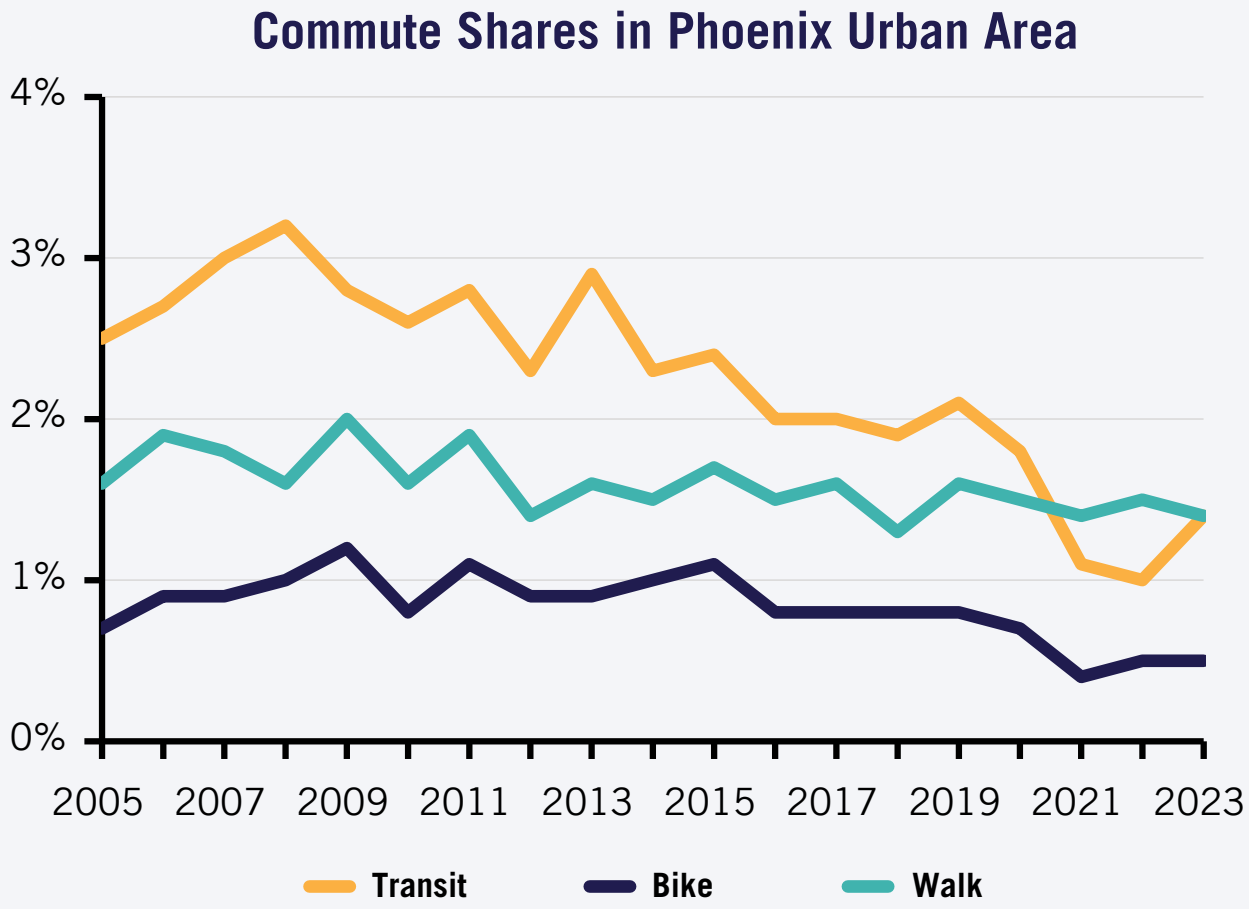

Figure 1: *Despite MAG spending billions on transit and hundreds of millions on walking and cycling, the shares of those methods of commuting have significantly declined. Source: American Community Survey for 2005 through 2023, table B08301, for the Phoenix urban area. The Census Bureau did not do a complete American Community Survey in 2020, so 2020 numbers are based on the average of five years of data, i.e., 2016-2020. The actual numbers in 2020 were probably closer to the numbers shown here for 2021 than the 2020 numbers.*

The goal of this spending has been to reduce congestion and increase mobility by boosting transit ridership, bicycling, and walking. Instead, all three have declined as forms of commuting while transit ridership, at least, has declined overall. In transit's case, this decline can be traced directly to the effects of light rail. The region's congestion has significantly increased and mobility, whether by auto, transit, or bicycle, has been reduced.

Between 2000 and 2019, all the money MAG spent on transit and the efforts it made to promote walking and cycling barely moved the needle on the region's transportation choices for commuting, and where the needle did move it was in the opposite direction from what MAG wanted (figure 1). Improvements in bus service boosted transit's share of commuting to a peak in 2008, but after the first light-rail line opened it declined and by 2016 had fallen below the share before 2005. After 2017, the introduction of Uber & Lyft increased taxi's share (which includes ride sharing), which may have come partly at transit's expense. Working at home more than doubled before the pandemic, coming at the expense of carpooling, walking, and bicycling, all of which declined.

Figure 1 shows that, between 2008 and 2019, the share of workers in the Phoenix urban area who commute to work by transit, walking, and cycling all declined. Figure 2 shows that transit ridership peaked in 2009 and then stagnated or dropped. These numbers are indications that MAG needs to completely reevaluate its transportation plans. Yet the agency's latest plans are simply more of the same. ■

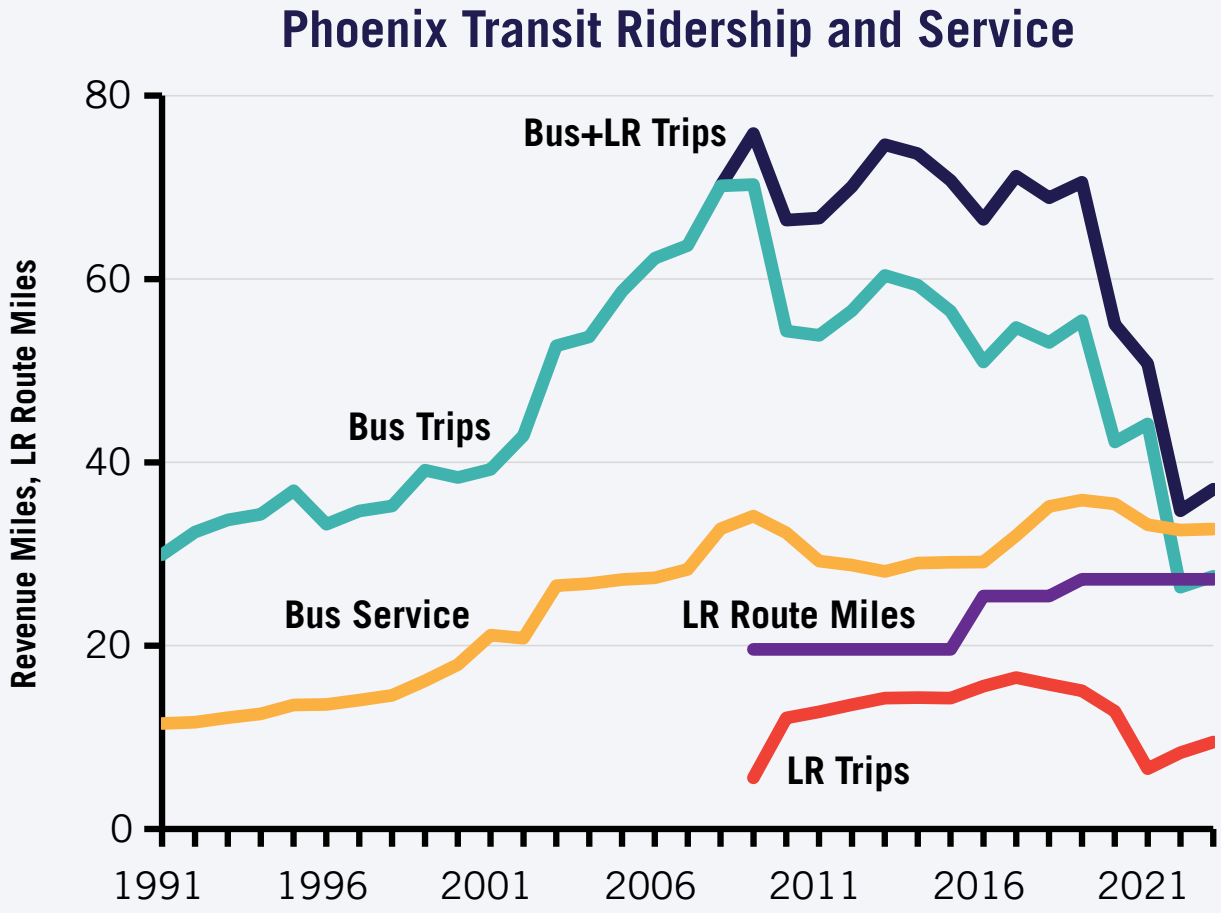

Figure 2: *Ridership, bus service miles, and light-rail route miles from 1998 through 2023. Ridership plunged after the first light-rail line opened and never recovered. Source: National Transit Database.*

THE FAILURE OF LIGHT RAIL

From 1998 to 2009, Phoenix had some of the fastest-growing transit ridership in the nation, with ridership increasing by more than 7 percent per year.[3] During the same time period, driving grew by less than 4 percent per year.[4] Ridership growth was a response to increased bus service, which grew from 14.6 million vehicle-miles in 1998 to 34.1 million in 2009.[5]

Although ridership was growing, transit remained insignificant compared to auto driving in the region. As of 2009, the average resident of the Phoenix-Mesa-Scottsdale urban area traveled 126 times as many miles by automobile as they did by mass transit.[6] Transit's share of commuting in the urban area peaked in 2008 at 3.2 percent and was even smaller in the rest of Maricopa County.[7]

The increase in ridership did not come for free. Between 1998 and 2009, inflation-adjusted Phoenix bus operating costs grew by 272 percent, from $64 million in 1998 to $239 million in 2009 (all dollars cited in this paper are adjusted for inflation using gross national product price deflators[8]). This means the cost per bus rider grew by 48 percent and the cost per bus passenger-mile grew by 44 percent.

Still, improving service on Phoenix's 90 or so bus routes cost less than spending $3.45 billion constructing two light-rail routes (plus at least $200 million more planning, engineering, and designing those routes). At a 4 percent interest rate, $3.45 billion amortized over 30 years is about $200 million per year. The light rail added another $33 million in operating costs in 2009, growing to $48 million by 2019. Spending a small fraction of that money on bus improvements would have significantly increased ridership.

Instead, after 2009, ridership declined while driving continued to grow. Bus and light rail peaked in 2009 at 75.9 million riders. Ridership dropped by 12.5 percent in 2010 and, though it went up and down over the next decade, it never fully recovered to 2009 levels.

The pandemic accelerated many of these trends. Although the pandemic reduced the number of people commuting by automobile, overall auto driving did not decrease as many people who work at home drive as many or more miles per day as people who work at a worksite.[9] Despite a 14 percent decline in the percentage of people driving alone to work, people drove 7 percent more miles in the Phoenix urban area in 2023 than in 2019.[10]

Transit defenders might blame the 2010 decline in ridership on the 2008 financial crisis. But the timing is wrong: the decline didn't really begin until two years after the crisis. Moreover, driving quickly recovered after the crisis, so if transit did not, then some other factor must be at work.

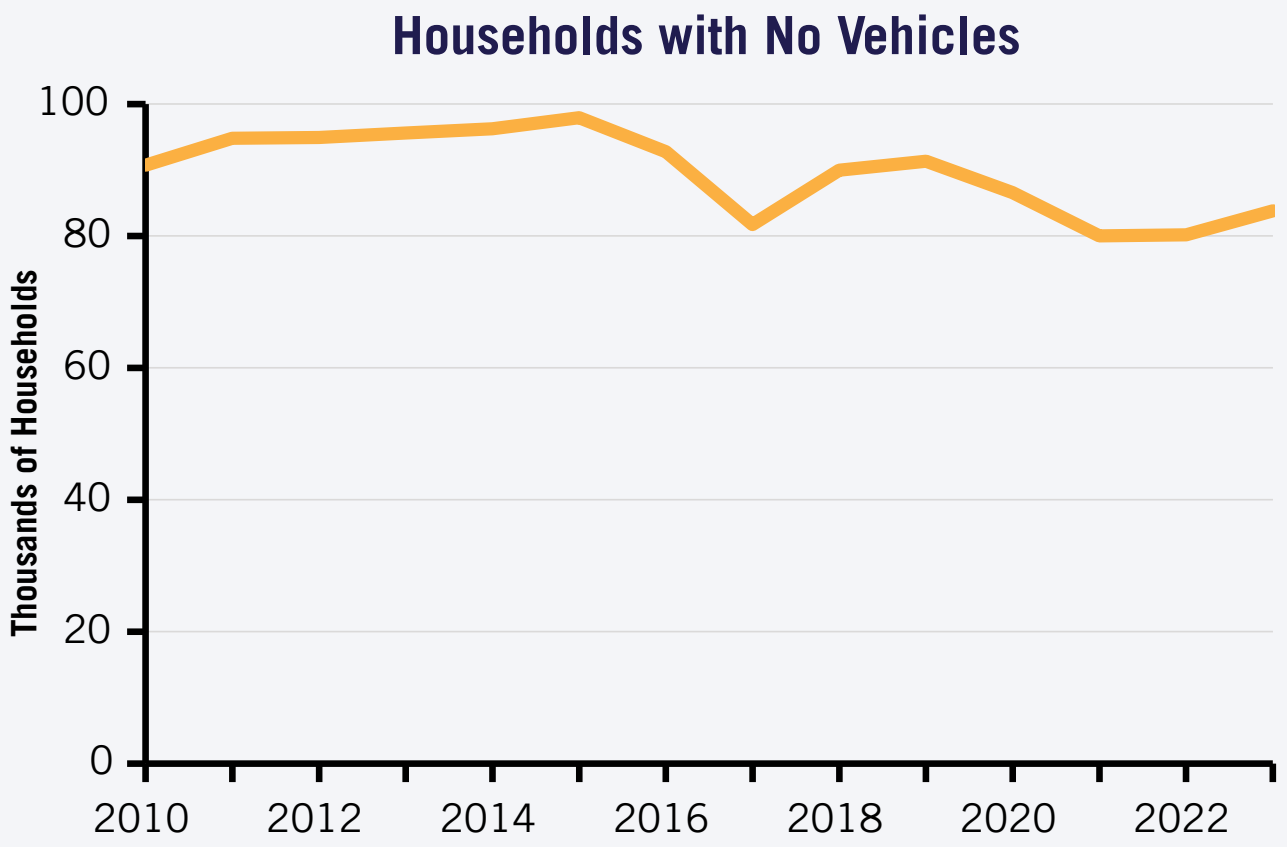

Figure 3: *Households with no vehicles should be a prime market for transit, but the number of such households in the Phoenix urban area declined after 2014 and declined again during the pandemic. The first decline was probably due to lower gas prices while the second may be related to Phoenix transit's failure to serve many major economic centers in the urban area. Source: American Community Survey table B25044.*

That factor appears to be the reduction in bus service, which steadily dropped from 34.1 million vehicle-miles in 2009 to 28.8 million miles in 2012. While it might be thought that bus service would decrease because some bus lines were replaced by light rail, in fact bus service should increase after a light-rail line opens because the rail line needs to be served by feeder buses connecting to neighborhoods that are too far away for people to walk to a rail station.

Bus service was fully restored in 2018, but by that time it was too late. Due partly to lower gas prices, the share of households in the Phoenix urban area that did not have a motor vehicle dropped by 13 percent between 2014 and 2018 while the number of vehicle-less households dropped 6.5 percent.[11] When transit has less than a 1 percent share of urban motorized travel, even a small increase in access to vehicles can have significant effects on transit.

This trend continued from 2018 to 2023, when the share of vehicle-less households dropped another 12 percent while the number dropped 7 percent.[12] The increase in vehicle ownership signals that Phoenix transit systems are not meeting the needs of travelers and will make it harder for transit to ever recover to 2019 ridership, much less 2009 ridership.

Being without a vehicle, incidentally, does not necessarily make people transit riders. In 2019, only 23 percent of workers in the Phoenix urban area who lived in households without cars took transit to work. By 2023, this had declined to 12 percent.[13] Households without cars should be a prime market for transit, and the fact that 88 percent of workers in such households don't commute by transit is another signal that the region's transit system has failed.

Continued

In short, due first to the decrease in bus service and second to growing auto ownership, ridership declined after 2009. By 2019 it was 7 percent lower than 2009 while miles of driving had grown by 25 percent. This drop is even worse considering that light-rail extensions made during this period increased light-rail route miles by 40 percent. In 2019, the average resident of the Phoenix urban area traveled 165 miles by auto for every mile they traveled by transit, showing that transit was becoming increasingly irrelevant to the region's residents.

Beyond these trends, the transit agencies within the Maricopa Association of Governments' jurisdiction have almost completely failed to serve the people in the region. In 2009, they managed to carry 3.2 percent of the region's workers to work.[14] By 2019, this had declined to 2.1 percent and fell again to 1.8 percent in 2023.[15]

This makes Phoenix one of the worst-performing transit systems of any region in the country. Among Phoenix's nearby peer urban areas, for example, Denver transit carried 4.8 percent of workers in 2019; Salt Lake City 3.7 percent; Houston 2.2 percent; and San Antonio 2.4 percent. Further away, Los Angeles transit carried 4.9 percent; San Diego 3.2 percent; and Seattle 11.7 percent.

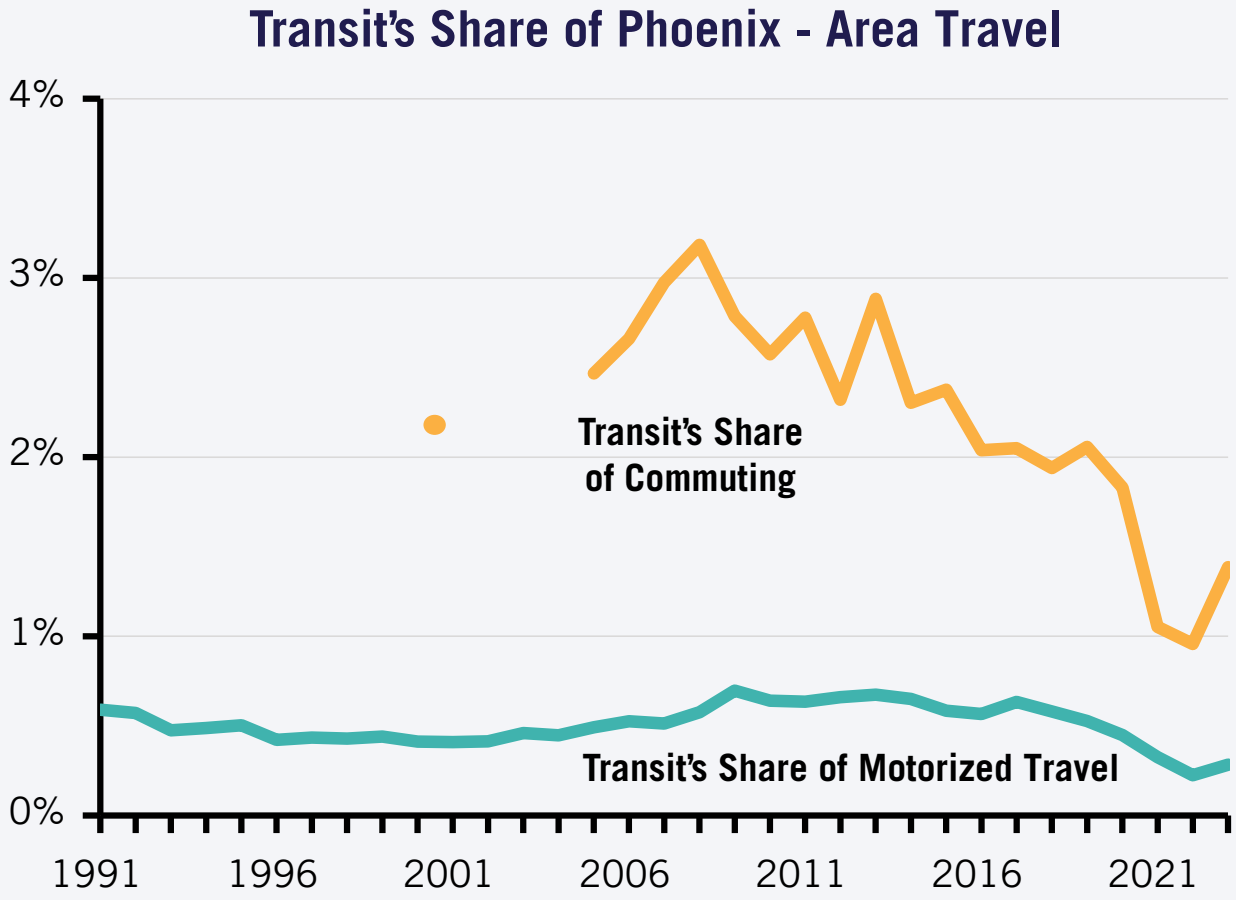

Figure 4: *Transit's share of commuting peaked in 2008, the year before the first light-rail line opened, and by 2019 it had declined by 35 percent. Transit's share of all motorized travel peaked in 2009, the year the light rail opened, and by 2019 it had declined almost 25 percent. Annual commuting shares are not available before 2005 but in 2000 it was 2.2 percent and in 1990 it was 2.1 percent. Source: Commuting shares from American Community Survey table B08301; motorized shares calculated from National Transit Databased and Highway Statistics, table HM-72.*

Table 1 shows that a major factor, if not the main factor, in high transit ridership is the share of jobs that are located downtown. Among the top 50 urban areas (the top 20 of which are shown in table 1), the factor with the highest correlation of transit's total share of commuters is the percentage of jobs that are downtown (correlation=0.92). The correlation between population density and transit commuting is much lower: 0.52.

Note that only 1.8 percent of jobs in the Phoenix urban area are in downtown Phoenix. This means that the light-rail system that MAG is funding and Valley Metro is building, which is a hub-and-spoke system focused on downtown, is not serving 98 percent of the workers in the Phoenix urban area. Before the pandemic, 12.5 percent of downtown workers commuted by transit (which itself is pathetically low), but only 2.1 percent of workers in the rest of the region took transit to work.

Things have gotten worse since the pandemic. As of 2023, the average resident of the Phoenix urban area travelled 300 times as many miles by auto as by transit, up from 126 in 2009 and 165 in 2019. Of the nation's 50 largest urban areas, only Memphis and Pittsburgh have transit systems that have been slower to recover from the pandemic than Phoenix's.

Table 1: Density, Downtown Jobs, and Transit's Share of Workers

	Population	Downtown Jobs		Transit Share of Workers		
Urban Area	**Density**	**Number**	**% of UA**	**DT**	**Non-DT**	**Total**
New York	5,981	1,927,440	21.8%	78.4%	19.9%	32.7%
San Fran. (Oak)	6,843	372,829	21.7%	56.1%	8.6%	18.9%
Washington	3,997	431,345	16.5%	49.2%	9.7%	16.2%
Boston	2,646	264,809	11.8%	55.8%	8.4%	14.0%
Chicago	3,709	572,724	13.9%	46.4%	7.3%	12.8%
Philadelphia	3,001	223,105	8.6%	49.8%	6.7%	10.4%
Seattle	3,607	212,340	12.8%	40.2%	5.5%	10.0%
Baltimore	3,377	84,851	7.6%	20.1%	6.8%	7.8%
Los Angeles	7,476	164,833	2.9%	23.3%	5.2%	5.7%
Minn. (St. Paul)	2,872	108,065	7.4%	33.2%	3.4%	5.6%
Denver. (Aurora)	4,168	132,406	9.9%	21.8%	2.6%	4.5%
Miami	4,885	92,189	3.4%	13.1%	3.6%	3.9%
Atlanta	1,997	264,809	7.8%	14.2%	2.5%	3.4%
St. Louis	2,369	59,807	5.7%	10.5%	2.8%	3.2%
San Diego	4,550	56,995	3.9%	12.0%	2.7%	3.1%
Houston	3,340	161,432	6.3%	17.7%	1.5%	2.5%
Phoenix	3,581	31,763	1.8%	12.5%	2.1%	2.3%
Dallas (Ft. Worth)	3,281	68,399	2.6%	16.6%	1.4%	1.7%
Detroit	2,940	73,690	4.5%	6.1%	1.5%	1.7%
Tampa (St. Pete)	2,872	32,252	2.7%	2.3%	1.4%	1.5%

Table 1: *Source: Population densities are based on the 2020 census ("Population, Housing, and Land Area by Urban Area," Census Bureau, 2023, https://www2.census.gov/geo/docs/reference/ua/2020_Census_ua_list_all.xlsx). The total number of jobs in an urban area (necessary to calculate the share that are downtown) is from the 2016 American Community Survey (five-year), table B08103 for urban areas; all other data are from Wendell Cox, United States Central Business Districts (Downtowns), 4th Edition (Belleville, IL: Demographia, 2020), table 1. Cox's data are based on 2016 five-year data so I used the same time period for urban area jobs.*

Continued

During the first year of the pandemic, bus plus light-rail fares dropped to 7 percent of 2019 fare revenues, and since then haven't increased to much more than half of 2019 fares. Despite the drop in fares and ridership, Valley Metro maintained bus service to at least 90 percent and light-rail service at least 86 percent of pre-pandemic levels.

Transit agencies argued that they needed to maintain service for "essential workers." But they didn't just maintain service; they dramatically increased spending on that service.

Phoenix transit took advantage of federal COVID relief funds to increase spending and bloat bureaucracies. Even though Valley Metro offered 10 percent fewer vehicle-miles of light-rail service in 2023 than in 2019, and inflation-adjusted fares were 47 percent lower, inflation-adjusted light-rail operating costs grew by 10 percent. Inflation-adjusted operating costs per vehicle-revenue mile grew by 22 percent for buses and 44 percent for light rail. "General Administration" (bureaucratic overhead) grew by 36 percent for buses and 60 percent for light rail.[16]

This should have been a time of austerity and reflection on how transit might change to accommodate pandemic-influenced changes

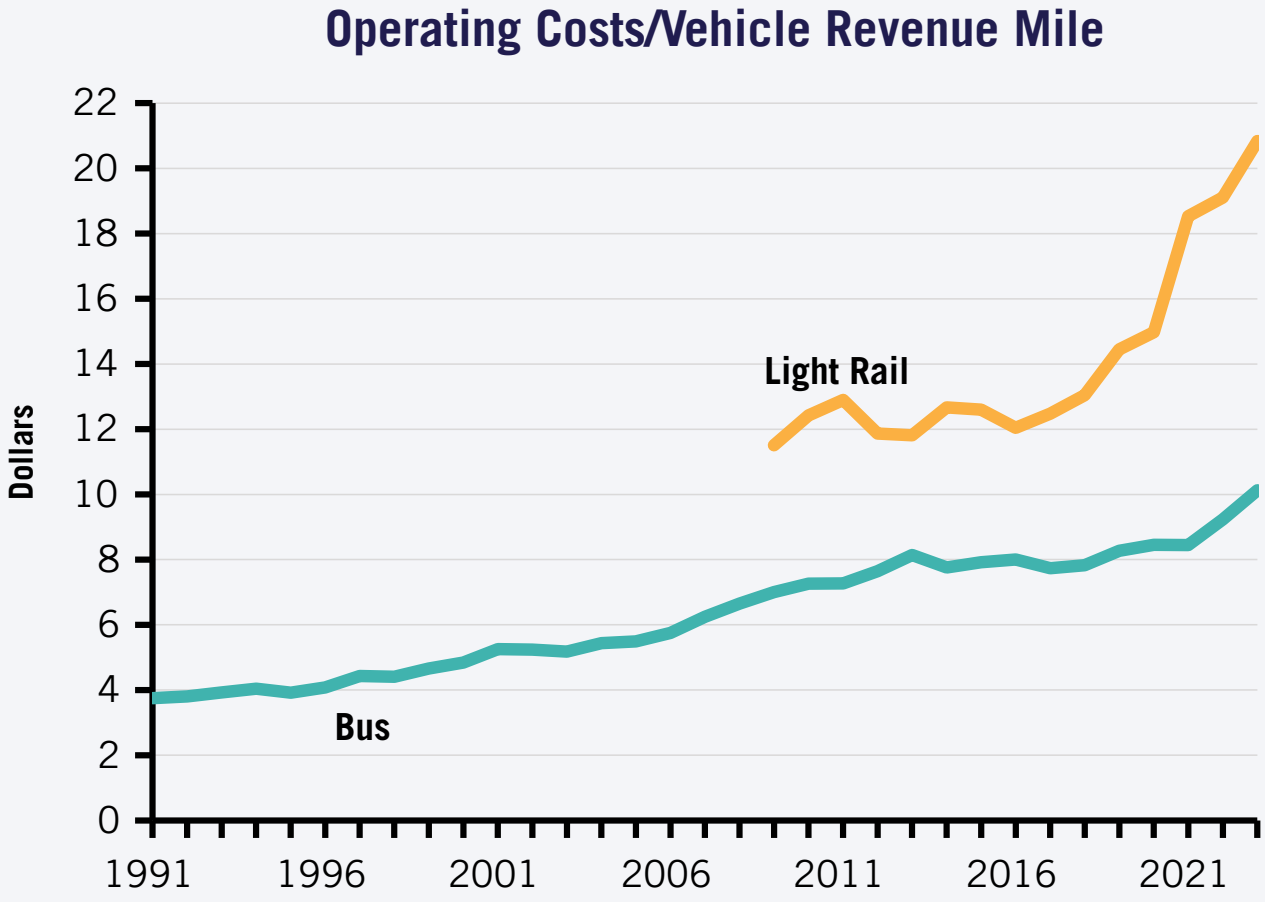

Figure 5: *After adjusting for inflation, operating costs per vehicle-revenue mile should have remained relatively constant, but Valley Metro is apparently flush with cash as they have steadily grown. Growth particularly accelerated during the pandemic. Source: Calculated from 2023 National Transit Database, table TS2.1, operating cost and vehicle revenue mile worksheets.*

in travel patterns. Instead, neither MAG nor Valley Metro appear to have made any effort to modify their plans to respond to new travel patterns.

Over the last 15 years, the share of transportation funds MAG dedicated to transit grew from 17 percent in the 2011-2015 Transportation Improvement Program to 30 percent in the 2020-2024 Program.[17] The 2025-2030 Program plans to spend 25 percent on transit.[18] Most of transit's share is going towards increasingly expensive light-rail lines (see table 2) that carry a diminishing number of passengers: light rail carried close to 366,000 riders per route mile in 2014, when the system was 19.6 miles long. By 2019, the system had grown to 27.2 miles but carried 24 percent fewer riders per route mile.

Considering that transit never carried more than 3.2 percent of commuters or more than 0.7 percent of all urban travel during that period, spending such a large share of funds on transit was and is a drastic misuse of resources. The fact that bus-plus-rail ridership declined between 2009 and 2019 shows that MAG's transportation allocations are especially poor. It is not cost effective to spend billions on new transit lines that result in the loss of close to 10 percent of riders. ■

Table 2: Light-Rail Miles and Costs in Millions

Line	Miles	Cost	Cost/Mile
Central Valley (Blue)	19.6	$1,412	$ 72.0
Central Mesa (Blue)	3.1	199	64.2
Northwest Extension (Orange)	1.6	401	250.6
South Central Extension (Orange)	5.5	1,345	244.5
Tempe Streetcar	3.0	202	67.3
Capitol Extension (Planned)	1.4	499	356.4

Table 2: *The Blue line cost an average of $72 million per mile. The orange line cost an average of $246 million per mile. The proposed capitol extension takes another leap to $356 million per mile. These numbers show only actual construction costs; the region has spent several hundred million more planning, engineering, and designing light-rail lines and infrastructure.*

CONGESTION AND MOBILITY

The law requiring state audits of MAG's transportation plan specifically requires the auditor general to "examine the performance of the system in relieving congestion and improving mobility." By both measures, the region has lost ground since the first light-rail line opened.

Figure 6 shows Phoenix-area congestion measured in terms of the number of hours of delay experienced each year by the average commuter. This congestion was growing at 1.1 percent per year before the opening of the region's first light-rail line, but the growth rate doubled to 2.2 percent per year after that line opened. MAG's plans not only did not relieve congestion; they made it worse. Although congestion dramatically declined during the pandemic, it has already returned to its post-light-rail trajectory.

MAG's transportation plans also reduced the region's mobility. For the purposes of this paper, mobility is defined as "the ability of a typical urban resident to reach large numbers of jobs and other economic, social, and recreation opportunities in a reasonable amount of time."

The University of Minnesota's Accessibility Observatory has published a series of reports calculating the number of jobs that are accessible to the typical resident of the

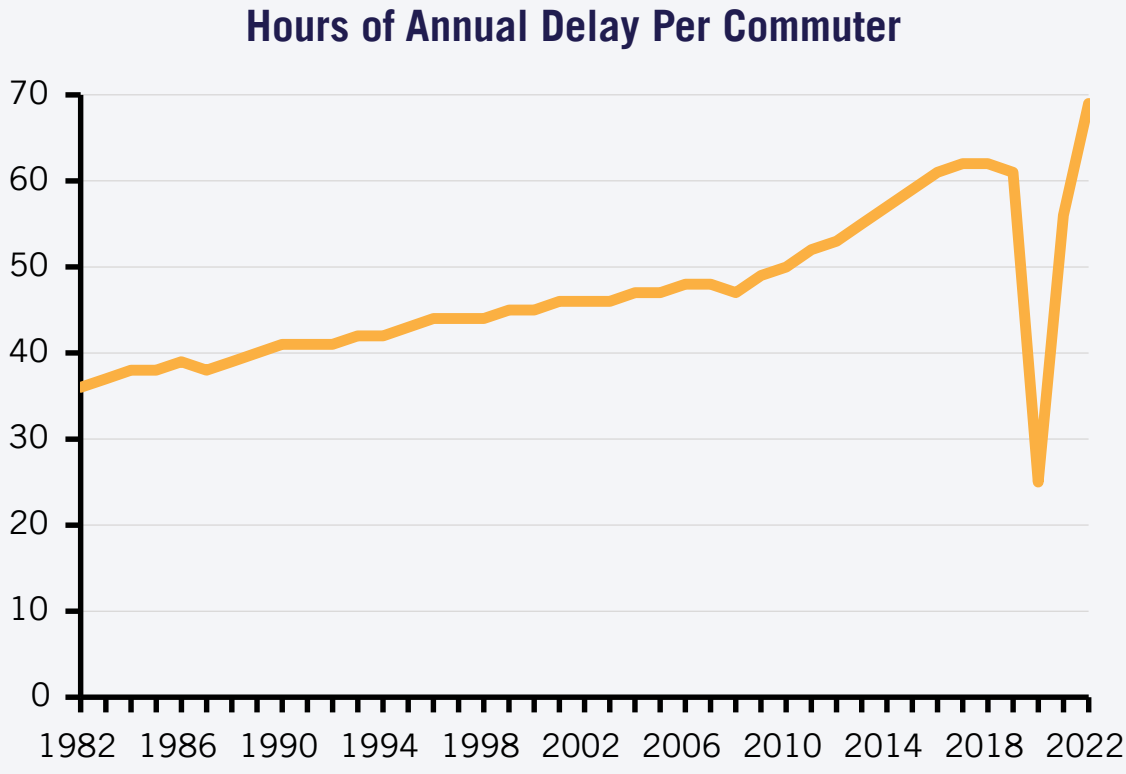

Figure 6: *Before 2009, Phoenix-area congestion grew twice as fast after 2009 than it did before. Source: David Schrank, Luke Albert, Karikeya Jha, and Bill Eisele, 2023 Urban Mobility Report (College Station, TX: Texas Transportation Institute, 2024), complete data spreadsheet.*

nation's 50 largest urban areas in auto, transit, and bicycle trips of 10, 20, 30, 40, 50, and 60 minutes. The reports for autos extend from 2013 to 2022; for transit they began in 2014 and for bicycles they began in 2017. While access to jobs is not the only purpose of mobility, jobs provide a useful proxy for other places that people need or want to reach.

The observatory's findings for Phoenix reveal that all three modes show a decline in mobility over the years tracked. Between 2013 and 2022, the region gained 21 percent more jobs, but the share of the region's jobs accessible by automobile declined for trips shorter than 50 minutes by an average of 16 percent. Even including trips of 50 and 60 minutes, the share declined by an average of 8 percent.[19]

Between 2014 and 2022, the region gained 17 percent more jobs yet the share of the region's jobs accessed by transit declined for all travel time periods. On average, the region's residents could reach 23 percent fewer jobs by transit in 2022 than in 2014.[20] Between 2017 and 2022, the region gained 6 percent more jobs yet the number of jobs accessible by bicycle also declined by an average of 38 percent.[21]
The observatory's estimates of the total number of jobs accessible by various modes show one reason why the automobile is the preferred choice for most Phoenix-area travel. In 2015, a 10-minute trip could reach 354 times as many jobs by auto as by transit while a 60-minute trip could reach 18 times as many. By 2022, the automobile's advantage had increased to 373 times as many jobs in 10 minutes and 19 times as many in 60 minutes, showing that MAG's transit plans were making transit relatively worse for commuters.

The poor design of Phoenix's transit system is further revealed by comparing bicycling with transit. In 10 minutes, someone can reach 10 times as many jobs on a bicycle as they can on transit. The bicycle's advantage continues up to 50 minutes, in which time a cyclist can reach 10 percent more jobs than a transit rider. Only in trips of 60 minutes does transit offer access to more jobs than bicycles. ■

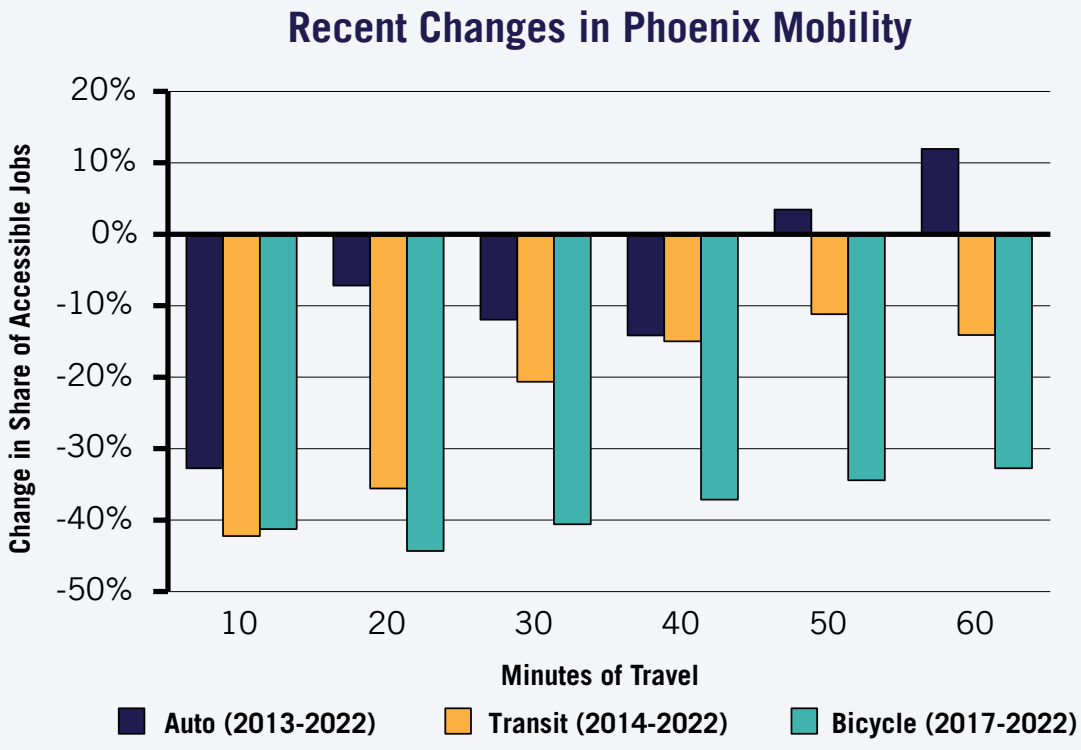

Figure 7: *When measured as a share of the region's jobs accessible to the typical resident of the Phoenix urban area, mobility has declined for trips of any length by transit riders and cyclists and for trips of under 50 minutes by auto users. Source: University of Minnesota Accessibility Observatory.*

OTHER PERFORMANCE STANDARDS

Arizona law lists several other transportation performance standards that ought to be considered in an audit of MAG's transportation plan. These include, among others, cost-effectiveness, operational efficiency, air quality, economic benefits, and safety.[22] MAG's plans fail all of these tests.

Cost-effectiveness: As previously mentioned, it is not cost-effective to spend billions of dollars on light rail only to have transit ridership decline. But even if ridership had not declined, light rail is not cost-effective compared with buses, namely because buses can do everything light rail can do but at a much lower cost.

MAG and Valley Metro frequently refer to light rail as "high-capacity transit." This is misleading because, by definition, light rail is low-capacity transit. The American Public Transit Association's Glossary of Transit Terminology defines light rail as "an electric railway with a 'light volume' traffic capacity compared to heavy rail."[23] In other words, the word "light" in "light rail" refers not to weight (light-rail cars in fact weigh more than heavy-rail cars) but to capacity.

While the definition specifies that light rail has a low capacity compared with heavy rail, it also has a low capacity compared with buses. Rail cars may be larger than buses, but because they all use the same track, light-rail stops can only serve about 20 trains per hour. Since buses can pass one another, streets can move hundreds of buses per hour.

Light-rail trains are limited in length by the length of the shortest city blocks on a light-rail route. Many city blocks on Phoenix are about 300 feet long, and since a light-rail car is typically just under 100 feet long, trains on most routes are or will be limited to three cars. Each car can hold about 150 passengers, so 20 trains per hour can move 9,000 passengers per hour.

For comparison, Portland has city streets that can move more than 160 buses per hour. The buses all stop every other block, but there are two stops in each block, which means four buses can stop at one time. Each stop can serve 41 buses per hour, which means the streets can serve 164 buses per hour.[24] Portland buses hold about 60 passengers, which means buses on these streets can move about 10,000 people per hour. If necessary, Portland could use articulated ("bendy") buses capable of carrying 100 people, allowing buses to move more than 16,000 people per hour.

This is far from the highest capacity busway in the world. Istanbul has a busway capable of moving 30,000 people per hour, about the same as the Washington DC subway system.[25] Bogota, Columbia has busways capable of moving 41,000 passengers per hour, about the same as the New York City subway system.[26] No light-rail line in the world can come close to these numbers.

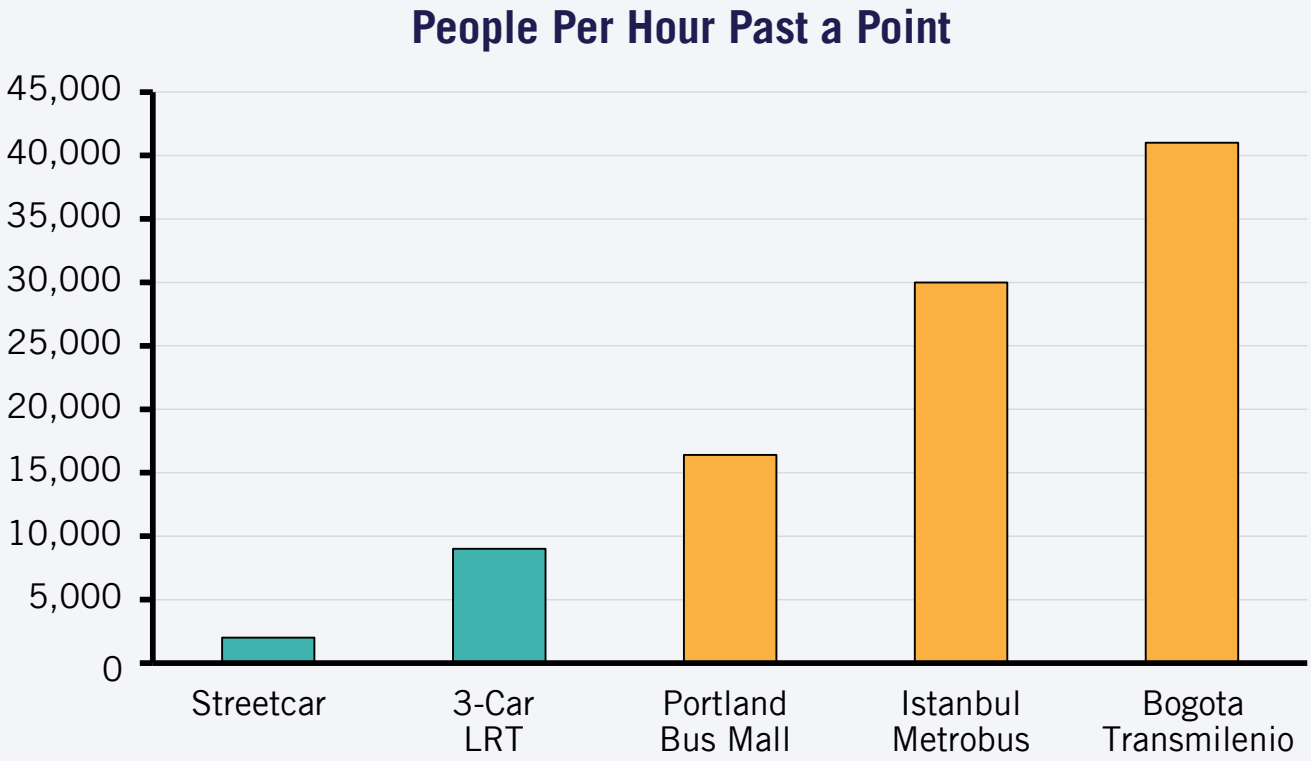

Figure 8: *MAG and Valley Metro persist in calling streetcars and light rail "high-capacity transit," but buses can move far more people per hour than light rail or streetcars.*

Unlike rail transit, buses are completely scalable. This means that, because they use existing infrastructure, the cost per seat-mile is roughly the same whether a route runs one bus per hour or 250. With light rail, the cost of the first seat-mile is really high, then if the system ever reaches capacity the cost of increasing capacity is high. Of course, a system that is capable of running three-car trains every three minutes that only runs one or two car trains every 12 minutes, as Valley Metro does, isn't coming close to the rail's capacity, which means too much money was spent on a low-capacity system that isn't even used to that low capacity.

Another disadvantage of light rail is that it is slow. While light-rail cars may have a top speed of 55 miles per hour, they are slow to accelerate and slow to decelerate. Since light-rail stops are normally located less than a mile apart, they can rarely reach their top speeds. St. Louis has the fastest light-rail schedules in America because its trains operate almost entirely on an exclusive right-of-way, yet their average speeds were just 22.5 mph in 2023. Most others average less than 20 mph.[27]

Phoenix light-rail trains operate mostly in streets and averaged just 13.9 mph, which is not a huge advantage over Phoenix buses, which averaged 12.7 mph.[28] MAG and Valley Metro want to supplement light-rail lines with bus-rapid transit lines, in which buses would stop only about once per mile rather than five or six times per mile. This is often described as "buses on light-rail schedules," but since light rail isn't fast enough to be competitive with automobiles, bus-rapid transit won't be either.

These speeds are not competitive with driving, especially since automobiles can take people

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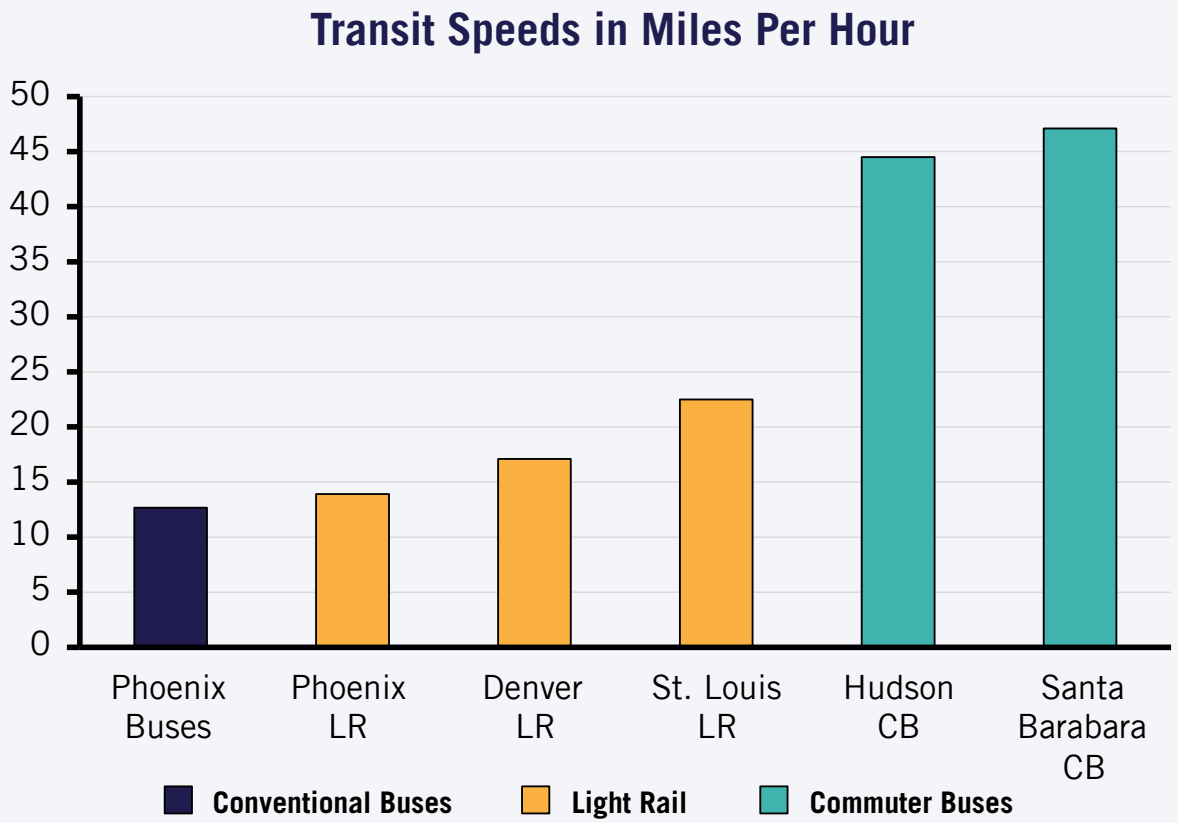

Figure 9: *Because it runs mainly on its own right of way instead of in streets, St. Louis has the fastest light-rail system in the nation. But it is much slower than some commuter bus lines (CB) that make few stops. Source: Calculated by dividing vehicle revenue miles by vehicle revenue hours in the 2023 National Transit Database.*

from door-to-door without requiring transfers, lengthy walks at one or both ends of a trip, or standing in the heat while waiting for a bus or railcar. A 2011 study of average travel speeds found that drivers in the city of Phoenix averaged 28 miles per hour, and driving in the suburbs was probably faster.[29]

Buses can be much faster if they make few or no intermediate stops. The National Transit Database shows several commuter bus systems whose average speeds exceed 40 mph. For example, Santa Barbara commuter buses average 46 mph and Hudson Transit and Trans-Bridge buses in the New York area average 44 mph.[30]

Besides its high cost, low capacities, and slow speeds, light rail has the disadvantage that it takes years to plan and build. This makes it difficult for transit agencies to respond to changes in transportation patterns.

For example, when it opened in 1973, Metrocenter was the largest shopping mall in Arizona and one of the largest in the country. MAG and Valley Metro planned to make it the terminus for one of their light-rail lines. After nearly two decades of planning and construction, Valley Metro opened its light-rail station in Metrocenter in January 2024—three-and-a-half years after the shopping mall closed.[31] There are still businesses and jobs in the vicinity, but the main reason for going there no longer existed.

Operational efficiency: All these problems mean that light rail is simply not cost-effective compared with buses. Nor is it operationally efficient. In 2023, Valley Metro spent 32¢ per seat-mile operating its light-rail trains but only 27¢ per seat-mile operating buses. When standing room is counted, light rail cost 10¢ per seat-plus-standing mile while buses cost 14¢.[32]

While buses are a little more expensive when standing room is included, bus capacities could be increased by removing seats as each seat takes up the standing room of at least two passengers. More than half the capacity of Valley Metro buses is seated while less than a third of the capacity of its light-rail cars are in seats, so buses are more comfortable for a higher percentage of passengers.

Transit defenders often say that "all transportation, including highways, is heavily subsidized," with the implication that it would be pointless to calculate those subsidies. However, it is worth comparing highway subsidies with transit subsidies.

Highway subsidies can be calculated using the annual editions of Highway Statistics, which includes tables on how much state and local governments spent on roads and how much they collected from users in the form of fuel taxes and vehicle registration fees (including the portion of the federal fuel tax distributed to Arizona).[33] Some of these user fees were diverted to mass transit and general funds, but to be conservative this analysis will only count those dedicated to highways. The net result is that Arizona highways, roads, and streets cost taxpayers about $1.3 billion in 2019, before the pandemic, and $1.8 billion in 2023, the most recent year available.

Arizonans drove about 75.3 billion vehicle-miles in cars and light trucks in 2019 and 70.3 billion in 2023.[34] That works out to a subsidy of 1.8 cents per vehicle-mile in 2019 and 2.6 cents in 2023. The 2017 National Household Travel Survey estimated that the average automobile held about 1.67 people, meaning the subsidy was 1.2 cents per passenger-mile in 2019. However, after the pandemic, the 2023 National Household Travel Survey estimated that average vehicle occupancy had declined to 1.5 people, so the subsidy in 2023 was about 1.7 cents per vehicle-mile.

Highways, unlike transit, do more than just carry passengers. They also move millions of tons of freight. Heavy trucks traveled about 7.3 billion vehicle-miles in 2019 and 12.0 billion in 2023.[35] In 2019, the average heavy truck carried 7.46 tons while in 2023 this had declined slightly to 7.1 tons.[36] At least some of the subsidy to highways should be attributed to freight, thus reducing the subsidy to passenger travel.

The best way to apportion the subsidy between passenger and freight is to estimate the value people place on each, which in turn can be based on how much people spend on each. According to the Bureau of Economic Efficiency, Americans spent $1.25 trillion buying, leasing, fueling, maintaining, repairing, and insuring their cars and light trucks in 2019, increasing to $1.66 trillion in 2023.[37] Americans traveled about 4.4 trillion passenger-miles by auto in 2019, increasing to 4.9 trillion in 2023.[38] That works out to average spending of 26 cents per passenger-mile in 2019 and 38 cents in 2023.

Trucking and courier companies earned revenues of $502 billion in 2019 increasing to $623 billion in 2022 (the latest year for which data are available).[39] That's an average of 23 cents a ton-mile in 2019 and 29 cents in 2022. While the average for 2023 was probably higher, using the 2022 number, freight represented 34 percent of the value of highway transportation in 2019 rising to at least 44 percent in 2023.

That means only 66 percent of the 2019 highway subsidy and 56 percent of the 2023 highway subsidy is attributable to passenger travel. The subsidy was therefore about 0.4 cents per passenger-mile in 2019 and 0.7 cents in 2023. This estimate is based on national data for average vehicle occupancies, average tons per truck, and average expenditures on passenger and freight travel combined with state data on the number of miles of travel by automobiles and heavy trucks, but even if the data could be made more accurate for Arizona, the calculated subsidy would still be only around a penny or less per passenger-mile.

Subsidies to transit are much greater. In 2019, Phoenix-area transit agencies collected $54 million in fares and spent $397 million on

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operations carrying 359 million passenger-miles for an average operating subsidy of 96 cents per passenger-mile.[40] In 2023 operating costs grew to $455 million, fares declined to $31 million, and passenger-miles declined to 295 million, for an average subsidy of $2.01 per passenger-mile.

This doesn't include any capital expenses, which are included in the calculations of highway subsidies. Capital expenses can vary greatly from year to year, and the expense in one year is generally aimed to support transit services for several years in the future. Since 2003, when Valley Metro began earnestly building light rail, the region has spent an average of $496 million a year (adjusted for inflation) on transit capital projects.[41] That adds $1.38 to the 2019 subsidy per passenger-mile and $2.34 to the 2023 subsidy per passenger-mile.

People may quibble with this methodology, but no matter how calculated, subsidies to transit passenger-miles were more than 100 times greater than subsidies to automobile passenger-miles in 2019 and in 2023, they were more than 400 times greater.

Some people argue that these subsidies should continue because transportation is a public good, but that's not true.[42] Part of the definition of a public good is that it isn't possible to exclude people from the use of that good, but it is relatively easy to deny people access to transit if they refuse to pay fares and to deny people access to highways if they refuse to pay fuel taxes or other highway user fees. Ending the subsidies will have a much bigger effect on transit than on auto driving.

Air quality: Despite the huge increase in people working at home, air quality in Maricopa County was measurably worse in 2023 than in 2019. According to the Environmental Protection Agency, carbon monoxide was about 17 percent worse; ozone was 8 percent worse; mean particulate matter (PM2.5) was 31 percent worse; while mean particulate matter (PM10) was 18 percent worse. Where in 2019 only one EPA air quality standard was violated (ozone), in 2023 three were (ozone, PM2.5, and PM10). Only sulfur dioxide and lead were lower in 2023 than 2019, but these aren't particularly related to transportation.[43]

Nor is Phoenix's transit system climate friendly. A comparison of energy consumption and greenhouse gas emissions by automobiles and Phoenix transit systems reveals that transit does not save energy or reduce emissions.

Department of Energy data show that, in 2019, the average car used about 2,800 British thermal units (BTUs) of energy and emitted just under 200 grams of carbon dioxide per passenger-mile, while the average light truck used under 3,300 BTUs and emitted 230 grams of carbon dioxide per passenger-mile.[44] Energy data in the 2019 National Transit Database indicates that Phoenix transit used an average of 5,400 BTUs and emitted 400 grams of carbon dioxide per passenger-mile, both far more than cars or light trucks.

Valley Metro's light rail was admittedly more efficient, using 2,165 BTUs and emitting 80 grams of carbon dioxide per passenger-mile.[45] But light rail cannot exist by itself; it must be supported by buses that are energy hogs. Moreover, this does not consider the huge amount of energy and greenhouse gas emissions required to construct light rail, a cost that may never be repaid by the operational savings. To the extent that electric vehicles are more climate-friendly than petroleum-powered vehicles, it would be more cost-effective to give Phoenix residents incentives to buy electric cars than to build light rail.

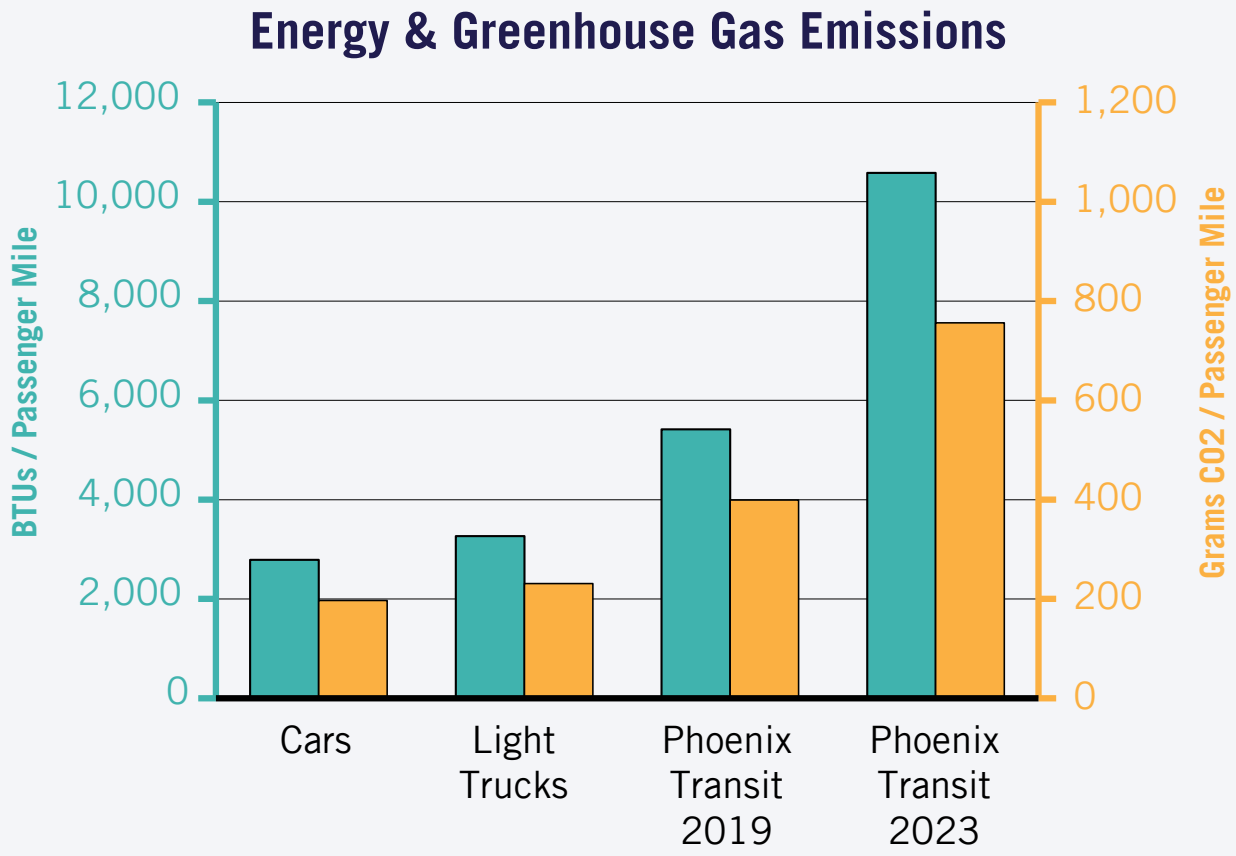

Figure 10: *Energy cost and greenhouse gas emissions per passenger-mile for cars and light trucks in 2019 and Phoenix transit in 2019 and 2023 (including buses, light rail, and, in 2023, the Tempe streetcar). Source: Cars & light trucks from Transportation Energy Data Book, 40th Edition; transit calculated from 2019 & 2023 National Transit Database.*

Transit performed much worse in 2023, using more than 10,500 BTUs and emitting more than 750 grams of carbon dioxide per passenger-mile. Light rail used more than 4,000 BTUs and emitted 120 grams of carbon dioxide per passenger-mile.[46] While ridership may recover somewhat from 2023, it will probably not reach 2019 levels anytime soon. Thus, transit is far more harmful to the environment than auto driving.

Economic benefits: Valley Metro insists that light rail promotes economic development. I thoroughly debunked this in a previous paper that showed that most of the development claimed by Valley Metro in fact had nothing to do with the light rail. Among the developments that Valley Metro claimed were generated by light rail were gasoline stations, an auto dealership, and an airport parking garage that could not be used by light-rail riders.

Other developments clearly would have taken place with or without the light rail, such as an expansion of the Phoenix convention center and construction of a new high school. Many other developments were subsidized, including numerous affordable housing projects, indicating they would have been built with or without light rail.[47] This confirms research in other cities that concluded that "urban rail transit investments rarely create 'new' growth, but more typically redistribute growth that would have taken place without the investment."[48]

Transit advocates might also claim that the jobs needed to build or run light rail are an economic benefit. But jobs aren't a benefit; they are a cost—no one wants to work 24 hours a day. The benefit is the income produced by the people who work those jobs.

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Since light rail loses money, there is no net benefit, merely transfers of wealth from one group of people to another. The United States has a severe job shortage and hiring people to do things like build money-losing light-rail lines takes away workers from more essential activities such as home construction.

Safety: Safety will be discussed in more detail in the section on bicycling and walking. Here, it is sufficient to say that 2023 saw 53 percent more urban traffic fatalities in urban Maricopa County than in 2019 and 135 percent more than in 2009.

Resilience: Resilience is not on the state list of performance standards, but it should be. Resilience in the face of change is a major issue for transportation systems. Past decades have seen important changes in transportation patterns, and Phoenix's transportation infrastructure should be able to respond to those changes.

For example, the growth of on-line shopping reduced the number of people patronizing shopping malls such as Metrocenter. The pandemic led the number of people working at home to more than double, and their transportation habits and needs are very different from those who commute to a worksite. Phoenix's transit system has not been able to respond to such changes.

The focus on light rail has rendered Phoenix transit less able than ever to respond to major social changes such as those brought about by the COVID pandemic. As of June 2025, Phoenix transit carried just 60.9 percent as many riders as it carried in the same month before the pandemic and just 53.9 percent as many as in June 2009. For comparison, the national average for transit systems is 80.4 percent of June 2019 riders.[49] Phoenix driving had fully recovered by 2021.[50] Despite transit's failure to recover, MAG doesn't seem to think that the effects of the pandemic warrant any changes in its strategy of building more light-rail lines.

Phoenix's historically low transit ridership, its decline after 2009, and its failure to come anywhere close to recovering from the pandemic are all related to a major problem with MAG's strategy, which is that MAG is focused on transit to downtown when 98 percent of the region's jobs are located elsewhere. ■

WHY PHOENIX TRANSIT DOESN'T WORK

MAG and Valley Metro transit plans are mainly oriented around downtown, yet according to 2017-2021 census data, downtown Phoenix has only 2.1 percent of the region's jobs. Between 30 and 40 percent of the region's jobs are in other major job centers, sometimes called Edge Cities, most of which host more jobs than downtown Phoenix and most of which are ignored by MAG and Valley Metro transit plans.

To find these job centers, I used the latest Census Transportation Planning Package, which includes 2017-2021 estimates of how many people work and live in each Maricopa County census tract and how they get to work.[51] Most Maricopa County census tracts are about a square mile in size, though a few are smaller or larger.

One of the definitions of an Edge City is that

Table 3: Phoenix Economic Centers Population, Jobs, and Transit Commuters

	Population	Jobs	Transit Commuters	Transit Share
Southwest Chandler	47,038	81,430	365	0.4%
Scottsdale Airpark	27,091	74,470	684	0.9%
Deer Valley	34,348	70,850	594	0.8%
Sky Harbor	7,431	62,210	1195	1.9%
University	22,129	59,580	2300	3.9%
Broadway Curve	23,051	55,135	819	1.5%
Central Industrial	18,475	53,365	1409	2.6%
Uptown	18,647	44,150	718	1.6%
Biltmore	37,975	43,085	830	1.9%
Downtown	10,445	39,940	3869	9.7%
US 60	24,615	39,910	405	1.0%
Scottsdale Old Town	6,797	22,710	270	1.2%
Metrocenter	15,744	19,470	344	1.8%
Peoria/Sun City	12,446	15,550	85	0.5%
Goodyear	8,661	14,210	24	0.2%
Falcon Field	8,048	12,270	0	0.0%
Tolleson	7,180	10,495	135	1.3%
Capitol	826	9,230	0	0.0%

Table 3: *These economic centers are listed in order of a declining number of jobs. While it seems likely that someone must commute by transit to jobs in the capitol, none were reported by the Census Bureau. Differences between this table and table 1 are because table 1 is based on the 2012-2016 Census Transportation Planning Package while this one is based on the 2017-2021 package. Source: "CTPP Data Portal," American Association of State Highway and Transportation Officials, tables B01003 (population) and B202100 (workers),* ***https://ctppdata.transportation.org/#/index****.*

Continued

it has more jobs than residents, so I mapped every census tract with a surplus of jobs and looked for clusters of such tracts.[52] When two clusters of census tracts with job surpluses were separated by a single census tract that had more than 1,500 jobs but perhaps a few more residents, I included that tract so that the two clusters became one.

This revealed nine different economic centers that each had more than downtown's 40,000 jobs, one that had about the same number of jobs as downtown, and seven other clusters of about 10,000 or more jobs (see table 3). At least four of the seven could potentially grow bigger than downtown. Including downtown, all these job centers together have 39 percent of the region's jobs.

Phoenix's transit system almost completely neglects commuters to most of these job centers. Transit carries less than one-half percent of commuters to the largest job center, Southwest Chandler, and less than a percent to second-largest Scottsdale Airpark and third-largest Deer Valley. Not counting downtown or the University, transit carries less than 1.3 percent of workers to these job centers.

MAG's plans barely acknowledge these job centers. The current light-rail line serves only three major job centers, downtown, the university, and Sky Harbor, and one minor one, Metrocenter. The South Central line does not go near any job centers. MAG's plans for light-rail expansions include a line to the capitol area—which doesn't even have 10,000 jobs—one to west Phoenix, one to Glendale, and one to north of Paradise Valley. None except the capitol line would reach any of the region's other major or minor economic centers.

The projected Glendale line would stop well short of the Peoria-Sun City minor economic center. The west Phoenix line would stop short of the Tolleson minor economic center. The Paradise Valley line might stop a couple of miles short of Kierland, on the west end of the Scottsdale Airpark, the region's second-largest edge city. None would come close to Southwest Chandler, the region's largest edge city, or Deer Valley, the third largest. Buckeye, which could become the edge city to end all edge cities long before MAG expects to complete its current light-rail projects, is not even under consideration.[53] Instead of designing a transit system that fits Phoenix's distribution of housing and jobs, MAG is attempting to change that distribution using "transit-oriented developments." Such developments combine high-density, multifamily housing with shops and offices that residents can reach on foot. Locating such developments on light-rail and other transit lines will supposedly boost ridership. MAG has received several federal grants to promote such developments.[54]

MAG argues that such developments are more "sustainable," meaning they would reduce auto driving (even though autos use less energy and emit less greenhouse gases than Phoenix transit).[55] Yet a literature review of the relationship between the built environment and driving compiled by University of California, Irvine, economist David Brownstone found little or no evidence that density or mixed-use reduces driving. Brownstone found that studies that reported that people who lived in transit-oriented developments drove less failed to account for self-selection bias, meaning that people who want to drive less tend to choose to live in such developments. Studies that accounted for self-selection bias, Brownstone concluded, found that dense or mixed-use housing had no impact on the amount of driving people did.[56]

In any case, MAG will never be able to turn Phoenix into a transit-oriented city like New York or San Francisco. Instead, it needs to redesign its transit system for the region as it is with flexibility to adjust that system as the region grows and evolves. ■

PROPOSED TRANSIT SYSTEM

If MAG were willing to give up its failed light-rail program, it could design a transit system that relies primarily on existing infrastructure, serves edge cities as well as the current system serves downtown, and takes advantage of the speed and flexibility of buses to make transit far more competitive with automobiles. Such a system would attract far more riders at a far lower cost than the light-rail system MAG wants to keep building.

Here is one way to do so. First, MAG could identify eight or nine major economic centers and locate primary transit centers near each center. MAG could also identify four or five secondary economic centers and locate secondary transit centers near freeways close to each of these secondary centers.

The transit centers should be close to freeway on- and off-ramps and do not need to be elaborate: space for parking four to six buses should be sufficient along with shelters to keep people out of the sun that include misting systems to cool people off when temperatures are above 90 degrees.

Next, MAG should plan a multiple hub-and-spoke bus system centered around frequent non-stop buses operating from every primary economic center to every other primary economic center. Non-stop buses would also run from every secondary economic center to two primary centers. Eight primary and six secondary centers would mean 40 non-stop bus routes. Buses could run five or six times an hour during peak periods and three to four times an hour during off-periods.

Third, MAG should plan local and, in some cases, bus-rapid transit buses radiating away from each of the primary and secondary transit centers. Together, these radial buses would provide coverage to the entire urban area. Six buses radiating from each of fourteen centers means 84 local and rapid buses, for a total of 124 bus lines. To minimize the number of transfers passengers would have to make, each non-stop bus between transit centers would circulate as a local bus or bus-rapid transit line radiating from transit centers.

Continued

For example, the US 60 linear edge city can be served by non-stop buses from a US 60 transit center on Dobson Road. From there, the non-stop buses can become bus-rapid transit buses stopping at the exits on US 60 between Dobson Road and Sossaman Road. Local buses might circulate in the businesses and neighborhoods at each exist.

One possible list of primary transit centers could include:

- Downtown/Uptown, near the intersection of I-10 and East or West 7th;
- Tolleson, near the intersection of I-10 and 101;
- Sun City/Peoria, near the intersection of I-10 and US 60;
- Deer Valley, near the intersection of I-17 and 101;
- Scottsdale Airport, near the intersection of 51 and Shea;
- Arizona State University, near the intersection of University Drive and Mill Avenue;
- US 60, near the intersection of US 60 and Dobson Road;
- Southwest Chandler, near the intersection of I-10 and Elliot Road.

Secondary transit centers could include:

- Central Industrial District, near the intersection of 19th Avenue and McDowell Road;
- Metrocenter, near the intersection of I-17 and Dunlap Road;
- Biltmore, near the intersection of Camelback and 51;
- Scottsdale Old Town, near the intersection of Camelback and Scottsdale Road;
- Sky Harbor, near the intersection of Broadway and 32nd Street; and
- The Broadway Curve, near the intersection of Broadway and 48th Street.

This system would serve many of the region's edge cities at least as well as the current system serves downtown. The non-stop buses would spend most of their travel time on freeways, using HOV lanes where available, thus making them some of the fastest urban transportation in the region. This would make it possible for people to travel from, say, Deer Valley to southwest Chandler or from the Scottsdale Airpark to Sun City almost as fast as they can do so by automobile.

Bus frequencies or bus sizes can easily be adjusted to accommodate higher or lower demands on various routes. If Buckeye or some other area grows into a new economic center, service can be added to that center with little delay.

Faster buses mean that bus vehicle-miles per day would be significantly greater than the current system, but bus vehicle-hours per day might be about the same as today. This means that operating costs that are proportional to hours, such as driver pay, would be about the same as today while costs proportional to miles, such as fuel, might be greater.

The capital cost of this system should be much lower than building more slow light-rail lines. The operating costs depend on the number of transit centers and the number of

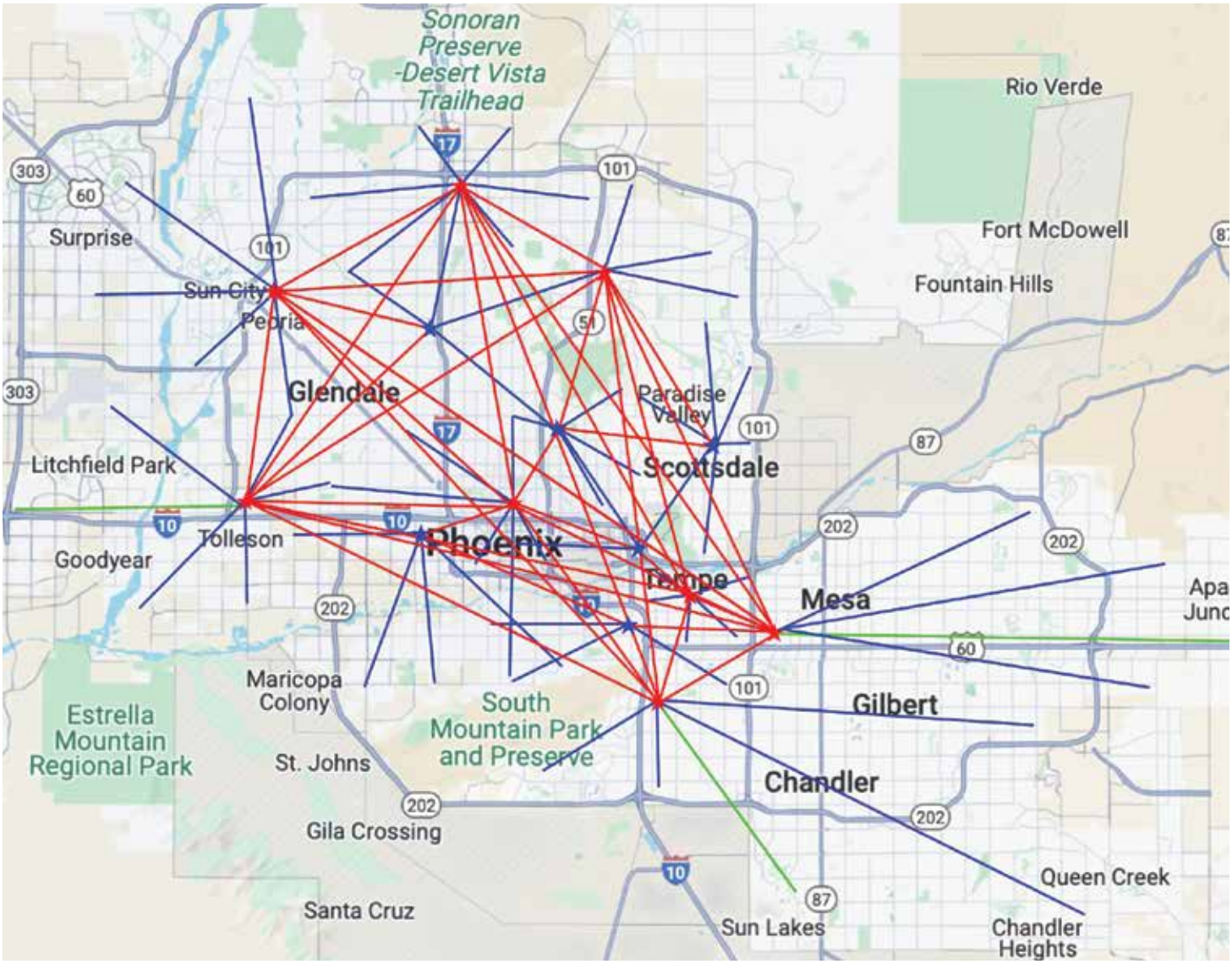

Figure 11: *Map showing possible transit routes. Red stars are primary transit centers; blue stars are secondary centers. Red lines represent non-stop buses between every primary transit center and every other primary transit center as well as between each secondary centers and two primary centers. Blue lines are local buses radiating away from every transit center; green lines would probably be bus-rapid transit lines, though other blue lines could be as well. Lines do not show exact routes but merely rough locations of destinations away from transit centers.*

local buses radiating from each center. It should be possible to design a system that serves the entire region at no greater cost than the region is spending to operate transit today.

Planning for a capitol extension and other light-rail lines should be halted. The existing light-rail lines should be redesigned to accommodate this system by providing non-stop or near-non-stop service between downtown, the university, and Metrocenter. Light-rail lines wear out after about 30 years, and when the existing lines wear out, they should be scrapped and replaced with buses. ■

MAG'S ACTIVE TRANSPORTATION PROJECTS SHOULD FOCUS ON SAFETY

In addition to spending a hefty share of the region's transportation funds on transit, MAG's plans call for spending a small share on "active transportation," meaning pedestrian and bicycle facilities. About 1.2 percent of the total funds in MAG's 2025-2030 Transportation Improvement Program are dedicated to pedestrians and cyclists, though some of the projects funded by this 1.2 percent may also benefit transit and motor vehicles and several projects classified as "streets," "safety," and even in one case "freeway" also benefit pedestrians and bicycle riders.[57]

Close to two-thirds of the funds spent on bicycle and pedestrian infrastructure come from the federal government, while all the remainder comes from the state. Local governments may have their own active transportation projects, but at least for projects planned by MAG, no local funds are spent on bike/pedestrian facilities.

MAG never clearly specifies the purpose and goals of its active transportation program. According to the U.S. Department of Transportation, the federal government funds active transportation because bicycling and walking are "healthy, affordable, and climate friendly." The aim of such spending is to "increase the safety" of those who choose to cycle or walk and to "enable more people to avoid traffic congestion and choose forms of travel that contribute low to no emissions."[58]

Figure 1 shows that cycling and walking together make up about 2 to 3 percent of Maricopa commuting trips. Bicycle and walking trips tend to be shorter than driving trips, so in terms of passenger-miles, walking and cycling probably always made up much less than 2.0 percent of commuting.

For purposes other than commuting, the 2017 National Household Travel Survey found that, nationwide, people were more likely to walk for non-work trips than for commuting. While the national survey found that 3.9 percent of commuting trips were on foot, 10.5 percent of all trips were on foot. This was the opposite of transit, which was used more for commuting than for other purposes: transit carried 5.5 percent of commute trips but only 2.5 percent of all trips.[59]

The survey also found that walking trips averaged about 1.2 miles in length, while driving and transit trips were about 12 miles.[60] Thus, if 10.5 percent of trips are on foot but the average trip is only 10 percent as long as by other modes, then walking accounts for about 1 percent of passenger-miles. Less information is available about cycling, but one group of researchers using the 2017 travel survey data concluded that Americans bicycle about one mile for every four miles they walk.[61]

If walking and cycling together account for 1-1/4 percent of passenger-miles, then it may be appropriate to spend 1.2 percent of the region's transportation infrastructure dollars on pedestrian and cycling facilities. At the same time, it isn't clear that the way MAG spending this money is achieving any of the goals outlined for active transportation by the Department of Transportation, namely increasing safety and personal health and reducing greenhouse gas emissions. Nor does MAG have any clear goals of its own; it just seems to be spending money that it could get in federal grants along with state matching funds.

As with transit, MAG's active transportation program has failed to increase cycling or walking, which would be necessary to increase health or reduce emissions. As shown in figure 1, commuting by bicycle and on foot peaked at 3.2 percent in 2009, then shrank to 2.3 percent by 2012 and 2.1 percent by 2019. The increase in remote working depressed it to 1.9 percent in 2023.

In attempting to promote cycling and walking, MAG faces three formidable obstacles. First, the American cities that have the most cycling and walking are college towns such as Boulder, Davis, and Eugene, which have a high proportion of people under 30. Second, Phoenix may be a mecca for walking and cycling in the early morning hours, but attempting to do them in hot afternoons, which would be necessary for most commuting, could be deadly. Third, cycling in particular is intimidating to people when they have to share the roads with autos and trucks.

MAG can't do anything about the region's age composition or its weather. Instead, the primary goal of its active transportation program should be to increase the safety of cyclists and pedestrians. Some of the projects it funds may do that, but others contribute little to safety and some may even be counterproductive.

Arizona paradoxically has the safest freeways in the nation, with just 1.4 fatalities per billion vehicle-miles compared with a national average of 5.6 in 2023, but the most dangerous non-freeway arterials, with 29.3 fatalities per billion vehicle-miles compared with a national average of 16.6.[62] These non-freeway arterials are particularly dangerous for pedestrians and bicycle riders: In urban Maricopa County, more than two-thirds of the cyclists and 90 percent of pedestrians killed on the roads in 2023 lost their lives on such non-freeway arterials as opposed to collector streets or local streets. Improving the safety of these roads and/or attracting pedestrians and cyclists to safer roads should be the focus of most of MAG's active transportation program.

Thanks to those dangerous arterials, pedestrian and cycling fatality rates per billion vehicle-miles are higher in Arizona than most other states. Nationally, pedestrian fatalities peaked in 1979 and cycling fatalities in 1975. Despite the increase in driving, pedestrian fatalities fell by 50 percent between 1979 and 2009 while cycling fatalities fell by 38 percent between 1975 and 2010. Some of those gains were lost between 2010 and 2022 as both pedestrian and bicycle fatalities grew by about 80 percent.

The decline in fatalities between the 1970s and about 2010 was probably due to safer roads. In particular, freeways tend to be the safest roads and construction of interstate highways and other freeways made other roads safer by removing some of their traffic. The increase in fatalities after 2010 has been blamed by some on smart phones and by others on the increase in the size of pickups and SUVs. A close look at the data reveals that the increase in fatalities was entirely in urban areas, and since large pickups and SUVs are

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most common in rural areas, while cell phone service is not, smart phones seem likely to be the most important culprit.

However, Arizona has not followed national trends. Both pedestrian and cycling fatalities rose until 2022, almost 50 years after the national peaks. In 2022, Arizona fatalities, most of which are in the Phoenix area, were more than double what they had been thirty years before. Both pedestrian and cycling fatalities in urban Maricopa County set records in 2022, and 2023 fatalities were higher than any year prior to 2022. MAG alone can't do much about smart-phone usage, but it can and should do everything possible to design roads so that they are safer for pedestrians and cyclists.

To do so, MAG needs to utilize a data-driven process for identifying and rectifying dangerous conditions. This should emulate the U.S. airline industry, which suffered 34 fatal crashes killing 931 people in the 1990s. In response, airlines, airplane manufacturers, government agencies, and the pilots union developed a data-driven incident reporting system that focused on fixing problems, not blaming individual errors or oversights. The result was that there has only been one fatal commercial airline crash in the United States since 2009.[63]

Instead of using such a data-driven process, the city of Phoenix adopted a vision zero plan in 2022.[64] Vision zero doesn't rely on data but instead is an urban planning fad that makes grandiose claims that slowing down auto traffic will reduce fatalities to zero in ten years without asking whether such slowdowns truly make streets safer.

In the United States, vision zero has a zero percent success record.

• In 2012, Chicago was the first American city to adopt a vision zero plan with the goal of reducing fatalities to zero by 2022.[65] In fact, fatalities there grew from 145 in 2012 to 192 in 2022.

• New York City adopted a vision zero plan in 2014; fatalities there grew from 250 in 2014 to 253, a near record for the city, in 2024.[66]

• Los Angeles and San Francisco also adopted vision zero plans in 2014 with goals of eliminating all traffic deaths in ten years. Instead, Los Angeles fatalities grew from 242 in 2014 to 302 in 2024, while San Francisco's grew from 32 in 2014 to 42 in 2024.[67]

• Portland adopted a vision zero plan in 2016; in 2024, the city auditor released a report saying that it wasn't working.[68]

• Jersey City adopted a vision zero plan in 2018 and at the end of 2022 it proudly announced that it had zero fatalities on city-owned streets in that year. What it didn't say is that it also had zero fatalities on city-owned streets in 2016 before adopting vision zero. It also had four fatalities on city-owned streets in 2023, which is the average number of fatalities it had on those streets for the previous eight years.[70]

Instead of relying on urban planning fads, MAG should draw from and add to the National Highway Traffic Safety Administration's database called the Fatality and Injury Reporting System Tool (FIRST). This has detailed data for crashes dating back to at least 2009.[71] The data can be broken out by state, county, city, and urban and rural areas of states or municipalities.

There are many gaps in this database that could be filled in by MAG using local data, but even with those gaps it provides much useful information. For urban Maricopa County, the data show, for example, more than three-fourths of pedestrian fatalities take place at night and nighttime fatalities are growing faster than daylight fatalities. The data also show that two-thirds involved pedestrians crossing streets away from designated crosswalks or corners where motorists might be more alert for

pedestrians. Further, more than 40 percent of the pedestrians killed were inebriated. Nine out of ten of those inebriated pedestrians had blood alcohol content levels greater than 0.08, which is widely recognized as the threshold for significant impairment.

Before someone reading this paper says it is "blaming the victims," remember that the goal of a data-driven process is not to assign blame but to find and fix problems. In this case, the increase of nighttime pedestrian fatalities may be related to the growth of homeless camps near non-freeway arterials.[72] The city of Portland reported that 70 percent of its pedestrian fatalities in 2021 were homeless people.[73] A similar report came from San Jose.[74]

The FIRST database doesn't record whether an accident victim is homeless, but the fact that so many fatalities happen when pedestrians cross streets away from crosswalks at night suggests some remedies. One is to install mid-block pedestrian crosswalks on many of Phoenix's longer blocks, thus giving pedestrians safer places to cross. Depending on how they are designed, such crosswalks with flashing lights when pedestrians use them can cost between $22,000 and $60,000.[75]

A few such crosswalks are included in recent MAG Transportation Improvement Programs, but not many. On the other hand, the 2025-2030 program includes building a 3rd Street pedestrian bridge over Rio Salado at a cost of more than $30 million, which is about a fifth of the active transportation dollars in the plan. Since there is already a bridge across the river with wide sidewalks just three blocks away, this is not a cost-effective way of improving pedestrian safety or, for that matter, accomplishing any other active transportation goal.

FIRST data also show that about 14 percent of cyclist deaths occurred when the cyclist was struck from behind by a motor vehicle while 43 percent of cyclist deaths occurred at intersections. Several of the bicycle projects in MAG's transportation improvement program involve adding bike lanes to existing streets, often at the expense of removing some lanes of traffic.

For example, in March 2014, north 15th Avenue was a four-lane street with a center left-turn lane.[76] By April 2015, it had been changed to a two-lane street with a center left-turn lane and two bike lanes.[77] Similarly, parts of West Alameda Drive in Tempe had four lanes with a center left-turn lane in 2021, but was reduced to two lanes plus center left-turn lane and two bike lanes by 2024.[78]

Such bike lanes are meant to reduce the possibility of bicycles being rear-ended by cars, but they do nothing to improve the safety at intersections. Fatalities at intersections may even increase if the bike lanes create an illusion of safety that leads more people to ride bikes on streets with those lanes. At least one researcher has estimated that bike lanes lead to a 160 percent increase in accidents.[79]

A better way is to attract bicycle riders away from arterial streets by designating and building bike routes on local streets that parallel those arterials. These are often called bicycle boulevards and may include chicanes or other minor barriers to allow through bicycle traffic and local auto traffic but prevent through auto traffic.

Only one bicycle boulevard is included in the 2025-2030 Transportation Improvement Program. That project, which is on Country Club Way between Warner Road and U.S. 60, is projected to cost $6.9 million for 3.5 miles, or almost $2 million a mile. However, a 2013 study found that bicycle boulevards in other cities have cost between $66,000 and $200,000 a mile (in today's dollars), so the cost of the Country Club Way boulevard seems excessive.[80]

At $200,000 a mile, for the cost of the Country Club Way boulevard, Phoenix could build almost 35 miles of bicycle boulevards. The price of the 3rd Street bridge could pay for hundreds of mid-block pedestrian crossings. More cost-effective use of MAGs active transportation funds would do far more to improve bicycle and pedestrian safety and thereby help to promote these activities. ■

CONCLUSIONS

This analysis has documented numerous indications that MAG's transportation vision for Phoenix has failed. These include:

- Between 2009 and 2019, bus and rail's share of regional travel declined by almost 25 percent and its share of commuting declined by 26 percent;
- Transit's relevance declined so much that the number of miles that Phoenix-area residents traveled by car rose from 126 for every mile they rode transit in 2009 to 165 in 2019 to 300 in 2023;
- While 3.2 percent of workers commuted by transit in 2009, this declined to 2.1 percent in 2019 and 1.8 percent in 2023, all of which are among the lowest of the nation's major urban areas;
- Prior to the pandemic, transit carried just 12.5 percent of commuters to downtown, which was lower than almost all other major urban areas. This more recently fell to less than 10 percent;
- Transit almost completely neglects the region's other major job centers, carrying just 1.6 percent of commuters to ten major economic centers that have 31 percent of the region's jobs;
- MAG's long-term light-rail plans would not serve any of the region's major edge cities other than the three already reached by light rail—not that it would make much difference if they did because Phoenix's light-rail trains are too slow to compete with driving;
- The growth of Phoenix-area congestion doubled from 1.1 percent a year before 2009—right after the region's first light-rail line opened—to 2.2 percent a year through 2019;
- When measured as a percent of the region's jobs accessible to the average resident in 10 through 60 minutes of travel, the mobility provided by transit and bicycling both declined for all travel times and for auto driving for travel times less than 50 minutes;
- Light rail is operationally inefficient as it costs more to operate per seat-mile than buses;
- By many indicators, Phoenix air pollution was worse in 2024 than in 2019;
- Phoenix transit uses far more energy and emits far more greenhouse gases per passenger-mile than the average car or even an average light truck;
- Phoenix transit's recovery from the pandemic is the third-worst of the nation's 50 largest urban areas;
- The pandemic significantly altered travel patterns, yet MAG hasn't significantly changed its plans for transit;
- Phoenix-area vehicle ownership is rising, partly because people know that transit doesn't serve their needs;
- Most people without vehicles don't use transit—just 23 percent of workers in households without vehicles commuted by transit in 2019 falling to 12 percent in 2023;

- Between 2009 and 2019, walking and bicycling's share of commuting also declined by 25 percent;
- During that same period, the number of pedestrian fatalities in urban Maricopa County grew by 127 percent while the number of bicycle fatalities grew by 42 percent;
- Bicycle and pedestrian fatalities both reached record levels in 2022.
- Prior to the pandemic, transit subsidies per passenger-mile were more than 100 times greater than highway subsidies; as of 2023, they are 400 times greater.

For all these reasons, the Arizona auditor general needs to take a hard look at MAG's transportation plans. At the very least, the audit should consider the following issues:

- Why should Phoenix build more expensive light-rail lines when ridership declined after construction of lines built to date?
- Why should 25 percent of the region's transportation resources be spent on transit systems that carried less than 0.6 percent of the region's travel before the pandemic and even less today?
- Why is Phoenix transit ridership still less than 60 percent of pre-pandemic numbers when driving fully recovered from the pandemic by 2021 and other transit systems average 80 percent of pre-COVID riders?
- How will building more slow and expensive light-rail lines help transit ridership recover to 2019 or, better, 2009 levels?
- Why have transit operating costs risen so much faster than inflation?
- Why did general administration rise even faster than operating costs?
- Why should MAG promote transit-oriented developments?
- Why have MAG's transit plans neglected major economic centers such as southwest Chandler and Deer Valley?
- Why hasn't MAG re-evaluated its transit plans in light of transit declines and other indications of failure between 2009 and 2019?
- Why hasn't MAG re-evaluated its transit plans in light of changes in travel patterns resulting from the pandemic?
- Why is Phoenix's transit system so poorly designed that the vast majority of the region's workers who live in households without cars elect to commute to work by means other than transit?
- Does MAG's active transportation program have any coherent goals or is it just spending money because the federal dollars are available?
- If MAG does have specific goals for active transportation, is its funding being cost-effectively spent?
- Why hasn't MAG incorporated a monitoring and feedback system into its planning to help it determine whether its plans are working or whether to adjust those plans?

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