# Employee and Student Trip Reduction: First-Year Results from Metropolitan Phoenix

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Initial trip reduction achievement by three commuter groups in the Maricopa County Regional Travel Reduction Program for metropolitan Phoenix, Arizona, is reported. Although students had the most success in changing their behavior, non-school employees, by far the largest commuter group, and school employees also reduced their percentages of single occupant vehicle trips. Total reductions in single occupant vehicle miles traveled were small but measurable. Although economic subsidies as well as less expensive measures were linked with trip reduction at non-school work sites, education measures were linked with trip reduction at school sites. These findings confirm that early progress can be expected from regional employer-based trip reduction programs, indicate the need to consider different commuter groups, and affirm the value of diverse trip reduction measures.

Trip reduction programs are now conducted at a wide range of locations from individual work sites to individual communities and metropolitan regions (*1*). Across the country regional ordinances have been enacted to address both the vehicle emissions portion of the urban air pollution problem and increasing traffic congestion. However, between 1980 and 1990, the national population growth rate was exceeded by drive alone trip growth and by growth in the number of vehicles (*2*). Mandatory trip reduction programs focused on commuting behavior may contribute to slowing these growth trends.

The experience of these programs must be examined to identify whether or not travel behavior can be changed and, if so, how much change occurs. Although researchers have not agreed on a single evaluation research design, every new trip reduction program should be evaluated for its initial efforts and later progress (*3*). Although these new public programs can be expected to take several years to become fully effective, especially the large regional programs (*4*), early results are useful as indicators of future program progress, as comparisons with other programs, and as predictions for newer programs.

This paper describes the first-year program impact of the Maricopa County, Arizona, regional program and examines three key commuter groups at single work sites where employers adopted trip reduction plans with multiple trip reduction measures: students, school employees, and non-school employees. Initial program impact is indicated by comparing commuting travel before the regional program was implemented with travel characteristics 1 year later.

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## MARICOPA COUNTY REGIONAL TRAVEL REDUCTION PROGRAM

Vehicle emissions are a major source of regional air pollution in metropolitan Phoenix (urban Maricopa County). The Arizona State Legislature established the Maricopa County Regional Travel Reduction Program (MCRTRP) in 1988 under pressure from the Environmental Protection Agency after a suit by an advocacy group, the Center for Law in the Public Interest. Attainment of a 22.3 percent reduction in regional carbon monoxide emissions by 1991 was to be achieved by four sets of activities: existing programs in the 1987 Carbon Monoxide Plan, a mandatory oxygenated vehicle fuels program, a loaded mode test for the vehicle inspection maintenance program, and this mandatory travel reduction program.

This program's small (1.8 percent) expected contribution to emission reduction understates its role in educating local employers and commuters to the need to reduce drive alone trips.

Employers with 100 or more workers at a site must participate and make a "good faith" effort to achieve trip reduction goals. Specific requirements are (*a*) to survey employees, (*b*) to appoint a transportation coordinator, (*c*) prepare a trip reduction plan, and (*d*) to disseminate alternate mode information (*5*).

Trip reduction goals were set as a 5 percent reduction each year in either the percentage of single-occupant vehicle (SOV) trips or the percentage of SOV miles traveled. This standard was set for the program's first 2 years and later mandated by the legislature for the third year. Employers have surveyed their employees' travel using a single survey instrument designed by the county program; students have been surveyed using a separate survey instrument.

The Maricopa County Trip Reduction Ordinance, effective July 1, 1994, expanded the program to include small employers with 50 or more employees at a single work site. New trip reduction goals were set to reach and maintain a 60 percent rate of SOV trips or miles traveled.

## STUDY DATA SETS

This study follows the approach and methods of Giuliano et al. (*6*) in their evaluation of the South Coast Air Quality Management District's Regulation XV in Los Angeles, a more stringent regional trip reduction program also initiated in 1988.

This metropolitan Phoenix study includes the 384 employers in the program on April 31, 1992, that had completed minimum requirements for the first 2 years: a baseline year employee and student survey, an approved trip reduction plan, and the first program year employee and student survey.

Baseline year data describe employee commutes before the trip reduction program went into effect. Additional employers were in the program on this date but, whereas some had completed baseline year requirements, none had completed their first-year plan and surveys. The first-year completion qualifier ensures that the measures in each employer's plan were available and changes in employee travel behavior from the baseline year to the first year were known.

The MCRTRP's approach of phasing large employers into the program before smaller employers biases results in favor of the larger companies. Smaller employers are likely to have entered the program later and not to have completed first-year requirements in spite of possible progress toward reduction goals. A maximum period of 17 months could occur between the baseline and the second year survey because the program's baseline period began in July 1988 and ended in December 1990.

The basic unit of analysis in this study is the work site with no examination of the combined effect of several work sites operated by one employer. Two types of work sites are included in the study: employer (525) and school (53). Travel behavior is reported for 332,980 commuters: 245,421 employees at 525 non-school sites; 13,451 employees at 50 school sites; and 74,108 students at 53 school sites.

Standard industrial classification codes at the four-digit level were available from the MCRTRP files and were summarized at the one-digit level to indicate the economic profile of participating employers. This profile indicates the importance of manufacturing (34.5 percent of non-school sites); services (50.5 percent of non-school sites and 100.0 percent of school sites); and state and local government (13.5 percent of non-school sites).

The 578 sites also vary by size and by type of commuters. Non-school employees are concentrated at small sites with over 40 percent of non-school employees at sites with 100 to 199 employees; over 60 percent at sites with less than 299 employees; and 77.6 percent at sites with less than 500 employees. School employment, however, is concentrated at large sites with only 24.5 percent at sites with below 500 employees. Sites with over 1,000 commuters account for 54.7 percent of all school sites, but only 6.9 percent of non-school sites. The main campus of Arizona State University is the largest single site in the program: 3,825 students and 9,349 employees participated in the baseline year survey (*7*).

Study data differ from the Giuliano et al. study of the initial Los Angles program. Although average vehicle ridership change was mandated for three Los Angeles regions, the metropolitan Phoenix program mandated the same SOV trip reduction measures throughout the region. The Phoenix program had a smaller total number of work sites (578) than the Los Angeles program even when 53 school sites were included. The Los Angeles study developed a 1,100 site sample from 4,032 non-school work sites. The Phoenix program also had fewer large work sites with 500–999 employees (15.6 percent), compared to 22 percent in the Los Angeles study, and fewer sites with over 1,000 employees (6.9 percent) compared to 15 percent in the Los Angeles study.

## CHANGE IN DRIVE-ALONE COMMUTING

### Total Change

The single most important indicator of the effectiveness of the trip reduction program is the change in drive alone commuting between surveys for each work site. This change is reported by the MCRTRP staff in two ways: change in the percentage of SOV commute trips per week and change in the SOV one-way commute miles per week.

Table 1 compares baseline year and first-year averages for both measures. Employees had similar high levels of drive alone commutes at non-school (81.7 percent) and school (82.8 percent) sites. Their drive-alone commutes were reduced during the study period at similar rates: 3.9 percent for non-school employees and 3.6 percent for school employees. Students not only had a lower baseline SOV travel rate (42.5 percent), but indicated the greatest percentage decline in SOV commutes (13.4 percent).

Change in drive-alone commute miles indicates a different trend. Average SOV miles traveled per week declined for all three groups (Table 2). Although school employees traveled fewer miles (46.3) than employees at other sites (53.5), they reduced their miles traveled by only 0.8 percent compared to a reduction of 1.3 percent for non-school employees. Students had a low initial level of miles traveled (31.2), but were able to reduce their travel by 5.7 percent, a rate higher than either school or non-school employees.

### Change by Number of Commuters

Detailed findings indicate trip reduction behavior. Bar charts show the frequency distributions of the average percentage of SOV trips and the average SOV miles during the baseline year and first year for non-school employees, school employees, and students at each work site. On Figures 1 through 6, an overall shift to the right in column heights from the baseline year to the first year shows that trip reduction occurred. Distinctive Arizona State University results are shown and discussed separately.

**TABLE 1 SOV Trips**

| Categories | Mean Baseline SOV % | Mean SOV % after 1 year | Change in SOV % | N |
|---|---|---|---|---|
| Employees at non-school sites | 81.7 | 78.5 | 3.9% | 525 |
| School employees | 82.8 | 79.8 | 3.6 | 50 |
| Students | 42.5 | 36.8 | 13.4 | 53 |

**TABLE 2 SOV Miles**

| Categories | Mean Baseline SOV Miles | Mean SOV miles after 1 year | Change in miles | N |
|---|---|---|---|---|
| Employees at non-school sites | 53.5 | 52.8 | 1.3% | 525 |
| School employees | 46.3 | 45.9 | 0.8 | 50 |
| Students | 31.2 | 29.4 | 5.7 | 53 |

Shifts toward trip reduction are clear for non-school employees. Their travel in the baseline year, grouped by the percentage of SOV trips reported for each non-school employee work site (Figure 1), peaked in the category of 89–85 percent, with a rapid decline in numbers of employees at sites with lower rates. This peak shifted downward to the 79–75 percent category a year later. The number of commuters in all higher percentage categories declined. The number of commuters in all lower percentage categories increased except for the 64–60 percent category, suggesting a minimum trip level that may be difficult to reduce.

The SOV miles per week for sites with non-school employees are shown on Figure 2. The numbers of commuters are distributed symmetrically around a peak in the 59–55-mi range in both years. After 1 year of the program's operation, however, this peak is lower, the number of employees in all lower mile ranges increases, and most higher mile categories show decreases.

School employees similarly shifted their trips, but their percentage of SOV commutes clustered in both years in a single peak category, 89–85 percent (Figure 3). Few sites had an average employee SOV commute below 64–60 percent, reinforcing the previous finding that 60 percent is a minimum level of drive-alone trips that may be difficult to reduce. First year travel, however, declined in the category above 89–85 percent (94–90 percent) and increased in all but one of the lower categories.

The school employees' pattern of SOV miles traveled shows a baseline year peak in the 44–40-mi range that shifted to the lower 39–35-mi range after 1 year (Figure 4). Fewer employees traveled in all but two of the eight categories above 39–35 mi.

These general patterns of school employee travel differ for the main campus of Arizona State University. The percentage of baseline year SOV trips, 71.5 percent, was reduced to 71.2 percent (Figure 3), whereas the average SOV miles (41) increased slightly to 41.57 mi (Figure 4). These results may have been influenced by the fact that fewer employees replied to the survey taken after 1 year of program operation (3,295) than completed the baseline survey (3,825).

All student travel contrasts strongly with employee commuting patterns, whether at school or non-school sites. Two different student groups appear to create these trends. Alternate mode use is likely to be higher for high school students who are primarily dependent on household members for use of a car than for university students, many of whom support themselves. Separating Arizona State University students from all other students clarifies this pattern on Figures 5 and 6.

The student baseline year percentage of SOV commutes had one cluster at a high peak of 79–75 percent and a second, lower peak at 25–30 percent (Figure 5). In the first year, the number of students declined in all percentage categories higher than 79–75 percent and increased overall in the lower than 79–75 percent categories. For

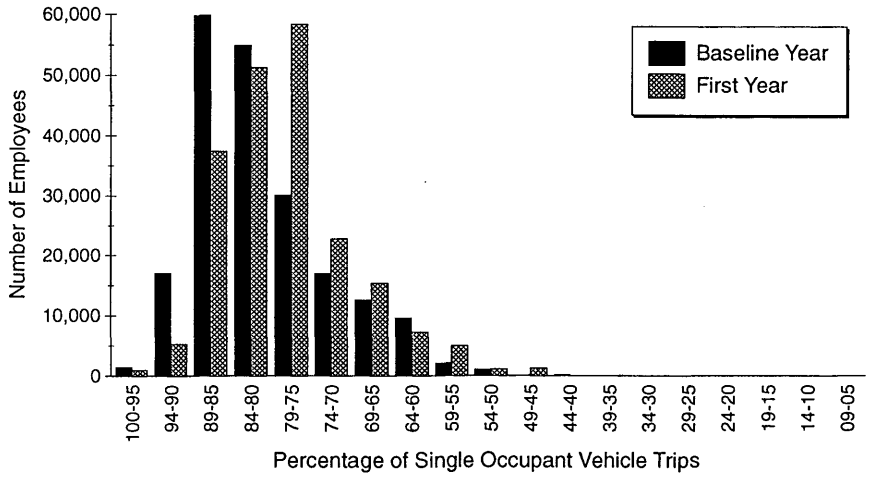


**FIGURE 1 SOV trips by employees at non-school sites.**

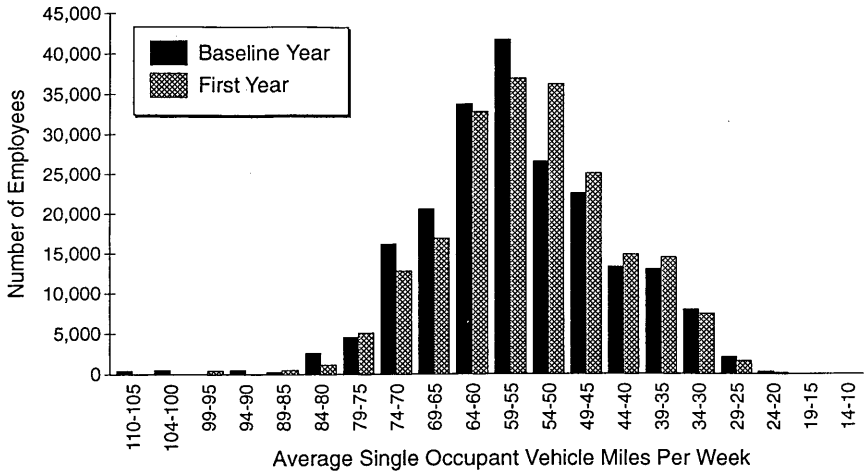


**FIGURE 2 SOV miles by employees at non-school sites.**

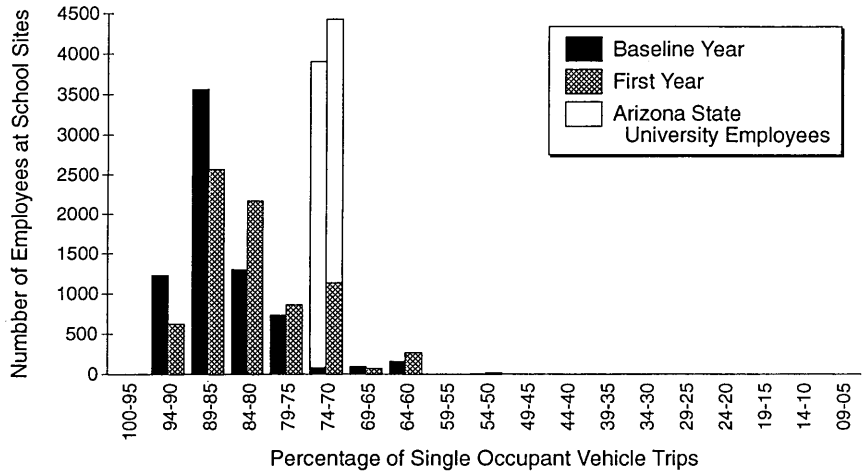


**FIGURE 3 SOV trips by employees at school sites.**

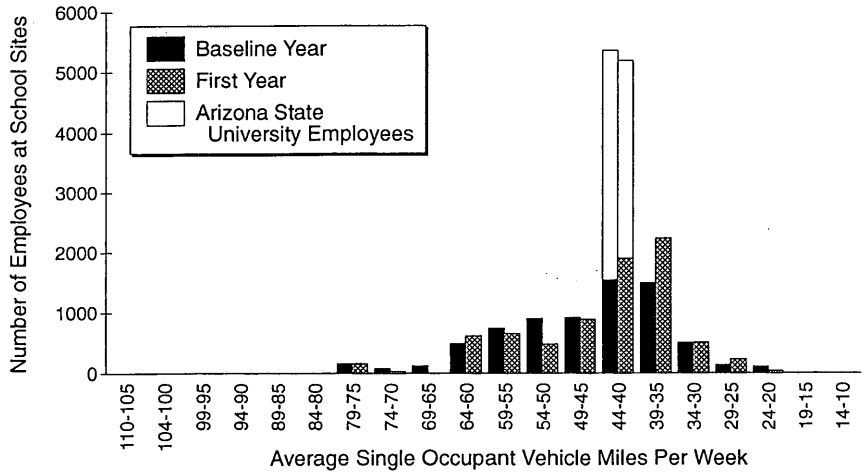


**FIGURE 4 SOV miles by employees at school sites.**

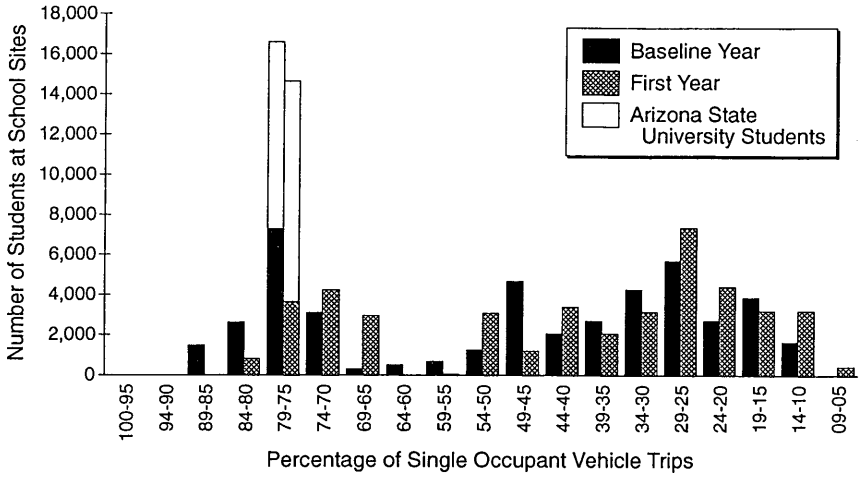


**FIGURE 5 SOV trips by students.**

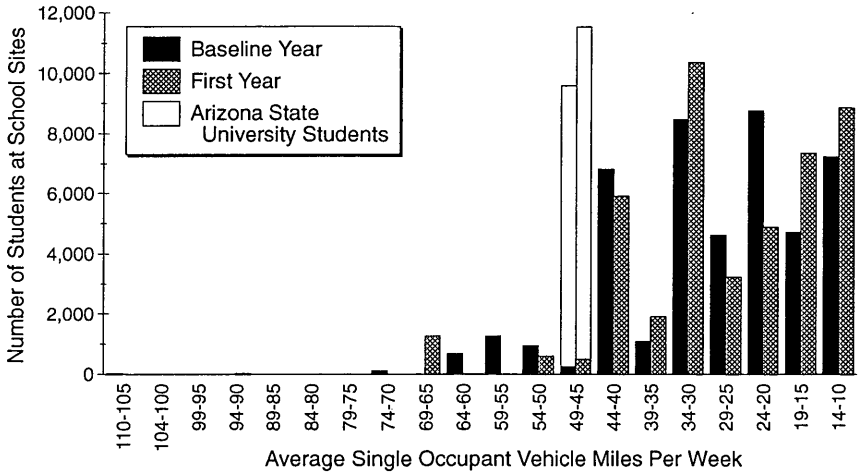


**FIGURE 6 SOV miles by students.**

SOV miles traveled (Figure 6), student commutes were concentrated in several categories with peaks at 44–40, 34–30, 24–20, and 14–10 mi. A clear peak emerged, however, at 34–30 mi in the first year.

Arizona State University students were two-thirds of all students in the category of 79–75 percent SOV trips. They achieved a 1 percent reduction based on a reported 77.5 percent baseline year percentage and a 76.7 percent first year percentage (Figure 5). These university students increased their SOV mile commutes by 3 percent, however, based on their reported 45-mi baseline year average and 46.4-mi average in the first program year (Figure 6). The varying number of student survey respondents at the Arizona State University main campus may have influenced these results. More students (11,036) completed surveys in the first program year than in the baseline year survey (9,344).

## Trip Reduction Achievement

Overall, these findings indicate that (a) fewer employee and student commuters drove alone and (b) a small reduction in miles driven occurred. Aggregate figures show the approximate air quality impact of the first year's program, calculated by using 25 mi as a measure for 1 pound of pollution and multiplying the midpoint value for SOV miles by the number of employees in each category. Non-school employees reduced pollution by 5.8 tons/week, based on a decrease of 290,737 mi from a baseline year total of 11,527,841 mi/week.

Net student and school employee emission amounts indicate the impact of the program's largest employer and site. Arizona State University's atypical findings were, in part, due to large differences in the large numbers of employees and students surveyed. School employees, including Arizona State University employees, decreased pollution by 0.24 ton/week from their baseline year level of 490,846 mi/week. The net student impact including Arizona State University students, however, was an emissions increase equal to 0.58 ton/week from an initial level of 1,705,720 mi/week.

Trip reduction achievement, defined as meeting one or both of the 5 percent trip reduction goals during the first program year, occurred at different levels for these employee and student groups. Non-school employees met the trip reduction goal on 39 percent of

their sites; school employees met the goal on 50 percent of their school sites; and students met the goal on 71 percent of the school sites (Arizona State University is considered as one site).

These differences are important considerations when trip reduction plans must be developed for distinct groups who commute to a single work site. Chi-square analyses confirmed that non-school employees, school employees, and students were distinct populations. Employee groups differed significantly when compared for progress or lack of progress toward trip reduction and when compared for achievement or lack of achievement of trip reduction goals. School employees and students were similarly compared and were separate populations.

## USE OF INCENTIVES

### Frequency of Measures by Mode

Each employer's plan is a mix of incentives to encourage ride sharing or other alternate modes and discourage use of drive alone commutes. The set of incentives for each site was identified for all 578 sites from each original plan document.

The quality of the incentive data is limited. Employers with multiple work sites routinely applied a single plan to all sites. Although 51 incentives are identified, plan descriptions are brief. There is no information on when an incentive is phased in during a year, so an incentive's impact could be limited by when it is initiated. Without direct monitoring of companies, a suggested measure may not be actually in place.

Initial trip reduction plans had an emphasis on education measures (publications/newsletters, new hire orientation) and carpool incentives (preferred parking spaces, guaranteed ride home, prizes). Incentives are grouped in the program's classification system by modes (Table 3).

Over half the non-school plans contained the following measures: preferred parking spaces for carpools (77.9 percent), guaranteed ride home for carpools (69.5 percent), publications and newsletters about the trip reduction program (68.6 percent), prize drawings for carpools (67.0 percent), new hire orientation (58.7 percent), Zip code matching for carpools (57.7 percent), and bike racks for bicycle riders (61.3 percent).

School sites had more uniform plans that focused on a few of the same measures most included in the non-school plans. The most common measures were: preferred parking spaces for carpools (84.9 percent), publications/newsletters about the trip reduction program (73.6 percent), bicycle racks for bicycle riders (67.9 percent), new hire orientation (64.2 percent). A guaranteed ride home for carpools, which can be expected to serve adult employees more than students, was included in only 17.0 percent of the school plans. Similarly, few school plans include ZIP code matching (3.8 percent) for carpools. Prize drawings for carpools were included in 45.3 percent of the school site plans.

Measures that shift or eliminate trips are not a large component of the initial plans. Flexible work hours (22.1 percent), compressed work week (15.6 percent), telecommuting/work at home (11.2 percent) were included in non-school plans. Interestingly, 26.4 percent of the school sites included the option of a compressed work week. This option could be easier to implement at elementary and high school sites than at employer sites where employees have diverse schedules and activities. Only 15.6 percent of the employer sites had a similar option. A shuttle between work sites, a measure that can shorten the SOV portion of a commute or eliminate SOV trips during the work day, was adopted for employee work sites (10.3 percent), but seldom mentioned in school plans (1.9 percent) where fewer sites require daily connection.

Parking fees, coupled with alternate mode incentives, are widely discussed nationally as an economic disincentive to drive alone commutes. Most Arizona employers provide free parking, however. Only 1.9 percent of the ten non-school plans and one school plan proposed a parking fee increase. Arizona State University, where parking fees are charged for students and employees, recommended a parking fee increase that was not adopted.

### Baseline Year Values and Number of Measures

Using a large number of measures is one reasonable strategy for an employer's first trip reduction plan. In such a plan each employee has more chances to respond to at least one incentive. In addition, employers with high baseline year levels of drive alone commuting may respond by offering a large number of plan measures in an effort to increase their chances of influencing more employees. There is little difference, however, in the average number of measures for non-school (13) and school plans (11).

Statistical correlations of the data indicate there is no statistically significant relationship for non-school sites between the level of baseline year SOV percent trips and SOV miles, the number of plan measures, and SOV percent trips and SOV miles reduced. For school sites, student trip reduction indicated no association between each measure of trip reduction and either the number of school plan measures or baseline year values and no relationship with SOV miles reduced for school employees. There is a low positive correlation ($r = +0.26$), however, between the percent of SOV trips reduced and the number of plan measures.

### Individual Measures

Aggregate analyses of trip reduction plans offer little insight into initial trip reduction progress in metropolitan Phoenix as each plan is a set of separate measures designed to respond to the specific concerns of employees or students. However, individual measures can be linked to changed commuter behavior.

The 51 measures were separately examined to determine whether a measure's presence in the employer plan was associated with a statistically significant decrease in the percentage of SOV trips or SOV miles. Significant relationships are reported for non-school and school plans (Table 3) from one-way analysis of means tests. This test compared the average change between the group of employer plans offering the incentive and the group of employer plans not offering the incentive. Similar tests compared each measure offered at sites where the regional program's goal of a 5 percent or greater reduction was and was not achieved.

Reduction in SOV trip percentage at non-school sites was associated with measures for four modes: carpool, vanpool, bus, and walking. Two vanpool measures—prizes and guaranteed ride home—plus a carpool measure, the local "Don't Drive One-in-Five" campaign have the strongest individual statistical association. Vanpool prizes and guaranteed ride home were associated with sites that achieved the 5 percent reduction goal.

For reduction in SOV miles, measures for carpool, vanpool, and bicycle modes are significant. Two vanpool measures—prizes and

TABLE 3 Frequency of Measures by Mode

| MEASURES | Non-School Sites (N = 525) Number | | Percent | School Sites (N = 53) Number | | Percent |
|---|---|---|---|---|---|---|
| **Carpooling-related Incentives** | | | | | | |
| preferred parking spaces | 409 | | 77.9% | 45 | | 84.9% |
| guaranteed ride home | 365 | b | 69.5 | 26 | | 49.1 |
| prize drawings | 352 | c | 67.0 | 24 | | 45.3 |
| zip-code matching | 303 | | 57.7 | 26 | | 49.1 |
| subsidize carpool drivers | 89 | | 17.0 | 6 | | 11.3 |
| "Don't Drive One-in-Five" | 23 | b | 4.4 | 6 | | 11.3 |
| free/discount parking for carpoolers | 21 | | 4.0 | 2 | | 3.8 |
| **Vanpooling-related Incentives** | | | | | | |
| preferred parking spaces | 190 | c | 36.2 | 19 | | 35.8 |
| guaranteed ride home | 161 | bc | 30.7 | 9 | | 17.0 |
| prize drawings | 121 | bd | 23.0 | 6 | | 11.3 |
| zip-code matching | 73 | d | 13.9 | 2 | | 3.8 |
| subsidize vanpool drivers | 42 | c | 8.0 | 0 | | 0.0 |
| **Bus-riding Incentives** | | | | | | |
| bus-route/schedule books supplied on site | 255 | | 48.6 | 11 | ac | 20.8 |
| guaranteed ride home | 236 | b | 45.0 | 16 | | 30.2 |
| subsidize bus tickets/passes | 229 | | 43.6 | 20 | | 37.7 |
| prize drawings | 208 | a | 39.6 | 9 | | 17.0 |
| work with local transits to extend service | 152 | | 29.0 | 7 | | 13.2 |
| bus ticket/pass on site | 131 | | 25.0 | 13 | | 24.5 |
| flexible work hours for riders | 79 | | 15.0 | 9 | | 17.0 |
| **Bicycle-riding Incentives** | | | | | | |
| bike racks | 322 | | 61.3 | 36 | | 67.9 |
| prize drawings | 195 | | 37.1 | 10 | | 18.9 |
| guaranteed ride home | 195 | | 37.1 | 9 | | 17.0 |
| showers and/or lockers | 118 | | 22.5 | 23 | | 43.4 |
| bike-lane maps supplied | 99 | | 18.9 | 17 | | 32.1 |
| bike safety workshops/printed materials | 78 | | 14.9 | 6 | | 11.3 |
| "Bike-to-Work Day" | 83 | c | 15.8 | 0 | | 0.0 |
| subsidize bike buyers | 57 | c | 10.9 | 15 | | 28.3 |
| "Bike One-out-of-Five" | 0 | | 0.0 | 0 | | 0.0 |
| **Walk-related Incentives** | | | | | | |
| prize drawings | 74 | a | 14.1 | 5 | | 9.4 |
| guaranteed ride home | 12 | | 2.3 | 0 | | 0.0 |
| "Walk-to-Lunch" program | 1 | | 0.2 | 0 | | 0.0 |
| **Education and Communication on TRP** | | | | | | |
| cafeteria/breakroom information center | 382 | | 72.8 | 44 | | 83.0 |
| publication/newsletters on TRP | 360 | | 68.6 | 39 | | 73.6 |
| new hire orientation | 308 | | 58.7 | 34 | | 64.2 |
| Clean Air Campaign | 158 | | 30.1 | 8 | ac | 15.1 |
| TRP information through pay stuffers | 137 | | 26.1 | 1 | | 1.9 |
| recognition in newsletters | 109 | | 20.8 | 10 | | 18.9 |
| Transportation Fair | 104 | | 19.8 | 7 | | 13.2 |
| TRP coordinator(s) | 79 | | 15.0 | 11 | | 20.8 |
| TRP committee | 59 | | 11.2 | 14 | | 26.4 |
| other kinds of TRP fairs | 50 | d | 9.5 | 1 | | 1.9 |
| **Others** | | | | | | |
| flexible work hours | 116 | | 22.1 | 9 | | 17.0 |
| compressed work week | 82 | | 15.6 | 14 | | 26.4 |
| telecommuting/work at home | 59 | | 11.2 | 1 | | 1.9 |
| shuttle service between work sites | 54 | | 10.3 | 1 | | 1.9 |
| award | 41 | | 7.8 | 3 | | 5.7 |
| on-site services | 26 | | 5.0 | 1 | | 1.9 |
| capital improvements | 12 | | 2.3 | 8 | | 15.1 |
| increased parking fees | 10 | | 1.9 | 1 | | 1.9 |
| subsidize apartment close to work | 8 | | 1.5 | 1 | | 1.9 |
| miscellaneous | 3 | | 0.6 | 0 | | 0.0 |

a: Presence of incentive significantly related to decline in SOV percent, at $p < .05$
b: Presence of incentive significantly related to decline in SOV percent, at $p < .01$
c: Presence of incentive significantly related to decline in SOV miles, at $p < .05$
d: Presence of incentive significantly related to decline in SOV miles, at $p < .01$

ZIP code matching—and an education category of specific trip reduction events other than an employer's general fair have the strongest statistical association. Vanpool preferred parking and a guaranteed ride home for vanpool and bicycle commuters were associated with work sites that achieved a 5 percent reduction as was the shuttle service between work sites.

School sites, where the trip reduction plans serve both employees and students, present a less complex pattern. Two education measures are strongly linked to reduction in SOV trips and miles—the availability of bus books on site and the local "Clean Air Campaign." School sites are effective settings for these measures; students reduced their SOV trips more than either school or non-school employees. Both measures were linked to achievement of a 5 percent reduction in SOV percent, whereas a guaranteed ride home and bicycle racks were linked to achieving a 5 percent reduction in SOV miles traveled.

The number and set of measures associated with progress in trip reduction varies by mode. The strong association of vanpool measures with a reduction in the percentage of SOV trips and SOV miles supports multiple efforts to serve this group of commuters who often travel long distances. Both direct economic rewards, in the form of prizes and subsidies, and assistance, as trip reduction events, ZIP code matching, and guaranteed rides home, matter to vanpool users. Carpool users are influenced by direct incentives—prizes—but also by assistance, a guaranteed ride home option, and education campaigns. Bus riders were similarly influenced by prizes and a guaranteed ride home. The combination of economic subsidy and education measures influenced bicycle riders, whereas walkers responded only to prizes.

Interestingly, individual measures with potentially high direct employer costs were identified only for two vanpool measures, subsidy and preferred parking spaces, and the "subsidize bicycle buyers" measure. Tests were conducted for the measures of prizes, subsidies, and guaranteed ride home combined for all modes. When these measures are considered across modes, the two economic incentives are strongly associated with reduced SOV miles traveled, whereas the guaranteed ride home is linked to a reduction in SOV trips.

It is important that at least two of these measures, prizes and guaranteed ride home, need not be extremely expensive for employers. Prize drawings may be effective because they maintain awareness of the trip reduction program, offer an immediate reward, and provide an incentive for continued participation. The frequency of prize drawings, employee eligibility requirements, and prize dollar values are not known, however, during this initial program year.

Assistance with emergencies outside the work site is essential for carpool, vanpool, and bus users, who, unlike bicycle and walking commuters, can find themselves stranded at work. These infrequent emergencies can be handled in a number of ways: loan of a company car, release time for a co-worker to drive an employee home, or payment of a taxi ride. In this trip reduction program and its Tucson, Arizona, counterpart, working women, especially mothers with young children, were more likely to drive to work alone than men (*8*). Their domestic and family responsibilities must be addressed so that women can participate in trip reduction efforts (*9–11*).

## CONCLUSIONS

The key finding of this study is the positive direction of trip reduction that occurred at metropolitan Phoenix work sites in the initial program year. Although non-school employees, by far the largest commuter group, and school employees had some success in reducing their percentage of SOV trips, students, the commuters with the lowest levels of drive alone use, were most successful in changing their behavior. Adult workers, even those with regular schedules provided by school employment, were least likely to change their commute trip behavior.

This study found a non-school employee pattern of initial progress toward meeting trip reduction achievement goals similar to that identified for metropolitan Los Angeles (*7*). Progress was greatest in Los Angeles for work sites with low baseline year average vehicle ridership where trip reduction measures apparently made a strong impact. The Los Angeles study, however, found positive relationships between trip reduction and the number of plan measures and between the number of measures offered and high levels of baseline year drive-alone commutes. Neither relationship was supported for metropolitan Phoenix in this program analysis.

The Phoenix results indicate limited positive findings for regional air quality improvement. Reductions in the number of SOV miles traveled per week were greatest for students and, again, smallest for school and non-school employees. The small reduction by large numbers of non-school employees with longer commutes than school employees and students produces the largest aggregate contribution to improved air quality.

Economic incentives were linked to trip reduction in metropolitan Phoenix, especially for carpool and vanpool users reducing the number of SOV miles traveled. Inexpensive measures such as participant prizes and a guaranteed ride home were also statistically significant. The Los Angeles study similarly found that these measures as well as financial incentives for specific mode users, other employee benefits, and time off with pay were significantly related to trip reduction.

Economic incentives alone, however, will not address the full range of family and household responsibilities that provide the context for individual commute mode decisions. For any given employer, the number of commuters who can easily shift modes can be expected to decline after the early program years. Retaining early program participants and expanding participation remain critical employer issues. Multiple measures that address the concerns of commuters who have no alternative to driving alone, disproportionately women, should be increasingly important in employer trip reduction efforts.

After 1 year the initial trip reduction program experience of metropolitan Phoenix indicates the promising result that employee and student commuters, at least initially, do respond to trip reduction measures. These findings also suggest that trip reduction measures have a limited, but measurable impact on regional air quality improvement. Together with other studies of trip reduction program efforts, this study contributes knowledge about larger issues of how travel demand can be managed both at the scale of individual employers and for metropolitan regions.

## ACKNOWLEDGMENTS

This research was supported by the U.S. Department of Transportation through the University of California Transportation Center research program. Data were provided by the Maricopa County Regional Travel Reduction Program. Patricia Butler, Jianling Gao, and Michael Schmandt provided research assistance.

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*All opinions expressed, as well as possible errors and omissions, are the responsibility of the author.*

*Publication of this paper sponsored by Task Force on Transportation Demand Managenent.*