TRAVEL DEMAND MANAGEMENT GUIDEBOOK

6-0702-P2

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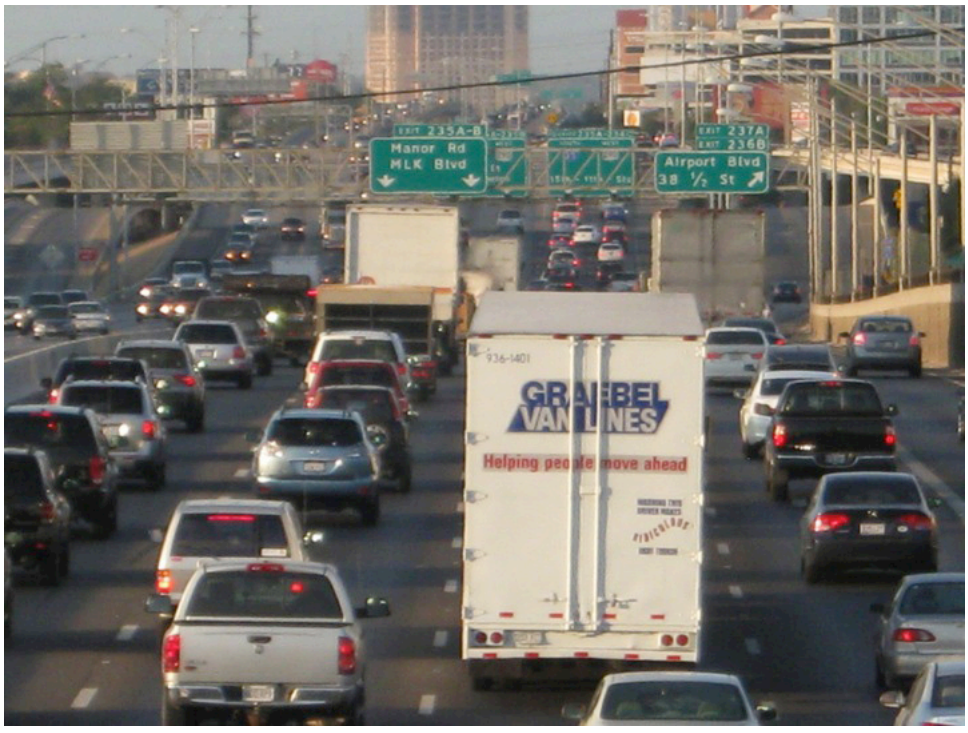
September 2013



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TxDOT Project 6-0702: Demand Leveling

SEPTEMBER 2013

Performing Organization:	**Sponsoring Organization:**
Center for Transportation Research The University of Texas at Austin 1616 Guadalupe, Suite 4.202 Austin, Texas 78701	Texas Department of Transportation Research and Technology Implementation Office P.O. Box 5080 Austin, Texas 78763-5080
Performed in cooperation with the Texas Department of Transportation and the Federal Highway Administration.	

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"Vision without action is merely a dream.
Action without vision just passes the time.
Vision with action can change the world."
—Joel Barker

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TxDOT Project 6-0702: Demand Leveling performed in cooperation with the Texas Department of Transportation and the Federal Highway Administration.

Introduction

From 2010 to 2011, the Texas population grew 2.10%, the highest rate of any state (US Census 2011). Congestion on Texas roads continues to increase as well. Dallas and Houston have the dubious distinction of ranking second and sixth, respectively, on the list of most congested morning commutes across US metro areas (as measured by yearly number of hours of delay per auto). For afternoon and mid-day travel, Austin, Houston, and Dallas rank in the top 10 of metro areas; Houston and Austin rank first and second for weekend congestion (Schrank, 2012). New strategies to manage the increasing travel demand are becoming increasingly essential. Building new infrastructure to keep up with the growth of passenger and freight travel is only part of the solution since construction is expensive, time consuming, and often infeasible. ***Demand leveling*** is a system of strategies to reduce congestion by reducing the number of single-occupancy vehicles (**SOV**) trying to simultaneously use congested roadways. By changing times of travel, diverting trips to other modes (walking, cycling, or transit), and/or increasing the vehicle occupancy, demand leveling can be part of the congestion solution. In the broader context, ***travel demand management*** (**TDM**) strategies may include demand leveling but also encompass techniques that can reduce travel demand (Rodriguez and Murtha, 2009).

Work trips account for only around 20% of all personal-vehicle trips taken in a day in Texas, but they comprise over half of the trips taken during peak periods (National Household Travel Survey, 2001). Leveling the demand during the peak periods can reduce congestion and traveler delays, improve air quality, and improve access to jobs. The type of TDM scheme that is best for employees of any specific company depends on various factors described in this guide.

1 Section 1 introduces the different types of voluntary TDM solutions and discusses their successes and limitations in different settings.

2 Section 2 applies the first section's insights to Texas metropolitan areas in the form of a Texas TDM guidebook (Project Product P2). Our largest metropolitan regions vary in size, demographics, and urban development, requiring varying approaches. This section presents tailored solutions for each city in layman's terms for quick reference.

3 Section 3 offers a separate discussion of mandatory demand management strategies.

4 Section 4 presents conclusions, noting that demand leveling concepts can also be classified in terms of their ease of implementation and cost effectiveness.

A The appendix contains a cost-effectiveness table (Project Product P1).

1. Synthesis of Published Experience

INTRODUCTION

Demand management strategies can be categorized as belonging to one of two large families: mandatory and voluntary. ***Mandatory strategies*** seek to control demand for roadway use through a set of rules or disincentives. ***Rule-based mandatory strategies*** include most of the voluntary strategies if they are mandated, such as required flextime or 4-day workweeks, as well as enforced license plate rationing and similar strategies. ***Disincentive-based mandatory strategies*** include road pricing, variable toll rates, and variable parking rate concepts.

Mandatory approaches tend to affect the travel behavior of more road users than voluntary strategies, but also tend to share the common characteristic of overhead cost due to enforcement requirements. When most voluntary strategies are converted to mandatory, enforcement overhead cost can be either minimal and distributed among employers, or extensive, as for many disincentive-based strategies. Implementation of some disincentive-based strategies may require changes in state or local statutes. If these changes are seen as "new taxes," they can be considered politically unpopular.

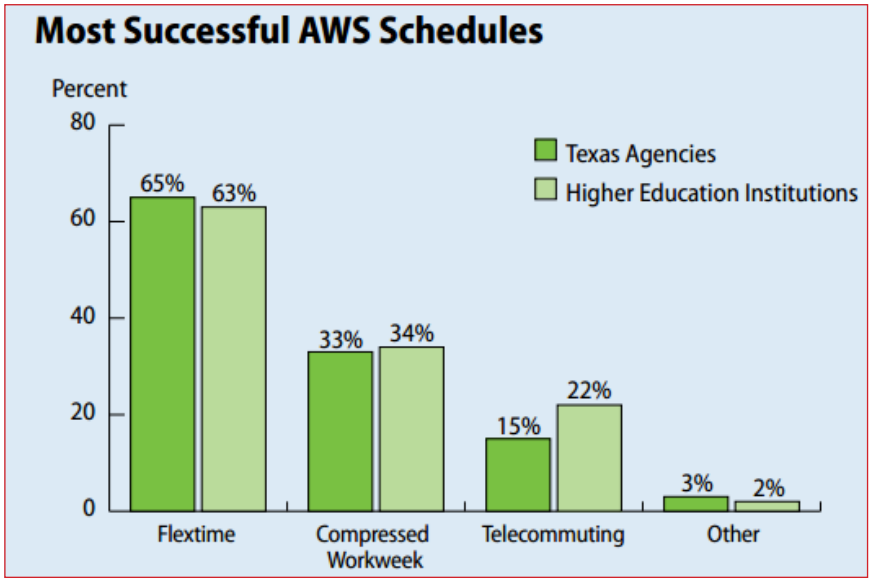
Voluntary strategies (collectively called ***flexible work arrangements***) can be cost-effective, readily implementable congestion mitigation strategies that tend to be viewed more favorably by the public than the mandatory concepts. Such programs have demonstrated success in the private sector and been successfully repurposed by transportation agencies to more efficiently utilize the existing transportation network, reduce overhead costs, and save energy.

> "If we can trust employees with millions of dollars' worth of equipment, I think we can trust them with their work schedules."
>
> —Nick Horiatis, Human Resources Manager at Cherry Point Refinery

VOLUNTARY MANAGEMENT SCHEMES

Review of Flexible Work Arrangements

Flexible work arrangements are solutions that reduce the number of vehicles on the road during rush-hour traffic by allowing employees to alter when and where they do their work. Some strategies, like compressed workweek scheduling and flextime, reduce traffic by encouraging employees to commute to work when the roads are less congested. Other strategies, like telecommuting or alternative work locations, can potentially eliminate commute trips altogether.



Source: Combs, 2010

Figure 1.1: Alternative work schedule applications in Texas

Although TDM theories were developed more than 40 years ago, the research literature shows that they are not widely applied in Texas. Large Texas businesses often make demand management options available to their employees, but statewide participation remains low. This situation likely stems from inadequate information and resources, personal situations, company needs, and a desire to keep with traditional work conventions. However, TDM strategies are flexible enough to accommodate these issues. Figure 1.1 shows the popularity of alternative work schedules (**AWS**) in Texas agencies.

Compressed Workweeks

A ***compressed workweek*** consists of 4 work days, 10 hours per day, instead of the traditional 8 hours a day/5 days a week. Compressed workweeks reduce employee travel time by eliminating two commute trips a week while also reducing overall travel time because the commute is shifted to non-peak periods. The earlier start time and later end time often allow the employee to avoid traffic by traveling before and after the typical commute congestion occurs.

Research by the Texas Comptroller of Public Accounts showed that compressed workweeks are especially suitable for government employees. Figure 1.2 shows that more local gov-

ernment employees in Texas benefit from compressed workweek scheduling than employees in any other employment category (Combs, 2010). The Comptroller notes that jobs suitable for AWS typically include legal, administrative, financial, regulatory, and IT positions. Other job types, such as executive and management, customer service, and security, typically cannot accommodate AWS, but may benefit from strategies like vanpools.

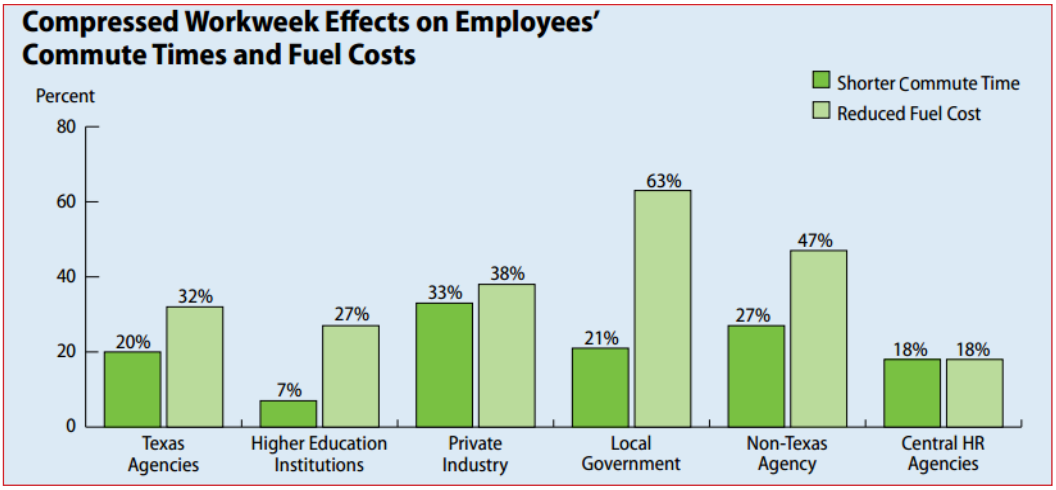
Texas agencies found that 32% of employees on a compressed workweek schedule reduced their commute time and 20% reduced their fuel expenses (Combs, 2010). Compressed workweeks can also allow organizations to close 1 day a week as a cost-saving measure. While compressed workweek employees enjoyed having more scheduled days off, they also cited fatigue and decreased job performance as drawbacks.

Certain government departments have had positive experiences with compressed workweek scheduling, and implementing a city or statewide compressed workweek schedule for Texas government employees has been considered. However, we recommend implementing this travel demand management strategy on a case-by-case basis. Some governments, like the state governments of Utah and New Jersey, legislated mandatory compressed workweek scheduling for 80% of all government employees in an effort to reduce overhead costs, but repealed the legislation later. Utah abandoned mandatory compressed work schedules in 2008, 3 years after implementation, due to lack of customer satisfaction and marginal utility savings. Ohio also abandoned compressed workweeks and greatly restricted other AWS "in hopes of improving customer service" (Lister and Harnish, 2011).

Compressed Workweek Programs in Texas

A compressed workweek pilot program is currently being used with TxDOT maintenance crews in the Austin District. Participating crews work Monday through Thursday for 10 hours a day. There is no statistical difference in productivity or vehicle wear between past 5-day conditions during Fiscal Years (FY) 2008–2011, and current 4-day workweek conditions (FY 2012). Employees and supervisors cite improved morale, reduced stress, increased family time, and the ability to make personal appointments without taking time off. With additional analysis, TxDOT is likely to see reduced expenditures through utility savings by shutting down departments or offices on Fridays as well as decreases in employee time off (Fournier, 2012).

The Texas Department of Insurance implemented an Alternative Work Opportunities Leave program after employees requested it. More than 28% of the employees now work a compressed workweek through this program. TDI reported that the program has aided in employee recruitment, retention, and morale; reduced congestion in the agency's parking garage; and helped alleviate employee stress and burnout (University of Texas-Austin, 1996).



Source: Combs, 2010

Figure 1.2: Compressed workweek effects on employees

Case Study: Compressed Workweek at Cherry Point Oil Refinery

ARCO Products Cherry Point Oil Refinery, just 5 miles south of the Canadian border in rural Washington State, introduced compressed workweek scheduling in 1980 with great success. Now, 30 years later, 95% of Cherry Point employees use flexible work scheduling. Managers choose from several different variations of compressed workweek scheduling depending on their department's needs. The 150 operating technicians work 3/12s (3 days a week, 12 hours a day) around the clock in a rotating schedule of night and day shifts. This schedule is popular among the operators, who appreciate having 14 out of every 28 days off, and managers appreciate the increased production and savings. Maintenance workers prefer working 10 hours a day, Monday through Thursday, with a "mini shift" worked Wednesday and Saturday by 15% of the crew to extend maintenance support throughout the week. Engineering staff presently work 9/80s, 9 hours a day with every other Friday off. Job coverage was ensured by dividing engineering into two tracks so that half of the engineering staff is present every Friday. Even the refinery's administrative and medical staff use some variation of compressed workweek scheduling, regardless of whether their managers are present. Rather than assume that one schedule would fit the whole company, ARCO management allows work units to customize their schedules to benefit their work and personal needs.

This no-cost strategy not only improves employee morale, but it also increases production efficiency and administrative employee effectiveness. The longer working days increase the 4/10 maintenance crews' productivity by reducing about 10% of their nonproductive time spent moving between jobs, getting parts, putting tools away, cleaning up, or attending meetings. For operating crews, a 3/12 schedule decreases the time

spent providing status reports between shift changes by 1 hour (a one-third reduction in time spent on transition duties). Administrators' productivity also increases with a longer work day by increasing the blocks of time available for quiet, uninterrupted work.

In addition to increased productivity, ARCO has reaped additional benefits. Many employees appreciate saving commute time and travel costs, and enjoy the increased quality of time off. The refinery's Training Supervisor, Jeff McSorley, says that "the freedom employees are given through work options builds morale, which pays off in dedication and extra time put in willingly." Absenteeism also decreases with compressed workweeks because employees tend to schedule medical appointments and errands on their own time. In fact, Cherry Point's attendance is in the 99th percentile. The flexible start times afforded by compressed workweeks also eases traffic congestion on the two-lane road that accesses the refinery (Washington State University, 1999).

Flextime

Flextime, short for "flexible work hours," refers to a schedule that allows employees to adjust the start and stop times within limits set by management to accommodate personal obligations and avoid peak traffic hours. One important aspect of management's limits is *core hours*, a time during which all employees must be present. For example, an employee might begin work at 10:00 a.m. and finish at 6:30 p.m. to commute during less congested times. Some organizations permit flexible lunch periods as well as flexible start and stop times. Figure 1.3 shows the difference between a standard workday and a flextime workday and how to adjust a flextime schedule to meet business needs, while Figure 1.4 shows the potential impact of flextime on congestion.

In Texas, flextime is the most commonly offered solution at institutions of higher education, but it is appropriate for a variety of other jobs (Lister and Harnish, 2011).

Standard Workday

7:00 AM	8	9	10	11	12	1	2	3	4	5	6	7:00 PM
	Work					Work						

Flextime Workday

7:00 AM	8	9	10	11	12	1	2	3	4	5	6	7:00 PM
Flexible Start			Core Hours		Flexible Lunch		Core Hours		Flexible Stop			

Figure 1.3: Standard workday schedule compared to a flextime workday schedule

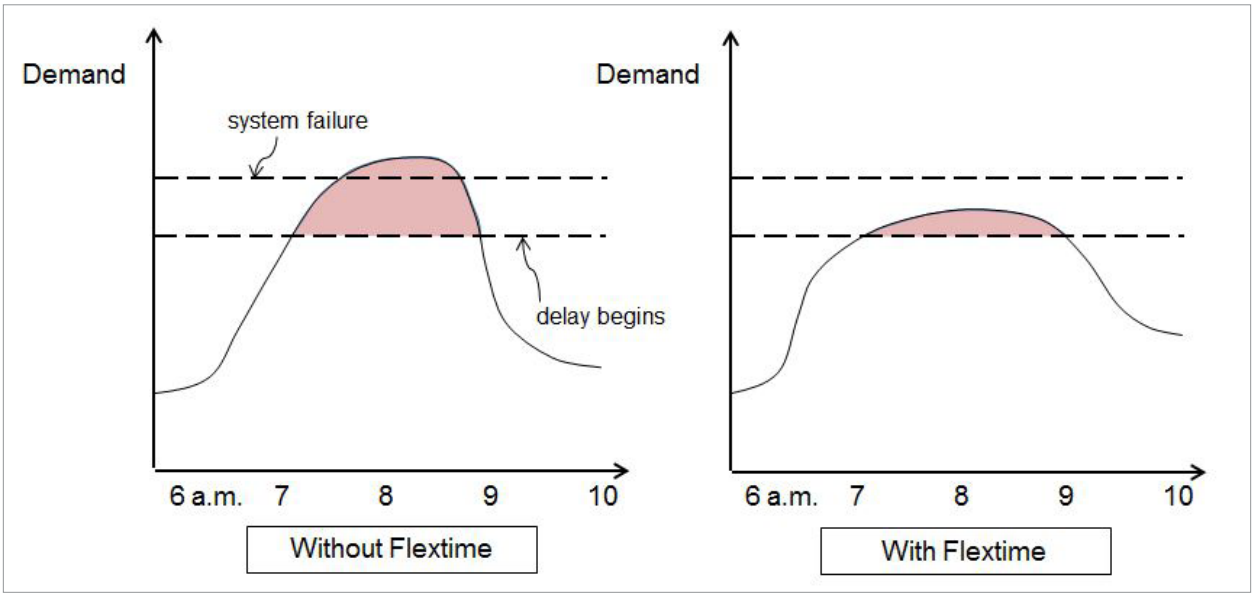


Figure 1.4: Illustration of flextime's potential impact on congestion

Case Study: Flextime at DDB Seattle

> "People are actually willing to work more if allowed some freedom in how and when they work. They are trying to have a better balance in their lives. If you're too rigid or work them too hard, they leave or just dry up and don't produce good work."
>
> —Sydney Hunsdale, Chief Operating Officer at DDB Seattle

Employees in the advertising and marketing industry tend to change jobs often to advance their careers. To address this problem, DDB Seattle advertising agency began offering flexible work options in 1990 to keep their best talent and to maintain happy, creative employees. Fifteen years later, a few employees occasionally telecommute, but flextime is a popular option used by most employees on a regular basis. DDB quickly observed that their employees work harder, produce better work, and stay with the company longer when allowed some freedom in how and when they work.

Flextime encompasses a wide spectrum of schedule possibilities, and some companies choose to limit their flexible start and stop times to just a couple hours outside the typical workday, but DDB has chosen not to write a detailed work options policy. Instead, they maintain high scheduling flexibility and determine work arrangements individually to create the most beneficial arrangement to both the employer and the employee. This approach has paid off with increased productivity and increased retention. DDB relies on a teams-based structure to complete projects, but flexible work scheduling has not hindered team work. In fact, teams with members using flexible work options tend to exchange more information and are more willing to cover for their teammates (Washington State University, 2005a).

Telecommuting

Telecommuting describes a work situation whereby the employee works away from the traditional work place and communicates with colleagues via technology. Many variations of telecommuting exist, but the most common form is working from home using a company computer that connects to the workplace's electronic server. Telecommuting also includes workers that spend most of their time in clients' offices, which causes them to regularly move from one work space to another, like real estate agents or auditors. Employees with this type of telecommuting arrangement, also called *hostelling* or *free addressing,* benefit from a shared work space at a permanent location (Turnbull et al., 2003).

"Teleworking one day a week is a wonderful way for me to get some concentrated time to work on projects."

—Alice Collingwood,
Communications Manager at
Puget Sound Clean Air Authority

"Developers like telework for lots of heads-down work, because it is a stress reducer, eliminates the commute, and increases productivity."

—Dan Willey,
Senior Project Manager at
Alliance Data Systems

Some employees associate a lack of career opportunities and loss of a sense of belonging with telecommuting, and miss interaction with colleagues on work-related matters; these factors may explain why it is the least-offered solution (Canada Treasury Board et al., 1996).

Telecommuting is most beneficial when implemented with results-based jobs. Table 1.1 displays the potential benefits of telecommuting for employers and employees.

Table 1.1. Potential Benefits of Telecommuting
Adapted from Turbull et al., 2003

Potential Benefits to the Employer	Potential Benefits to the Employee
• Increased productivity • Fewer sick and absent days • Better time management • Increased morale and commitment • Reduced office space • Reduced overhead • Reduced employee turnover • Better customer service • Ability to maintain operations during a disaster (i.e., fires, ice) • Employee retention during temporary or permanent changes to family situations	• Reduces or eliminates the time, stress, and costs that stem from commuting twice a day. • Increased concentration in the absence of office distractions and interruptions. • Allows employee to take advantage of their most productive hours of the day • Greater flexibility to organize their day and take care of responsibilities • Reduced car insurance premiums • Job retention during temporary or permanent changes to family situations

Case Study: Telecommuting at Holland America

Holland America Line (HAL), a tour and cruise company headquartered in Seattle, implemented a modest telework program in 1994 to comply with the Washington Commute Trip Reduction Law but quickly expanded participation after observing the benefits to employers and employees. By 2005, HAL had 78 full-time teleworkers and 12 teleworking management staff. The telework program has increased productivity, increased employee retention, improved coverage, and reduced absenteeism.

HAL's top performing reservation agents have consistently been teleworkers. Teleworkers are able to work without distractions, and, contrary to popular belief that telework hinders customer service, HAL considers telework employees to be an integral part of customer service. In an area with severe winters, teleworkers provide the much-needed ability to work from home during inclement weather. In the event of a crisis on a ship or during a hurricane, teleworkers make it possible for the company to open the call center early or stay open late to ameliorate the resulting problems. Previously, HAL limited teleworking to 25% of call center agents, but now 50% of agents telework full time with proven reliability.

Employees at HAL appreciate the flexibility that telework affords, and enjoy the extra time that was previously spent commuting. One HAL employee, a single mom, asserts that "if it wasn't for teleworking, I'm afraid I would have to find another job." This increased employee retention saves HAL enough money to offset the initial costs of equipping an employee for telework. Employee retention is especially important in the travel industry because the special training required is expensive. In addition to reducing employee turnover, HAL has also been able to add additional call center agents without having to add more office space to house them at their full-capacity headquarters (Washington State University, 2005b).

CONCLUSION

Publicly promoted flextime, compressed workweeks, and telework (collectively called flexible work arrangements) offer some of the most cost-effective, readily implementable congestion mitigation strategies available. Such programs have demonstrated success in the private sector and have been successfully repurposed by local departments of transportation to more efficiently utilize the existing transportation network, reduce overhead costs, and save energy. Further, employees tend to prefer flexibility in their work schedule, which has proven to increase productivity and improve company morale.

2. Texas TDM Guide

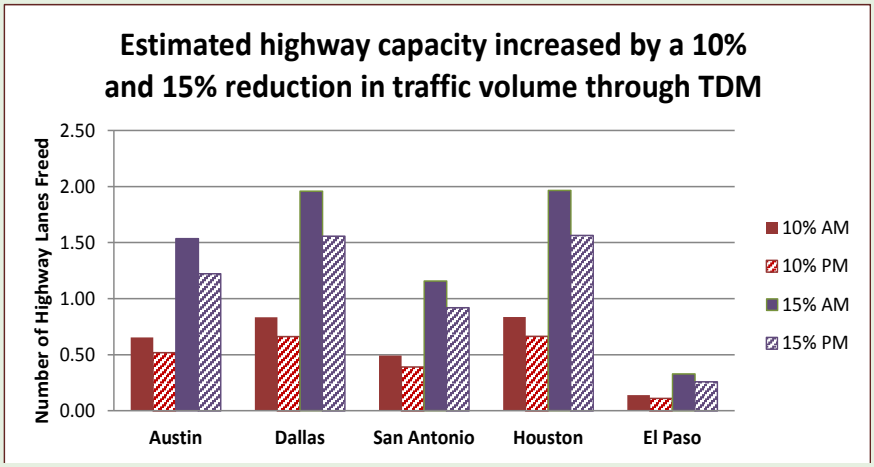
INTRODUCTION

We can all agree that congestion is a problem in Texas. Demand management has been considered a desirable part of the congestion solution for decades. However, it was not generally considered essential because policy makers and travelers both assumed that new infrastructure construction would provide the real congestion solution. Under the current fiscal conservatism, we need to respond to congestion with cost-effective solutions. Fortunately, many solutions are available other than expanding infrastructure. This guide will explore methods for managing transportation demand.

As discussed in the Introduction, some solutions are *voluntary*, meaning that the individual gets to decide whether to use the strategy. Section 1 outlined these strategies. Other methods require *mandatory* compliance. Examples of mandatory strategies include legislation requiring all state employees to work a compressed workweek and calibrating toll prices to discourage road use on notoriously congested roads. Some strategies are more easily implemented than others, and some are politically sensitive. For that reason, **this guide focuses on voluntary strategies**. Note, however, that one way to increase the number of participants in such programs (and thereby program effectiveness) is for employers or public agencies to require the participation of all or part of the work force—i.e., make the strategy mandatory. Converting voluntary strategies to mandatory generally requires only policy initiatives within the agency or private company. Section 3 covers mandatory methods.

The efficacy of a strategy depends on the economy and demographics of the city where it is implemented. This guidebook characterizes five metropolitan statistical areas (**MSA**s)—Austin/Round Rock, Dallas/Fort Worth/Arlington, Houston/Sugar Land/Baytown, El Paso, and San Antonio—and presents a demand management guide unique to each MSA's characteristics.

Highway Capacity Increase



This chart shows the number of highway lanes freed by a 10% and 15% reduction in traffic through TDM strategies, based on annual average daily traffic (**AADT**).

Austin/Round Rock MSA

SUMMARY

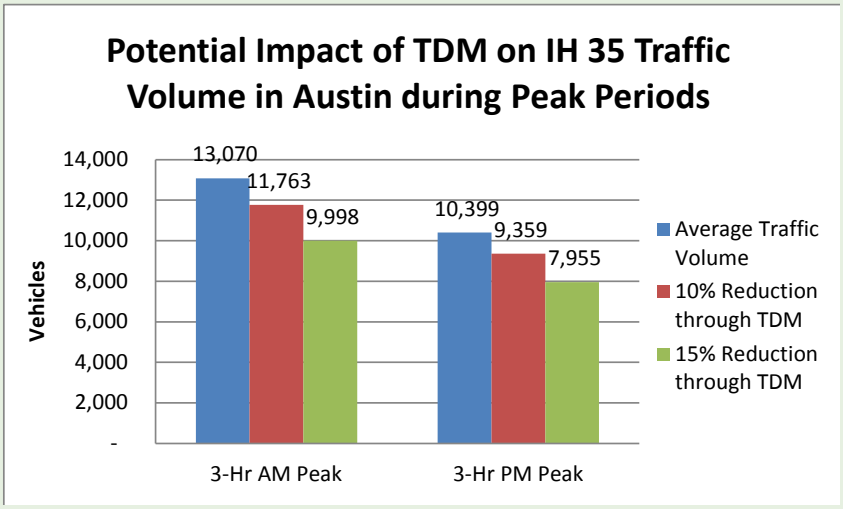
The Austin/Round Rock MSA includes data from the following counties: Travis, Williamson, Caldwell, Hays, and Bastrop. Austin is home to two Fortune 500 companies (Dell and Whole Foods Market). Ten businesses employ 90,478 people, or 14% of the entire Austin MSA workforce, and 20 businesses employ 110,438 people, or 17% of the workforce.

Recommended Strategies
1. Telecommuting
2. Compressed workweek
3. Flextime

Compared to the four other Texas metro areas, Austin has the lowest rates of SOV commuting and the highest rate of telecommuting. Austin commuters have the highest rate of public transportation use and the highest rate of commuting by means other than driving, public transit, and walking. (See the cost-effectiveness table in the appendix for details.)

Austin's growing technology industry has brought engineers to the "Silicon Hills" of central Texas. Telecommuting and mobile officing are suitable for these results-based engineering jobs and at the several universities in town (Lister and Harnish, 2011). Telecommuting is growing in popularity. In fact, Austin has the highest rates of telecommuting employees for any city in the state. Potential benefits include reduced overhead, reduced employee turnover, and increased morale. Telecommuting, however, is not a practical option for Austin's largest industries (US Census Data, 2010).

Estimated Benefits



If 10% of work trips on IH 35 in Austin north of Loop 111 and south of FM 2222 were reduced using TDM, then almost 3,000 trips in the AM Peak and 2,400 trips in the PM Peak would be saved. A 15% reduction would reduce AM Peak trips by over 4,500 and PM Peak by 3,600.

EXISTING STRATEGIES

The University of Texas at Austin (UT) is the largest employer in the Austin metropolitan area. Limited campus parking (16,000 spaces) for the roughly 75,000 student, faculty, and staff that access campus daily has spurred the development of an effective alternative transportation initiative. UT partnered with Capital Metro to provide campus shuttles and free fare on mainline metro buses and rail with a UT identification card. During FY 2009–2010, UT faculty, staff, and students made 2.4 million trips aboard Capital Metro mainline buses. Campus shuttles provided nearly 5.4 million rides, and the E-bus shuttle that connects campus to downtown on nights and weekends provided 230,275 rides. UT also provides Texas Express greyhound shuttle service to Dallas and Houston on weekends and holidays. During FY 2009–2010, the Texas Express ferried 2,694 riders to Houston and 3,463 riders to Dallas. UT Parking and Transportation Services credits its program's success to effective marketing that informs faculty, staff, and students of the benefits of alternative transportation. Another education institution, Austin Community College, offers free Green Pass bus passes to students, which resulted in a 6% reduction in personal vehicles on campus just 1 year after implementation.

Recommended Strategies

1. Telecommuting is the most suitable TDM strategy for Austin's technology-industry-centered economy because tech jobs are largely results-based, which allows employees to work independently from home. Tech industry employees also have the computer skills and resources necessary for successful telework.
2. Compressed workweek scheduling, in which an employee works longer than a typical 8-hour work day in exchange for working fewer days each month, is also suitable for technology industry jobs because they usually do not require the employee to be present at their desk Monday–Friday. A popular compressed workweek schedule is 4/10, working 4 days each week for 10 hours a day.
3. Flextime is also suitable to Austin, whose flexible occupations can accommodate varying start and stop times.

Advanced Micro Devices (**AMD**) began their North American Go Green commuter initiative in Austin and then implemented the program across all AMD locations. The Go Green program encourages carpools and vanpools, provides transit and cycling resources, and awards monthly prizes to participants. In 2008, the nationwide program collectively eliminated an estimated 1,027,000 miles of driving, conserved approximately 50,000 gallons of gasoline, and prevented approximately 430,000 kilograms of carbon dioxide emissions from being released into the air. Meanwhile, the Dell Corporation introduced flexible work options in 2009. Employees are permitted variable daily work times, compressed workweek scheduling, and telework arrangements.

Introduction to the Dallas/Fort Worth/Arlington MSA

TDM in Dallas and Fort Worth will be discussed individually in greater detail, but first the authors would like to look at interdependent transportation networks connecting the tri-city metro area.

The Dallas/Fort Worth MSA is the fourth-largest city in the US, with an estimated current population of approximately 6.4 million. This MSA has an extensive transportation system, made up of a complex network of highways, high occupancy vehicle (**HOV**) lanes, the nation's first commuter rail system, and a network of van and carpools. Despite this, the North Texas area continues to suffer from crawling congestion because most North Texas residents do not live and work in the same city and they prefer commuting in their own vehicle. Data from the 2010 US Census shows that only 4% of the area's residents commute using public transportation. Compounding these intercity commute patterns are expanding business and general urban sprawl.

The Dallas Area Rapid Transit (**DART**) commuter transportation system provides service to and from 12 surrounding cities via DART Rail, the Trinity Railway Express (**TRE**) commuter rail, and bus service. The DART system moves more than 220,000 passengers per day across a 700-square-mile service area. DART also operates a system of HOV lanes, which are used by more than 45,000 commuters each weekday (DART, 2012). All of DART's top 10 corporate pass buyers are hospitals or government entities (Hallman, 2011).

Although public transportation networks and highways enmesh Dallas, Fort Worth, and Arlington geographically, the economic bases of each of the three cities are different. In Arlington, for example, the most common industries as of 2009 were educational services (18%), motor vehicles and parts (13%), professional, scientific, and technical (12%), followed by health care with approximately 10% of the area employment. The profiles in this section address the economic bases of Dallas and Fort Worth.

Arlington's current population is more than 365,000, having increased 10% from 2000 to 2010. Very few public transportation options are available to Arlington residents, although the TRE stop for Arlington is about 10 minutes from the Entertainment District. The University of Texas at Arlington, one of the city's larger employers, has an active TDM program that includes flextime, compressed workweek scheduling, telecommuting, and part-time work or job sharing (University of Texas at Arlington, 2012).

Dallas

SUMMARY

The Dallas economy has traditionally been associated with banking, commerce, telecommunications, computer technology, energy, healthcare and medical research, transportation, and logistics. In Dallas, retail trade employs the largest sector of the local workforce. The next three sectors, in order from most to least employees, are healthcare and social assistance, accommodation and food services, and manufacturing (US Census, 2010).

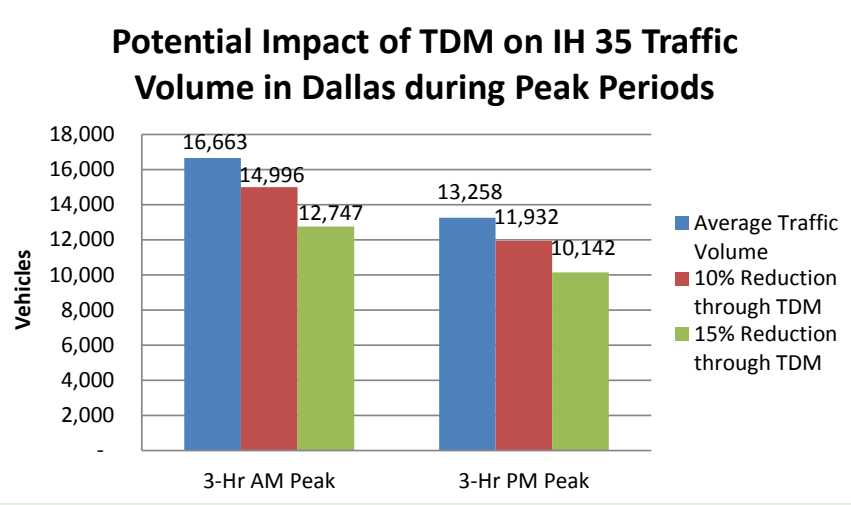
Recommended Strategies
1. Compressed workweek
2. Flextime

Dallas is home to 22 Fortune 500 companies. In 2010, 10 employers in the Dallas metroplex region employed 184,320 people, which is slightly more than 7% of the total Dallas MSA workforce, while 20 businesses employed 282,354 people, which is about 11% of the MSA's total workforce (Dallas Business Journal, 2012). Significant reductions in travel demand can be achieved by promoting TDM strategies within these 10 largest businesses. For details, please see the Dallas section of the appendix.

EXISTING STRATEGIES

Considering work type is important when implementing TDM strategies because a strategy's success depends on its suitability to the work environment. Dallas's economic background is most suitable to AWS and telework. Currently, Mobil, Frito Lay, IBM, Texas Instruments, Xerox, AT&T, GTE, and J.C. Penney allow telecommuting.

Estimated Benefits



In 2009, IH 35 in Dallas north of SH 366 and south of the Dallas North Tollway had an AADT count of 269,000 vehicles; 6.2% of those trips were considered AM Peak work trips and 4.9% were PM Peak. If 15% of those work trips were reduced using TDM, then almost 4,000 trips in the AM Peak and 3,100 trips in the PM Peak would be saved on this highway segment.

In addition to altering times and frequencies of commutes, travel demand can also be managed with alternative travel modes. At least 596 major Dallas employers have employee trip reduction programs. Area vanpools remove 39,160 vehicle trips per day at full implementation. FW Natural Energy reports that telecommuting saves the company $30,000 per year.

As mentioned, Dallas has the DART commuter transportation system providing service to and from 12 surrounding cities via DART Rail, the TRE commuter rail, and bus service.

TDM is a low-cost way to mitigate congestion, but it also delivers discernible environmental benefits. For the 2011 Ozone Season, city employees carpooled or alternatively commuted a total of 3,239,194 miles, saving 4.6 tons volatile organic compounds (**VOC**), 2.6 tons nitrogen oxides (**NOx**), and 1,383 tons carbon dioxide ($\mathbf{CO_2}$) from being released into the atmosphere.

Recommended Strategies

1. Compressed workweek scheduling is especially suitable to Dallas's commerce-based economy because it benefits employers by increasing the available business hours without contributing to overtime. In a compressed workweek schedule, employees work longer than a typical 8-hour work day in exchange for working fewer days each month. Studies have shown that employers enjoy the increased productivity that compressed workweeks lend, and employees enjoy having an extra day off each week.
2. Flextime is also appropriate for Dallas because the commerce industry's flexible occupations can accommodate varying start and stop times.

Estimated Benefits: Additional Notes

Compressed workweek scheduling alleviates congestion in two ways: shifting travel times away from the peak hour (leaving before the AM peak and after the PM peak) and eliminating some work trips altogether. The popular 4/10 schedule eliminates one AM and one PM commute every week. Flextime similarly alleviates congestion by shifting travel times so that fewer cars are traveling during the same peak period (rush hour).

The FHWA reports that in 2000, nearly 45% of people in the Dallas MSA left for work between 7:00 a.m. and 8:29 a.m. and almost 30% left between the hours of 5:00 and 7:00 a.m. Only 10% departed for the office between 8:30 and 9:00 a.m. If just 10% of SOV commuters that currently depart between 7:00 and 8:29 a.m. used a flextime schedule that allowed them to work from 10:00 a.m. to 6:30 p.m., then 109,000 cars would be removed from the largest AM peak period—an equivalent of 54 highway lanes.

If TDM achieved a 15% reduction in all area-wide work trips during the traditional 3-hour peak periods, then 350,000 AM Peak trips and 280,000 PM Peak trips would be saved.

Fort Worth

SUMMARY

Fort Worth, nicknamed "Cow Town" in the 1850s, has historically been associated with oil and industrial manufacturing. Unlike Dallas, Fort Worth has a manufacturing industry focus. A significant portion of a manufacturing company's employees must be physically present to operate machinery, so telecommuting and flexible work scheduling are not suitable. Compressed workweek scheduling, however, suits the labor needs of a manufacturing facility while also potentially maximizing efficiency. Manufacturing equipment often takes an hour to reach full working capacity and another hour to cool down at the end of a work period—leaving only 6 hours in a traditional 8-hour day for employees to work on the production lines. Instead of having 6 available work hours per day, compressed workweek scheduling that requires employees to work 4 days a week for 10 hours a day allows for 8 production hours. Additionally, research shows that compressed workweek scheduling reduces absenteeism and increases employee morale and retention at no additional cost.

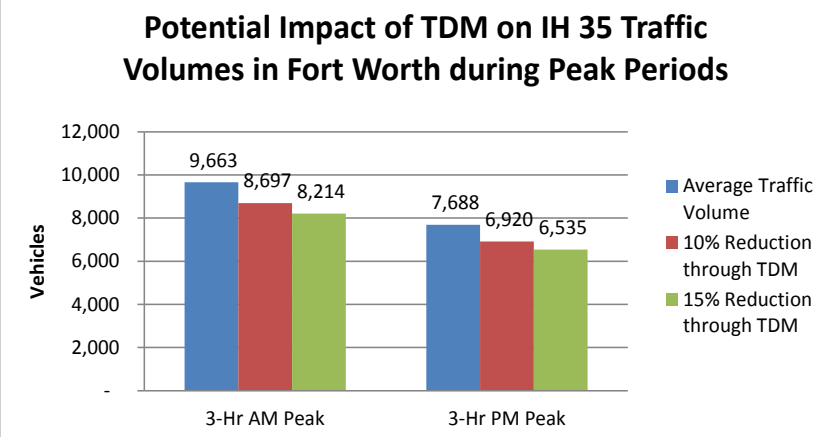
Recommended Strategies

1. Compressed workweek
2. Staggered shift times
3. Company-supported carpooling

EXISTING STRATEGIES

Fort Worth is home to the first commuter rail built in the southwest. The TRE commuter rail line has 35 miles of track connecting downtown Fort Worth, downtown Dallas, and the Dallas/Fort Worth Airport. Its 49 weekday trains shuttle an average of 9,800 passengers across the metroplex each weekday. Fort Worth's transit authority provides bus service to areas

Estimated Benefits



A conservative estimate of Fort Worth resident employed by the manufacturing industry is 41,700. If 15% of these employees reduce their commute through TDM, then 6,255 cars would be removed from the road—the capacity of more than three freeway lanes.

surrounding downtown with an average daily ridership of 23,000 (Fort Worth Transit Authority, 2009).

The Fort Worth Transit Authority is developing plans to extend the rail line from existing track in southwest Fort Worth through Grapevine and then into the north entrance of the Dallas/Fort Worth Airport. Construction of this new rail line that connects the southwest to the northeast across Tarrant County is planned to begin in 2016. Fort Worth has the state's highest rate of SOV commuting and one of the lowest rates of carpool use. Nearby Dallas enjoys higher rates of carpooling, perhaps due to greater employer support of carpooling. Houston, the birthplace of company carpooling, far outpaces Fort Worth in this TDM.

Recommended Strategies

1. Compressed workweek scheduling is especially suitable to the manufacturing industry because it benefits employers by increasing production hours and decreasing absenteeism. Factory employers commonly use a 3/12 schedule in which two shifts each work 3 days a week for 12 hours a day so that equipment runs 6 days a week. Employers enjoy increased productivity, and employees enjoy having an extra 2 weekdays off each week.
2. Staggered shift times, similar to flexible work schedules, adjust shift start and stop times, reducing congestion during shift changes.
3. Company-supported carpooling is another recommendation for this city. See the Houston section of this guide for a description of how company support can yield results.

Estimated Benefits: Additional Notes

Compressed workweek scheduling alleviates congestion in two ways: shifting travel times away from the peak hour (leaving before the AM peak and after the PM peak) and eliminating some work trips altogether. The 3/12 work schedule popular in the manufacturing industry reduces congestion by eliminating 2 commute days each week. Staggered shift times alleviate congestion by redistributing commute trips across a longer period of time.

A conservative estimate of Fort Worth residents employed by the manufacturing industry is 41,700. If 15% of these employees reduce their commute through compressed workweek scheduling or carpooling, then 6,255 cars would be removed from the road—the capacity of more than three freeway lanes.

El Paso MSA

SUMMARY

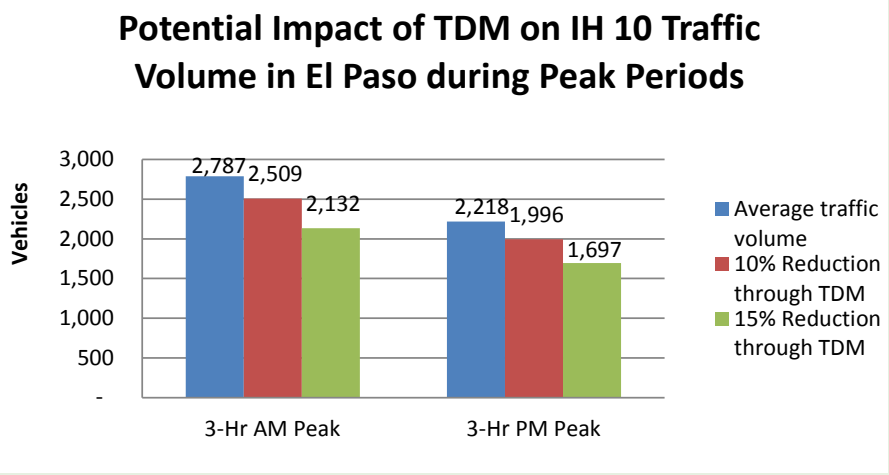
El Paso has historically been closely intertwined culturally and economically with its sister city, Juarez, across the border. Together, the two cities have a combined population of more than two million people.

Recommended Strategies
1. Compressed workweek
2. Telecommuting

The education and health care service industries are growing quickly and filling the void left by a shrinking manufacturing industry. The number of employees working in El Paso manufacturing jobs has decreased by 50% over the past 10 years, presumably because companies have relocated their manufacturing operations to Juarez where wages are significantly lower. Juarez assembles high-tech parts manufacturing in the US and abroad, and the assembled products are trucked to El Paso for distribution.

Data from the 2010 US Census reports that only 5,300 El Paso residents, or 2% of the workforce, commute to work each day using public transportation. However, El Paso's public transportation system, Sun Metro, serves more than 15 million passengers a year, or about 41,000 people each day (Sun Metro, 2012). A recent origin-destination transit survey helps explain this apparent discrepancy between Sun Metro and US Census data. Researchers at the University of Texas at El Paso revealed that a large portion of Sun Metro's ridership originates in Juarez or El Paso's non-residential downtown transfer station and terminates in El Paso's residential areas (Galicia, 2011). Historically, many people lived and worked on different sides of the border, crossing to enjoy food and recreation on both sides as well. This commingling of the sister cities continues in spite of the recent years of violence in Juarez.

Estimated Benefits



In 2010, IH 10 in El Paso north of SH 178 and south of US 370 had an AADT count of 69,000 vehicles. Of these trips, 6.2% were considered AM Peak work trips and 4.9% PM Peak. If TDM reduced 15% of those work trips, then more than 600 AM Peak trips and 500 PM Peak trips would be saved.

In 2009, approximately 7.5 million pedestrian trips were made at points of entry between El Paso and Juarez.

EXISTING STRATEGIES

A large commuter vanpooling program operates from suburban Sunland Park. Three new Park and Ride facilities have been recently constructed and Sun Metro is cooperating with partner agencies in developing Brio, a rapid transit system that uses high-capacity vehicles, improved fare collection systems, and priority traffic signals to move riders more efficiently. Sun Metro operates 166 fixed route vehicles and 65 paratransit LIFT vehicles and serves more than 15 million passengers a year. Sun Metro also operates a large natural-gas-fueled fleet, which at one time was the world's largest operating natural gas mass transit fleet.

Recommended Strategies

1. Compressed workweek scheduling is suitable for those employed in El Paso's service industry because it increases available business hours without contributing to overtime. In a compressed workweek schedule, employees work longer than a typical 8-hour work day in exchange for working fewer days each month. Studies have shown that employers enjoy the increased productivity that compressed workweeks lend, and employees enjoy having an extra day off each week.

2. Telecommuting is suitable for many El Paso residents who work in call centers. Travel agencies report that customer service and sales representatives are more productive and deliver higher levels of customer service when working from home. Companies say that while extra training and resources are required initially, the benefits of telework outweigh the initial costs.

Estimated Benefits: Additional Notes

Compressed workweek scheduling alleviates congestion in two ways: shifting travel times away from the peak hour (leaving before the AM peak and after the PM peak) and eliminating some work trips altogether. The popular 4/10 schedule eliminates one AM and one PM commute every week. Telecommuting alleviates congestion by eliminating an AM and PM car trip each day that the employee telecommutes.

A conservative estimate of El Paso residents employed by the service industry is 123,000. If 80% commute alone each day, an estimated 99,500 cars are carrying service industry employees. If 10% of these employees telecommuted or reduced a commute day through compressed workweek scheduling, then over 9,950 cars would be eliminated—the equivalent capacity of five highway lanes.

El Paso's daily vehicle trips are 10 million; 640,000 are AM Peak work trips and 510,000 are PM-Peak work trips. If TDM strategies could achieve a 15% reduction in all area-wide work trips, 100,000 AM Peak trips and 80,000 PM Peak trips would be saved.

Houston/Sugar Land/Baytown MSA

SUMMARY

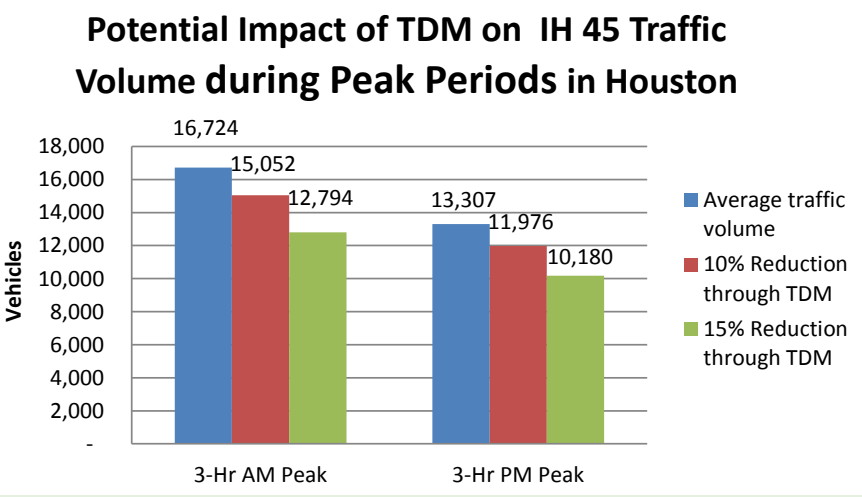
Houston is the fifth-largest US city, only recently surpassed in population by the Dallas/Fort Worth/Arlington metropolitan area. With a combined population of 6.1 million people, the Houston/Sugar Land/Bay Town metropolitan area is more populated than either Denmark, Ireland, or New Zealand.

Recommended Strategies
1. Compressed workweek
2. Staggered shift times
3. Telecommuting

Houston's economy has diversified significantly over the past 30 years. In 1981, 85% of all jobs were in energy-related businesses. Today, 18 Fortune 500 companies have headquarters in Houston, and nearly half of all jobs are in non-energy fields, such as business, technology, medicine, manufacturing, and aerospace engineering. Houston is the hub of a massive trucking and rail system that links the southern, south central, midwestern, and western United States. More than 600 trucking firms operate in Houston and 2 major rail systems operate 14 mainline tracks that radiate from Houston. This extensive transportation network supports the city's vibrant economy, but it has also contributed to the area's famously heavy traffic.

Houston's traffic was so heavy in the 1980s that companies were having trouble hiring enough employees because people did not want to move to Houston and suffer a long commute in congestion every day. Companies responded by setting up their own private car and vanpools. This early foray into TDM later expanded with city government support after Houston was placed on the ozone non-attainment list. Now, public and private partnerships provide Houston with a number of commute alternatives.

Estimated Benefits



In 2010, IH 45 in Houston north of IH 10 and south of Loop 610 had an AADT count of 270,000 vehicles. Of those trips, 6.2% were AM Peak work trips and 4.9% PM Peak. If TDM reduced 15% of those work trips, over 2,500 trips in the AM Peak and almost 2,000 trips in the PM Peak would be saved.

EXISTING STRATEGIES

The Houston-Galveston Area Council (H-GAC) established a Commute Solutions program in 1994 to help reduce emissions and improve the area's severe ozone levels. The program provides advice, answers, and assistance on commuting options and employee transportation programs as a "one-stop" alternative transportation resource for both commuters and businesses in the Houston-Galveston area (H-GAC, 2011). Commute Solutions' programs include a regional vanpool program; NuRide, which rewards people who take greener trips; a commuter and transit services pilot program, which includes trolleys and several express commuter bus routes; regional telework incentive program; bicycle and pedestrian program; advertising, marketing, and a public relations campaign.

During its 17-year existence, Houston's vanpool program has reduced vehicle miles traveled by 5,021,903 and prevented 8,304 pounds of NOx air pollutant from being released into the atmosphere. The NuRide program has 18,091 registered participants in the Houston area and is steadily growing. The program reduced vehicle miles traveled by 944,198 and prevented 49,632 tons of emissions from entering the atmosphere since its establishment in June 2005 (H-GAC, 2011).

Recommended Strategies

1. Compressed workweek scheduling, in which an employee works longer than a typical 8-hour work day in exchange for working fewer days each month, is suitable for Houston's petrochemical industry jobs because it increases productivity by reducing the amount of time spent starting and stopping machinery.

2. Staggered shift times have been used in the ship channel for decades to reduce congestion around petrochemical plants during shift changes. Staggered shift times, similar to flexible work schedules, adjust shift start and stop times so that employees enter and exit work at staggered times throughout the day.

3. Many engineers work in research and development jobs related to the petrochemical industry, which are well suited to telecommuting part or full time. Research jobs are largely results-based, allowing employees to work independently from home. Tech industry employees also have the computer skills and resources necessary for successful telework.

In February 2012, Houston METRO (the Metropolitan Transit Authority of Harris County) opened a segment of the Gulf Freeway (IH 45) HOV lanes to SOVs at tolled rates that vary from $1 to $4.50 depending on the time of day and level of congestion (Delaughter, 2012).

Compared to the other Texas MSAs, Houston has the highest rates of public transportation use and carpooling. Perhaps the city's TDM success is due to its advertising, marketing, and public relations campaigns that are designed to educate on and create awareness of Houston's air quality programs (which incorporate TDM strategies). However, even though Houston's TDM solutions are successful in reducing vehicles on the road, 74% of the workforce still commutes daily in SOVs.

San Antonio MSA

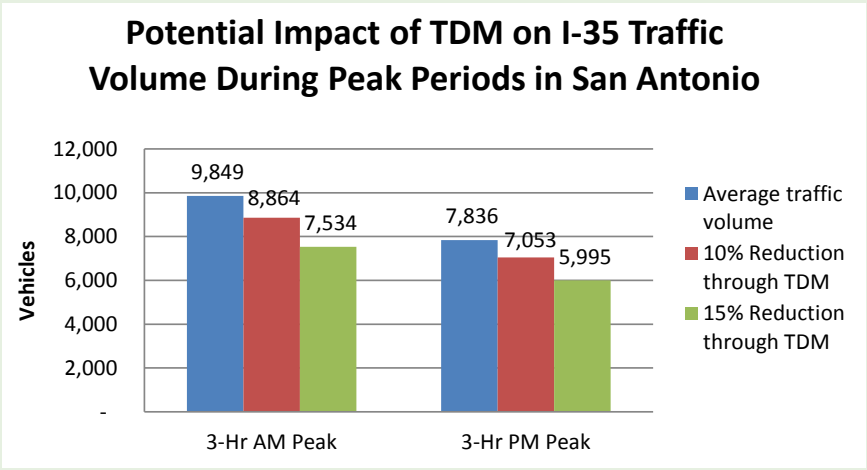
SUMMARY

In 2010, only 3.3% of the San Antonio workforce used public transit despite having what has been traditionally considered the best public transportation system in the whole state. The San Antonio workforce uses public transit at higher rates than Fort Worth and El Paso, but at lower rates than Houston, Austin, and Dallas (US Census Bureau, 2010).

San Antonio has historically been characterized as a blue-collar military complex. Today, the city is home to Fort Sam Houston, Lackland Air Force Base, Randolph Air Force Base, and Brooks-City Base. The defense industry employs over 89,000 people and produces a $5.25 billion impact on the city's economy (City of San Antonio, 2012).

Recommended Strategies
1. Compressed workweek
2. Flextime

Estimated Benefits



In 2010, IH 35 in San Antonio north of US 90 and south of SH 536 had an AADT count of 159,000 vehicles. Of those trips, 6.2% were AM Peak work trips and 4.9% PM Peak. If TDM reduced 15% of those work trips, almost 1,500 trips in the AM Peak and 1,200 trips in the PM Peak would be saved.

EXISTING STRATEGIES

The NuRide green transportation incentive program was introduced to San Antonio in August 2008. By 2009, the program claims to have reduced vehicle miles traveled by more than 3 million. The program encouraged 66,207 walking trips, 963,427 carpool and vanpool trips, and 362,646 public transportation trips over the past 4 years. These San Antonio employers offer various AWS incentives:

- USAA: flextime, telecommuting, largest vanpool program in Texas, NuRide
- Six Flags: Reduced-rate bus passes and bicycle racks, security, showers. (Six Flags reports higher employee retention because of these incentives.)

Recommended Strategies

1. Flextime is appropriate for San Antonio because the military operations can accommodate varying start and stop times.
2. Compressed workweek scheduling, in which an employee works longer than a typical 8-hour work day in exchange for working fewer days each month, is also suitable for technology industry jobs because they usually do not require the employee to be present at their desk Monday–Friday. A popular compressed workweek schedule is 4/10, working 4 days each week for 10 hours a day.

Estimated Benefits: Additional Notes

Military operations employ about 195,000 people in San Antonio. If 10% of this workforce were to use compressed workweek scheduling or flextime, then over 19,000 commuters would be shifted to a non-peak travel time or their trip would be eliminated altogether. This figure is the equivalent capacity of nine and a half freeway lanes.

San Antonio's daily vehicle trips are 26.8 million; 1.7 million of those are AM Peak work trips and 1.3 million are PM Peak work trips. If TDM strategies could achieve a 15% reduction in work trips, over a quarter of a million AM Peak work trips and 200,000 PM Peak work trips would be saved.

3. Mandatory Strategies

This section considers the mandatory strategies involving congestion pricing and parking fees.

ROADWAY PRICING

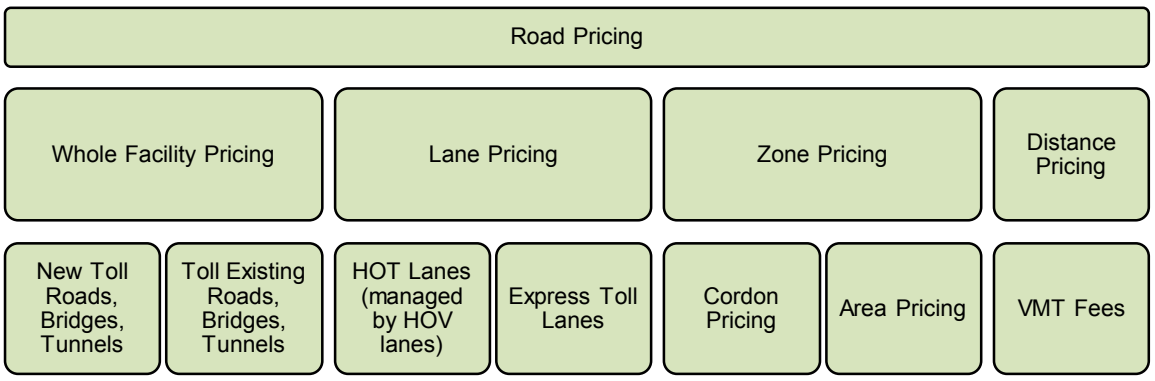
Roadway pricing is a common answer to the challenges of declining transportation revenues and increasing roadway congestion. Roadway pricing can take many forms, from tolling users across an entire facility to charging drivers in a specific lane or entering a specific zone, as shown in Figure 3.1.

No matter the size of the tolled facility (whether an entire facility or a single lane), roadway pricing generally falls into two categories: ***flat-rate tolls*** and ***variable tolls***. Flat-rate (constant) tolls exist on almost all Texas tolled roadways, including SH 121 in Dallas/Fort Worth, the Westpark Tollway in Houston, and SH 130 in Austin. Such tolls typically are used to generate revenue rather than manage demand. If congestion levels were problematic on a tolled facility and relatively constant throughout the day or over an extended period, flat-rate tolls may be a worthwhile demand management strategy.

In cases of more dynamic bottlenecking, due to recurring peak-period congestion, variable tolls that are pre-set by time of day and day of week (to mimic congestion levels) are most effective for managing demand (by encouraging travelers to shift to lower-priced and less-congested times of day). Temporary tolling can be used in the case of construction work zones, and truly ***dynamic tolling*** can be applied to moderate demand in the face of highly uncertain traffic levels, including the effects of crashes or other incidents. Regardless of the setting, pricing strategies tend to be the most effective strategy for demand management and congestion abatement, in that

they apply to all travelers equally along a corridor (rather than focusing on a relatively small set of commuters who are employed by the region's biggest companies, for example). Travelers who have a low value of time (such as high school students heading to the mall for socializing or to a distant town for a camping trip) can adjust by shifting their departure times/trip schedules, destinations, modes, and route choices—these travelers are not limited to simply carpooling or telecommuting. In the longer term, if price signals are strong enough, households and businesses may relocate to bring their trip origins and destinations closer together, and away from some of most congestible and highly tolled links in the region's network.

When roadway pricing is tailored specifically for congestion management and reduction in traveler delays, it is known as ***value pricing*** or ***congestion pricing*** (**CP**). As already indicated, CP tolls may be pre-scheduled tolls that vary in anticipation of demand (as utilized along the Katy Freeway in Houston and IH 394 in the Twin Cities, Minnesota), or truly dynamic tolls that vary in response to actual demand (as approximated by Stockholm's tolled roads). The latter adds price uncertainty, which is generally not appreciated by travelers, but such dynamism enables more flexible toll adjustments to better reflect the great uncertainty in traffic patterns that exists in many settings. A combination of either (e.g., monthly or quarterly updating of pre-set variable tolls to keep traffic moving, or caps on dynamic tolls) offers a valuable balance, as seen in Southern California's SR 91. Utilizing the principle of supply and demand, CP manages congestion on roadways by adjusting the price (toll) to control the demand (traffic volume). Examples of CP strategies for different forms of toll facilities are discussed in this section.



Source: Buxbaum et al., 2010

Figure 3.1: Forms of road pricing

Whole Facility Pricing

Converting a flat-rate-tolled (or non-tolled) facility to a variable tolling scheme (where the toll is higher during peak travel hours and lower [or zero] during off-peak hours) incentivizes certain drivers to utilize the facility less during congested times of day.

In Lee County, Florida, the Midpoint and Cape Coral toll bridges started using a variable pricing scheme in August 1998. **The existing flat toll was discounted during shoulder periods immediately before and after the rush hour, resulting in a maximum 20% increase in traffic during the discount toll periods and corresponding decrease in traffic during rush hour.** Bridges in New York City have a similar pricing strategy, with $9.50 peak period tolls and $7.50 off-peak tolls on all tunnels and bridges operated by the Port Authority of New York and New Jersey. However, since the rate differentials are relatively small for many NY travelers and not explicitly priced to moderate congestion, little to no effect on congestion has been detected (DeCorla-Souza, 2009).

Lane Pricing

The most common form of congestion pricing in the US involves adding tolls to existing HOV lanes so that vehicles with lower occupancy can use the lane for a price (Ecola and Light, 2009). The high-occupancy/toll lane is then known as a ***HOT lane***. Variably priced lanes are generally designed to ensure reasonable flows and/or speeds, subject to toll rate limits. For example, a management board sets caps of $8 for a 20-mile section of IH 15 HOT lanes in San Diego and $9 for a 10-mile section of SR 167 HOT lanes in Seattle (DeCorla-Souza, 2009). Presently, fewer than 10 HOT lanes exist in the US with an explicit objective of moderating congestion via variable pricing.

In contrast, California's IH 15 and Minneapolis's IH 394 offer truly dynamic pricing with capped rates. These caps do not change often, largely because they are set sufficiently high. On IH 15, tolls vary in 25¢ increments as often as every 6 minutes. **About 50% of the revenues generated by congestion pricing on IH 15 is used to support transit service in the corridor.** Colorado's E-470 toll road is also governed by a board, and bond covenants have a toll rate structure built in, with periodic rate increases scheduled and subsequently approved by the board.

Zone (Cordon) Pricing

In ***zone pricing*** (also called ***cordon tolling***), prices change as vehicles either enter or are already within a defined zone. Singapore was the first to introduce a cordon pricing scheme in 1975, followed by the central London cordon zone in 2003, and Stockholm in 2006. I**n Singapore, time-of-day-based (variable) charges were introduced with the automated electronic charging system and traffic within the cordon fell 13% as vehicle speeds rose 22%** (FHWA, 2006). The London cordon charge is a fixed toll during peak periods (between 7:00 a.m. and 6:30 p.m. Monday through Friday). The cordon is bounded by an inner ring road, and vehicles are charged per day for entering or traveling within the cordoned zone. Paired

with public transit improvements, central London has seen a congestion reduction of 15% (FHWA, 2006). **Findings from the Stockholm trial were similar: a large shift to public transit occurred concurrently with a 22% drop in vehicle trips in the city** (FHWA, 2006).

Case Study: Lane Pricing on California's SR 91

In Southern California, SR 91's toll levels are pre-set, and thus not truly dynamic, but near-peak prices vary hourly (according to schedule), and by day of week and direction of travel. Friday afternoon eastbound travelers (between 3:00 and 4:00 p.m.) pay the highest tolls (at 97¢ per mile), while weekend fares are nearly flat (generally around 30¢ per mile between 8:00 a.m. and 10:00 p.m.). As with California's IH 15, SR 91 essentially aims for a "C" level of service target, offering maximum flow at nearly free-flow-speed (zero-delay) conditions. California's SR-91 authority has been making small adjustments in rates almost every year, with little political fight, thanks to the size of the increments, regularity of past experiences, and clear existing policy. SR 91's policies are quite public in nature, and monitoring for rate changes occurs on 12-week cycles (though, in practice, its toll schedules tend to change just once a year) (Perez and Sciara, 2003).

Distance-Based (VMT) Pricing

Vehicle-miles-traveled **(VMT)** ***taxes*** seek to more equitably charge for roadway usage based on travel distances (ideally incorporating vehicle weight and emissions information into the tax rate), rather than fuel-use taxes (which reflect fuel economy more than pavement damage and other costs). VMT fees that rise and fall with traffic levels (e.g., by time of day) are also designed to moderate congestion.

Beyond provision and maintenance of roadways and their attendant infrastructure, drivers receive public services in the form of policing, traffic signal management systems, and emergency services, for which costs are estimated to run between 1 and 4¢ per vehicle-mile (Litman, 2011). **VMT taxes can also be set to reflect emissions or air quality impacts, noise impacts, habitat loss, stormwater management, and heat-island effects** (Litman, 2011). Estimates of other external costs of light-duty vehicles run about 2 to 5¢ per VMT. In contrast, current US fuel taxes average about 2¢ per mile on a 20-mpg vehicle and 1¢ per mile on a 40-mpg hybrid electric vehicle (Litman, 2011).

As the following sidebar notes, Oregon recently explored two variations of VMT pricing. Other states that have explored VMT tax options include Alabama, California, Iowa, Indiana, Kentucky, Michigan, Minnesota, Utah, and Washington (Boos and Moruza, 2008).

In 2006, Germany implemented a distance-based toll for trucks that varied with the number of axles and the vehicle's emissions class. Charged electronically using GPS

technology, the average toll was approximately Euro 0.15 per kilometer. In 2011, The Netherlands tested a GPS-based VMT tax, which varied based on fuel efficiency, day, and route. Drivers were billed monthly, and proponents saw this system as a possible revenue generator in lieu of gas taxes and toll roads. Although politically unpopular, this approach is being considered by several other countries (Rosenthal, 2011).

Case Study: VMT Pricing in Oregon

The 2001 Oregon Legislature established a Road User Fee Task Force "to develop a design for revenue collection for Oregon's roads and highways that will replace the current system for revenue collection" (ODOT, 2011). The Oregon Department of Transportation (ODOT) conducted a 12-month study of two strategies for more efficiently collecting revenue: 1) replacing the gas tax with a mileage-based fee collected at gas stations, and 2) using this system to collect congestion charges. The study demonstrated the feasibility of collecting mileage fees at gas stations, and how different pricing zones can be established electronically with variable fees charged for driving in each zone, at particular times of day. The pilot program tested two types of mileage fees: a flat per-mile charge and a premium for travel in congested zones during peak hours. Despite paying a VMT fee equivalent to the current gas tax, the per-mile charge group reduced their VMT by about 12%. In comparison, the congestion-fee group's peak-period travel decreased by 22%. Oregon's Road User Task Force recommended 2011 legislation for new fees on plug-in vehicle owners (ODOT, 2011).

Equity Issues in Road Pricing

Public and political opposition to congestion pricing policies often arise based on equity concerns. The value of travel time varies based on trip type, household income, and other factors. Typically, those with higher incomes have higher values of travel time, and thus stand to benefit the most from pricing (as time-savings values are more likely to exceed the toll). Although higher-income travelers use congestion pricing more often and bear most of the charges, a low-income driver in the peak direction during the peak hour is still negatively affected by the charges.

Strategies to increase equity in congestion pricing include revenue redistribution and toll exemptions/rebates. A study based on Stockholm's system found that using congestion pricing revenues for transit funding had the most benefit for low-income travelers (Eliasson and Mattson, 2006). In addition to toll revenue redistribution, researchers have suggested toll credits and discounted "lifeline" pricing based on income to increase traveler equity. For example, Fair and Intertwined (FAIR) lanes work on the basis of providing toll credits to those regularly using/needing the free lanes adjacent to the toll lanes. Accumulated credits allow for periodic use of the tolled lanes (DeCorla-Souza, 2000). Kalmanje and Kockelman's (2004) ***credit-based congestion pricing*** (**CBCP**) grants drivers a monthly

allowance of travel credits (typically monetized) to use on priced roads. The policy proposes drivers do not pay money out of pocket unless they exceed their allowance. Those spending less than their limit can use the credits later or exchange them for cash, bus passes, or other benefits. For drivers with special, socially desirable travel needs (e.g., welfare-to-work participants, and single-parent low-income household heads), extra credits may be allotted. In essence, CBCP encourages travelers to budget their travel based on congestion. **Such strategies can bridge the gap of user benefits of congestion pricing for different income groups and increase the political acceptability of roadway pricing.**

PARKING PRICING

Current parking pricing policies tend to forgo charging user fees or undercharge for user costs. Instead, parking is subsidized by revenues not directly related to parking usage. For example, free parking at a grocery store is subsidized by all shoppers as groceries are priced to include the construction and maintenance of the parking lot. Shoppers who do not require parking (those who choose transit, walk, or bike modes) are in essence cross-subsidizing the cost of parking for those who choose the automobile mode and park for free.

In downtown areas where curb parking is prevalent, free and underpriced parking not only encourages the automobile mode (as users are not paying the marginal cost), but also consumes substantial portions of streets that could otherwise be devoted to traffic flow. When the demand for free or inexpensive parking exceeds available curb space, local governments form development policies that require developers to provide off-street parking, thus increasing development costs (borne by everyone, not just those who park for free at the development).

Parking Costs

Providing parking is costly, particularly where land is expensive. Cambridge Systematics et al. (1998) estimated the total cost per parking space (including land, construction, design and engineering, interest payments, and operating costs) to be between $5,100 and $34,300 for surface lots, between $24,600 and $53,300 for multilevel parking structures, and between $38,800 and $99,300 for underground garages. More recently, Small and Verhoef (2007) used Southern California data to estimate the daily average cost of parking per vehicle at $4.44 for a suburban surface lot, $9.18 for a suburban parking structure, and $15.04 for an urban parking structure.

In addition to undervaluing the cost of a physical parking space, the search for underpriced empty spaces leads to a derived activity known as ***cruising***. Shoup (2005) estimates that cars in downtowns of various cities cruise on average for 3.5 to 14 minutes per trip, thereby exacerbating existing urban congestion. In an effort to reduce parking cruising, San Francisco has implemented SF Park, a program that uses embedded censors in on-street parking spaces to detect parking vacancies and varies parking fees based on time of day and location (SF Park, 2012).

Parking Cash-Out

Since parking is heavily subsidized by governments, businesses, and employers (and ultimately consumers), **pricing parking at marginal cost can have a significant impact on travel behavior**. In fact, demand studies comparing the commute behavior of employees with and without free parking at their places of work showed a decrease of drive-alone commuters by 19% to 81% in Los Angeles and 20% in Ottawa when free parking was eliminated (Young et al., 1991; Willson, 1992). In order to maximize parking efficiency, a spatially differentiated parking price structure where parking spaces furthest from the destination are priced lowest can be very helpful to reduce cruising (Anderson and de Palma, 2004). Additionally, when price gaps exist between inexpensive public curb parking and expensive private off-street parking, wasteful cruising for on-street parking is prevalent (Calthrop and Proost, 2006). However, as is the case with roadway pricing, public acceptance of first-best parking pricing policies may be low, due to parking's historical precedence of being "free" to users (at least in many neighborhoods).

One parking pricing initiative that has become rather common in California and Washington is parking cash-out. Employer-paid parking is essentially a grant-matching program encouraging employees to choose private automobiles while those who choose alternate modes of travel to work do not receive a subsidy. In a study by Shoup (1997), employment sites that offer employer-paid parking were shown to generate 33% more private car trips to work than sites that required employee-paid parking. **Parking cash-out programs allow employees to take out the cash equivalent of any parking subsidy offered, and effectively demonstrate the opportunity cost of free parking to employees.** Commuters who choose the auto mode can continue to park for free, but the cash option incentivizes carpooling, transit, walk, and bike modes.

4. Conclusions

TDM reduces traffic congestion by managing transportation demand. TDM techniques include employer-based strategies that shift travel away from the peak travel hour using compressed workweek scheduling, flextime, and telecommuting. It also includes managing congestion through tolling that varies by time of day. Both the public and private sectors can implement and benefit from TDM.

RECOMMENDATIONS

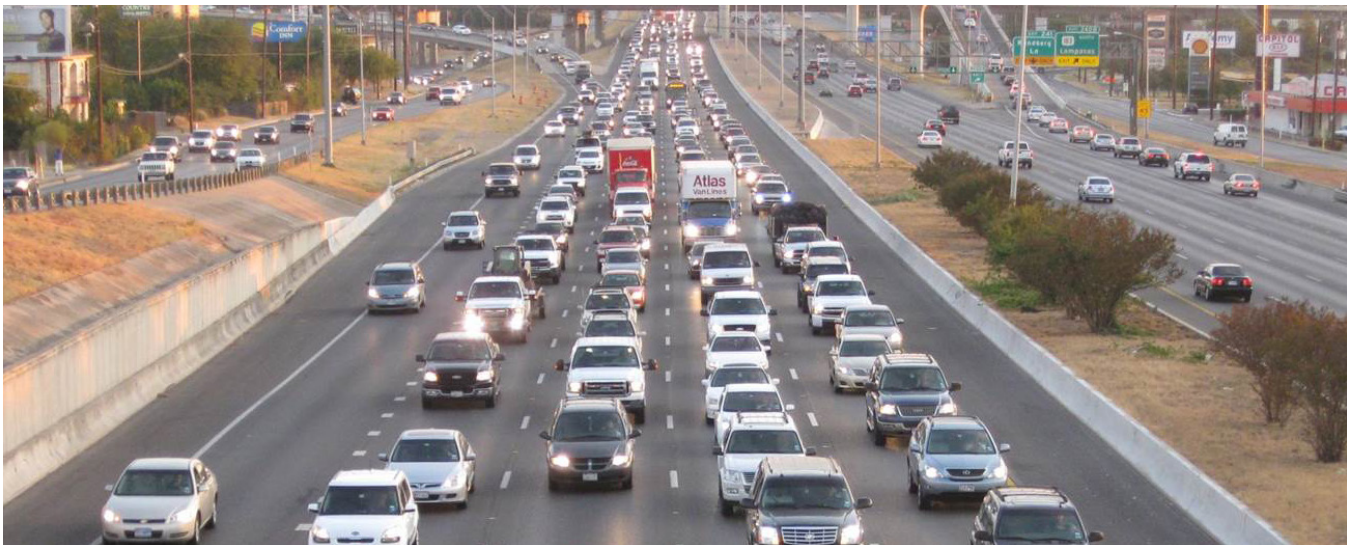
TxDOT can help promote TDM by serving as an example to other state agencies and the private sector. Under current state law, TxDOT cannot require private-sector employers to implement TDM strategies. TxDOT can, however, implement a level of required TDM participation for all of its roughly 10,000 employees. This approach would require telling people to change their ways, but mandating a level of participation makes the TDM more effective.

One method to consider is compressed workweek scheduling. Research by the Texas Comptroller of Public Accounts showed that compressed workweek scheduling is especially suitable for government employees.

It is important to consider several dimensions when evaluating the effectiveness of a TDM program. Employer-based TDM offers the potential for reduced overhead costs, increased employee morale, increased employee retention, reduced absenteeism, increased customer service, and reduced congestion.

TxDOT must communicate clearly to the public the reasons for implementing any mandatory TDM strategy. Research shows that mandatory strategies, such as pricing and required participation in employer-based strategies, are more effective, acceptable, and politically viable when 1) the strategies are communicated clearly to the public, and 2) they are combined with voluntary employer-based strategies (Garling and Schuitema, 2007).

Pricing transport facility use can have a significant impact on traffic congestion by discouraging travel during congested hours. Where electronic toll collection systems exist, toll rates can vary based on time of day and congestion levels. Some underutilized toll segments with parallel toll-free facilities may need to charge less during the peak hours to encourage drivers to move from the congested toll-free streets onto the less-congested toll lanes. This strategy increased truck traffic by 50% when applied to the SH 130 toll road, which runs parallel to the perpetually congested IH 35 in Austin.



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Appendix

The following table is offered as the P1 for Project 6-0702. The table provides a summary of the guide and report being developed through the study. It individually addresses the state's six largest urban areas—including Houston, Dallas, Fort Worth, San Antonio, El Paso, and Austin—in terms of the demographics and socio-economic characteristics of the areas. It includes demand leveling success stories for each urban area and, based upon the urban area characterization, provides recommendations for demand leveling implementation.

The likely effectiveness of each demand leveling concept and the cost are described using low, medium, or high categorical assessments. Generally the low-cost category includes zero or near-zero capital and maintenance costs. Effectiveness is further described as "potential impacts after implementation" in terms of reduced trip making, and the equivalent numbers of freeway lanes.

A brief summary of demand leveling prospects for locations other than the six major urban areas is included in a "non-urban city" table section. Due to less severe congestion and generally shorter travel times in these cities, the impacts of demand leveling would be less significant compared to the congested larger cities.

Potential applications of "mandatory" demand leveling concepts are addressed in a separate table section. Again, potential effectiveness and costs are assessed in terms of low, medium, or high categories and significant political or social considerations are included in the assessments.

Voluntary Strategies: Austin

Demographic and Economic Characteristics	Travel Characteristics	Success Stories	Recommendations (based on likely effectiveness and cost)	Potential Impact after Implementing Recommendations
• Growing rapidly. The 1990s saw a 48% increase in population, and growth has been averaging 3.2% annually since the 2000 Census. • Historically, infrastructure expansion limited in effort to keep the town small. Present expansion efforts continue to lag behind population growth. • Growing technology industry employs a results-based workforce suitable to telecommuting and mobile officing. • Well educated population; higher education	• Average commute: 23 minutes; 14% of the workforce commutes longer than 45 minutes. • Lowest rates of single-occupant vehicle (**SOV**) commuting • Highest rate of telecommuting • Highest rate of public transportation use • Highest rate of commuting by means other than driving, public transit, and walking • Ties with Houston for highest rate of public transportation to commute to work. Austin's daily vehicle trips are 17 million; 1.07 million are AM Peak work trips and 0.85 million are PM	• AMD: AMD North American Go Green commuter program, eliminating an estimated 1,027,000 miles of driving, conserving approximately 50,000 gallons of gasoline (international program, but started in Austin). • Austin Community College: ACC began offering Green Pass (bus passes), reducing personal vehicles on campus by 6% in just 1 year. • Dell: Started in 2009, 15% use flexible work option: variable daily work times, compressed workweeks, telecommuting	• Telecommuting is the most suitable TDM strategy for Austin's technology-industry-centered economy because tech jobs are largely results-based, which allows employees to work independently from home. Tech industry employees also have the computer skills and resources necessary for successful telework. **Likely Effectiveness: High** **Cost: Low** • Compressed workweek scheduling, in which an employee works longer than a typical 8-hour work day in exchange for working fewer days each month, is also suitable for	• Telecommuting alleviates congestion by eliminating an AM and PM car trip each day that the employee telecommutes. A conservative estimate of Austin residents employed by the tech industry is 63,000. If only 10% of these employees who commute as SOVs telecommuted instead, more than 6,000 cars would be removed from the road, which is the equivalent volume of three highway lanes. If 20% of these employees switched to telecommuting, then 12,600 cars would be removed from the road, which is the capacity of six highway lanes. • Compressed workweek scheduling alleviates congestion in two ways: shifting travel times away from the peak hour (leaving before the AM peak and after the PM peak) and eliminating

Demographic and Economic Characteristics	Travel Characteristics	Success Stories	Recommendations (based on likely effectiveness and cost)	Potential Impact after Implementing Recommendations
attainment rates than state and national average. • Technology industry is the nucleus of Austin's economy.	Peak work trips.	arrangements • Rideshare program in 2009: o Total miles saved 1,377,172 o VOC saved 1,961,093 grams o NOx saved 1,101,737 grams o CO2 saved 1, 296,434 lbs	technology industry jobs because they usually do not require the employee to be present at their desk Monday–Friday. A popular compressed workweek schedule is 4/10, working 4 days each week for 10 hours a day. **Likely Effectiveness: Medium** **Cost: Low** • Flextime is also suitable to Austin, whose flexible occupations can accommodate varying start and stop times. **Likely Effectiveness: Medium** **Cost: Low**	some work trips altogether. The popular 4/10 schedule eliminates one AM and one PM commute every week. • Flextime alleviates congestion by shifting travel times so that fewer cars are traveling during the same peak period (rush hour). • If 15% of work trips on IH 35 in Austin north of Loop 111 and south of FM 2222 were reduced using TDM, then almost 3,000 trips in the AM Peak and 2,400 trips in the PM Peak would be saved. • A 15% reduction in *all* area-wide work trips through telecommuting or compressed workweek scheduling would save over 160,000 AM Peak trips and 130,000 PM Peak trips.

Voluntary Strategies: Dallas

Demographic and Economic Characteristics	Travel Characteristics	Success Stories	Recommendations (based on likely effectiveness and cost)	Potential Impact after Implementing Recommendations
• Economy traditionally associated with banking, commerce, telecommunications, computer technology, energy, healthcare and medical research, transportation, and logistics. • Retail trade employs the largest sector of the local workforce, followed by healthcare and social assistance, food services, and manufacturing • Commerce is the nucleus of Dallas' economy. A conservative estimate of Dallas residents employed by the industry is 186,000.	• Average commute: 25 minutes; however, 17.7% of the workforce has commutes longer than 45 minutes. • Median rate of SOV commuting • High rates of carpooling, public transportation, and telecommuting • The Dallas/Fort Worth MSA has an extensive transit system, made up of a complex network of highways, high-occupancy vehicle (**HOV**) lanes, the nation's first commuter rail system, and a network of van and carpools. • Dallas Area Rapid Transit (**DART**) Rail, the Trinity Railway Express commuter rail,	• All of DART's top 10 corporate pass buyers are hospitals or government entities. • At least 596 major employers have ETR (employer trip reduction) programs. • Vanpools reduce travel by 39,160 vehicle trips/day at full implementation. • FW Natural Energy: Telecommuting saved $30,000/yr. • These Dallas companies allow telecommuting: Mobil, Frito Lay, IBM, Texas Instruments, Xerox, AT&T, GTE, and J.C. Penney.	• Compressed workweek scheduling is especially suitable to the city's commerce-based economy because it benefits employers by increasing the available business hours without contributing to overtime. In a compressed workweek schedule, employees work longer than a typical 8-hour work day in exchange for working fewer days each month. Studies indicate that employers enjoy the increased productivity of compressed workweeks, and employees enjoy having an extra day off each week. **Likely Effectiveness: High** **Cost: Low**	• Compressed workweek scheduling alleviates congestion in two ways: shifting travel times away from the peak hour (leaving before the AM peak and after the PM peak) and eliminating some work trips altogether. The popular 4/10 schedule eliminates one AM and one PM commute every week. • Flextime alleviates congestion by shifting travel times so that fewer cars are traveling during the same peak period (rush hour). • The FHWA reports that in 2000, nearly 45% of people in the Dallas/Fort Worth metro area left for work between 7:00 a.m. and 8:29 a.m. and almost 30% left between the hours of 5:00 and 7:00 a.m. Only 10% of employees depart for the office between 8:30 and 9:00 a.m. If a flextime schedule that allowed employees to work from 10:00 a.m. to 6:30 p.m. was used by just 10% of SOV

Demographic and Economic Characteristics	Travel Characteristics	Success Stories	Recommendations (based on likely effectiveness and cost)	Potential Impact after Implementing Recommendations
	and bus service move more than 220,000 passengers per day across a 700-square-mile service area. • HOV lanes are used by more than 45,000 commuters each weekday.		• Flextime is also appropriate for Dallas because the commerce industry's flexible occupations can accommodate varying start and stop times. **Likely Effectiveness: Medium** **Cost: Low**	commuters currently departing during the 7:00–8:29 a.m. window, then 109,000 cars would be removed from the largest AM peak period—an equivalent of 54 highway lanes. • In 2009, IH 35 in Dallas north of State HW 366 and south of the Dallas North Tollway had an annual average daily traffic (**AADT**) count of 269,000 vehicles. Of those trips, 6.2% were considered AM Peak work trips and 4.9% were considered PM Peak work trips. If 15% of those were reduced using TDM, then almost 4,000 trips in the AM Peak and 3,100 trips in the PM Peak would be saved on this segment of highway. • If TDM achieved a 15% reduction in *all* area-wide work trips during the traditional 3-hour peak periods, then 350,000 AM Peak trips and 280,000 PM Peak trips would be saved.

Voluntary Strategies: Fort Worth

Demographic and Economic Characteristics	Travel Characteristics	Success Stories	Recommendations (based on likely effectiveness and cost)	Potential Impact after Implementing Recommendations
• Historically associated with oil and industrial manufacturing. Unlike Dallas, Fort Worth presently has a significant manufacturing industry. • Growing rapidly at 3.9% per year. If Fort Worth continues to grow at this rate, the city's population could easily exceed one million by 2030. • The Dallas/Fort Worth/Arlington MSA is the fourth-largest city in the US. • Manufacturing is the nucleus of Fort Worth's economy.	• Average commute: 26 minutes • Highest rate of SOV commuting • Lowest rate of using alternative commute strategies (everything but SOV commuting) • Many people live in Fort Worth and commute to Dallas. • Fort Worth residents are still especially reluctant to give up SOV commuting, so congestion can be reduced if companies would incentivize carpool and vanpool programs.	• The DART commuter transportation system provides service to and from 12 surrounding cities via DART Rail, the Trinity Railway Express commuter rail, and bus service. The DART system moves more than 220,000 passengers per day across a 700-square-mile service area. DART also operates a system of HOV lanes, which are used by more than 45,000 commuters each weekday.	• Compressed workweek scheduling is especially suitable to manufacturing industry because it benefits employers by increasing production hours and decreasing absenteeism. Employees work longer than a typical 8-hour work day in exchange for working fewer days each month. A 3/12 schedule is commonly used by factory employers: two work shifts each work 3 days a week for 12 hours a day so that equipment is run 6 days a week. Studies have shown that employers enjoy increased productivity, and employees enjoy having an extra 2 days off weekly. **Likely Effectiveness: High Cost: Low** • Staggered shift times, similar to flexible work schedules, adjust shift start and stop	• Compressed workweek scheduling alleviates congestion in two ways: shifting travel times away from the peak hour (leaving before the AM peak and after the PM peak) and eliminating some work trips altogether. The 3/12 work schedule popular in the manufacturing industry reduces congestion by eliminating 2 commute days each week. • Staggered shift times alleviate congestion by redistributing commute trips across a longer period. • A conservative estimate of Fort Worth residents employed by the manufacturing industry is 41,700. If 15% of these employees reduce their commute through TDM, then 6,255 cars would be removed from the road—the capacity of more than three freeway lanes.

Demographic and Economic Characteristics	Travel Characteristics	Success Stories	Recommendations (based on likely effectiveness and cost)	Potential Impact after Implementing Recommendations
			times so that employees enter and exit work at staggered times throughout the day. This reduces congestion during shift changes. **Likely Effectiveness: Medium** **Cost: Low** • Company-supported carpooling. Fort Worth has the state's highest rate of SOV commuting and one of the lowest rates of carpool use. Nearby Dallas enjoys higher rates of carpooling, perhaps due to greater employer support of carpooling. Houston, the birthplace of company carpooling, has much higher ridership in car and van pools due to convenience and company incentives. **Likely Effectiveness: High** **Cost: Medium**	

Voluntary Strategies: El Paso

Demographic and Economic Characteristics	Travel Characteristics	Success Stories	Recommendations (based on likely effectiveness and cost)	Potential Impact after Implementing Recommendations
• Closely intertwined culturally and economically with its sister city, Juarez, across the border. Together, the two cities have a combined population of more than two million people. • The once-large manufacturing industry has shifted to Juarez where wages are significantly lower; Juarez assembles high-tech parts manufactured in the US and abroad, and the assembled products are trucked to El Paso for distribution. • Education and health care service	• Average commute: 22 minutes • Lowest rates of carpooling • Lowest rates of telecommuting • Only 5,300 El Paso residents, or 2% of the workforce, commute to work each day using public transportation. However, El Paso's public transit system, Sun Metro, serves about 41,000 people each day, many of whom are Juarez residents who work in El Paso. • Historically, many people lived and worked on different sides of the border, crossing to enjoy food and recreation on	• Commuter vanpooling in Sunland Park. Constructed three new Park and Ride facilities. Currently developing Brio, a rapid transit system that uses high-capacity vehicles, improved fare collection systems, and advanced traffic signals to move riders more efficiently. Sun Metro operates 166 fixed route vehicles and 65 paratransit LIFT vehicles, and serves more than 15 million passengers a year. Sun Metro also operates a large natural-gas-fueled fleet, which at one	• Compressed workweek scheduling is suitable to those employed in El Paso's service industry because it increases available business hours without contributing to overtime. In a compressed workweek schedule, employees work longer than a typical 8-hour work day in exchange for working fewer days each month. Studies have shown that employers enjoy the increased productivity of compressed workweeks, and employees enjoy having an extra day off each week. **Likely Effectiveness: High** **Cost: Low**	• Compressed workweek scheduling alleviates congestion in two ways: shifting travel times away from the peak hour (leaving before the AM peak and after the PM peak) and eliminating some work trips altogether. The popular 4/10 schedule eliminates one AM and one PM commute every week. • Telecommuting alleviates congestion by eliminating an AM and PM car trip each day that the employee telecommutes. • A conservative estimate of El Pasoans employed by the service industry is 123,000. Approximately 80% of El Paso residents commute alone each day, so an estimated 99,500 cars carry service industry employees each day. If 10% of these employees telecommuted or reduced a commute day through compressed workweek scheduling, then over 9,950 cars would be eliminated, which is the equivalent capacity of five highway lanes. • In 2010, IH 10 in El Paso north of SH 178 and south of US 370 had an AADT count of 69,000 vehicles. Of those trips,

Demographic and Economic Characteristics	Travel Characteristics	Success Stories	Recommendations (based on likely effectiveness and cost)	Potential Impact after Implementing Recommendations
industries are growing quickly and filling the void left by manufacturing. • The number of El Paso employees working in El Paso manufacturing jobs has decreased by 50% over the past 10 years, presumably because companies have relocated their manufacturing operations to Juarez. • The service industry is the nucleus of El Paso's economy.	both sides. This commingling of the sister cities continues in spite of the recent years of violence in Juarez. In 2009, approximately 7.5 million pedestrian trips were made at points of entry between El Paso and Juarez.	time was the world's largest operating natural gas mass transit fleet.	• Telecommuting is suitable for many of El Paso residents who work in call centers. Travel agencies report that customer service and sales representatives are more productive and deliver higher levels of customer service when telecommuting. Companies say that while extra training and resources are required before beginning telecommuting, the benefits of telework outweigh the initial costs. **Likely Effectiveness: Medium** **Cost: Low**	6.2% were considered AM Peak work trips and 4.9% were considered PM Peak work trips. If 15% of those were reduced using TDM, then almost 3,300 trips in the AM Peak and 2,600 trips in the PM Peak would be saved. • El Paso's daily vehicle trips are 10 million, with 640,000 of those AM Peak work trips and 510,000 PM Peak work trips. If TDM achieved a 15% reduction in *all* work trips, 100,000 AM Peak trips and 80,000 PM Peak trips would be saved.

Voluntary Strategies: Houston

Demographic and Economic Characteristics	Travel Characteristics	Success Stories	Recommendations (based on likely effectiveness and cost	Potential Impact after Implementing Recommendations
• Fifth-largest US city, recently surpassed in population by the Dallas/Fort Worth/Arlington MSA. • With a combined population of 6.1 million people, the Houston/Sugar Lang/Bay Town MSA is more populated than either Denmark, Ireland, or New Zealand. • Houston's economy has diversified significantly over the past 30 years. In 1981, 85% of all jobs were in energy-related businesses. Today, nearly half of all jobs are in non-energy fields, such as business, technology, medicine, manufacturing, and aerospace engineering. • Houston is the hub of a massive trucking and rail system that links the southern, south central, midwestern, and western United States. More than 600 trucking firms operate in Houston and 2 major rail systems operate 14 mainline tracks that radiate	• Average commute: 26 minutes; however, 20% of Houston's workforce has a commute longer than 45 minutes. • Compared to the other Texas MSAs, Houston has the highest rates of public transportation use and carpooling. Perhaps the city's TDM success is due to its advertising, marketing, and public relations campaigns that are designed to educate on and create awareness of Houston's air quality programs that incorporate TDM strategies. • Even though several TDM solutions are successfully reducing the number of	• The Houston-Galveston Area Council established a Commute Solutions program in 1994. Commute Solutions' programs include a regional vanpool program; NuRide, which rewards people who take greener trips; a commuter and transit services pilot program, which includes trolleys and several express commuter bus routes; a regional telework incentive program; a bicycle and pedestrian program; and an advertising, marketing, and public relations campaign. • During its 17-year existence, Houston's vanpool program has reduced vehicle miles traveled by 5,021,903 and prevented 8,304 pounds of nitrogen oxide air pollutant from being released into the atmosphere. • The NuRide program has 18,091 registered	• Compressed workweek scheduling, in which an employee works longer than a typical 8-hour work day in exchange for working fewer days each month, is suitable for Houston's petrochemical industry jobs because it increases productivity by reducing the amount of time spent starting and stopping machinery. **Likely Effectiveness: High** **Cost: Low** • Staggered shift times have been used in the ship channel for decades to reduce congestion around petrochemical plants during shift changes. Staggered shift times, similar to flexible work schedules, adjust shift start and stop times so that employees enter and exit work at staggered times	• Compressed workweek scheduling alleviates congestion in two ways: shifting travel times away from the peak hour (leaving before the AM peak and after the PM peak) and eliminating some work trips altogether. The 3/12 work schedule is best suited for petrochemical plants, and would reduce congestion by eliminating 2 commute days each week. • Staggered shift times alleviate congestion by redistributing commute trips across a longer period of time. • If compressed workweek scheduling and staggered shift times were used by 15% of the estimated 220,000 people who work in petrochemical-related jobs, then 33,000 work trips would be removed from the peak period. The impact would be significant because a large majority of Houston residents travel during the same morning peak period. The FHWA's report on travel and departure time in 2000 reported that 31.8% of Houston commuters left for work between 5:00 a.m. and

Demographic and Economic Characteristics	Travel Characteristics	Success Stories	Recommendations (based on likely effectiveness and cost	Potential Impact after Implementing Recommendations
from Houston. This transportation network supports the city's vibrant economy, but has also contributed to the area's famously heavy traffic. • Traffic became a significant concern in the 1970s, and by the 1980s companies began setting up their own private car and vanpools. This early foray into TDM later expanded with city government support after Houston was placed on the ozone non-attainment list. Now, public and private partnerships provide Houston with a number of commute alternatives. • The petrochemical industry is the nucleus of Houston's economy.	vehicles on Houston's roads, 74% of the workforce still commutes daily in SOVs. • HOV lanes were introduced in 1978 and the HOV system expanded significantly from 1985 to 2003. Houston HOV lanes have been shown to effectively reduce congestion, but poor public understanding of the HOV lanes success has made the HOV lane concept unpopular. • In February 2012, Houston METRO opened a segment of the Gulf Freeway (IH 45) HOV lanes to SOVs at tolled rate that varies from $1 to $4.50 depending on the time of day and level of congestion.	participants in the Houston area and is steadily growing. The program reduced vehicle miles traveled by 944,198 and prevented 49,632 tons of emissions from entering the atmosphere since its establishment in June 2005. • BHP, a natural resources refining company, provides $64.50/month for bus riders; $60/month for carpoolers; $30/month for vanpoolers (plus $35/month METRO subsidy); and $60/month for bikers. • Employee Benefit Solutions provides employees with the necessary tools to telework. The company provides VPN technology, dial-up capabilities, cell phones, and smart phones to keep employees well connected.	throughout the day. **Likely Effectiveness: High** **Cost: Low** • Many engineers work in research and development jobs related to the petrochemical industry, which are well suited to telecommuting either part or full time. Research jobs are largely results-based, which allows employees to work independently from home. Tech industry employees also have the computer skills and resources necessary for successful telework. **Likely Effectiveness: Medium** **Cost: Medium**	7:00 a.m., and 41.5% left between the hours of 7:00 a.m. and 8:30 a.m. • In 2010, IH 45 in Houston north of IH 10 and south of Loop 610 had an AADT count of 270,000 vehicles. Of those trips, 6.2% were considered AM Peak work trips and 4.9% were considered PM Peak work trips. If 15% of those work trips were reduced using TDM, then almost 4,000 trips in the AM Peak and 3,100 trips in the PM Peak would be saved. • In Houston, the daily vehicle trips are 56 million; 3.5 million are AM Peak work trips and 2.8 million are PM Peak work trips. If TDM achieved a 15% reduction in *all* work trips, over half a million AM Peak trips and 420,000 PM Peak trips would be saved.

Voluntary Strategies: San Antonio

Demographic and Economic Characteristics	Travel Characteristics	Success Stories	Recommendations (based on likely effectiveness and cost)	Potential Impact after Implementing Recommendations
• Top four largest industries: healthcare and social assistance; retail trade; accommodation and food services; construction. • Historically a blue-collar military complex; the city is home to Fort Sam Houston, Lackland Air Force Base, Randolph Air Force Base, and Brooks-City Base. • The defense industry employs over 89,000 people and produces a $5.25 billion impact on the city's economy. • Military operations is the nucleus of San Antonio's economy.	• Average commute: 23 minutes • Third highest rate of commuting via public transportation • Tied with Austin and Houston for highest rate of walking to work	• USAA allows flextime and telecommuting, and sponsors the largest vanpool program in Texas. • Six Flags offers reduced-rate bus passes, bicycle racks, security, and showers (and reports higher employee retention because of these incentives).	• Flextime is appropriate for San Antonio because the military operations can accommodate varying start/stop times. **Likely Effectiveness: High** **Cost: Low** • Compressed workweek scheduling, in which an employee works longer than a typical 8-hour work day but works fewer days each month, is also suitable for technology industry jobs because they usually do not require the employee to be present at their desk Monday–Friday. A popular compressed workweek schedule is 4/10. **Likely Effectiveness: High** **Cost: Low**	• Military operations employ about 195,000 people in San Antonio. If 10% of this workforce used compressed workweek scheduling or flextime, then over 19,000 commuters would be shifted to a non-peak travel time or their trip would be eliminated altogether—the equivalent capacity of nine and a half freeway lanes. • In 2010, IH 35 in San Antonio north of US 90 and south of SH 536 had an AADT count of 159,000 vehicles. Of those trips, 6.2% were considered AM Peak work trips and 4.9% were considered PM Peak work trips. If 15% of those work trips were reduced using TDM, then almost 2,300 trips in the AM Peak and 1,800 trips in the PM Peak would be saved. • San Antonio's daily vehicle trips are 26.8 million; 1.7 million of

Demographic and Economic Characteristics	Travel Characteristics	Success Stories	Recommendations (based on likely effectiveness and cost)	Potential Impact after Implementing Recommendations
				those are AM Peak work trips and 1.3 million are PM Peak work trips. If TDM achieved a 15% reduction in *all* work trips, over a quarter of a million AM Peak work trips and 200,000 PM Peak work trips would be saved.

Voluntary Strategies: Non-Urban Cities in Texas

Demographic and Economic Characteristics	Travel Characteristics	Success Stories	Recommendations (based on likely effectiveness and cost)	Potential Impact after Implementing Recommendations
• Smaller than the large metro areas but still have their own transportation challenges • Cities in West Texas where oil is found are unprepared for influx of traffic and road degradation caused by heavy vehicles and equipment related to oil extraction.	• Average commute: 17 minutes	• Compressed workweek scheduling successfully used with rural maintenance crews in the Odessa and Austin Districts of TxDOT.	• Compressed workweek scheduling reduces one work trip each week, which increases safety by reducing the potential for crashes on rural roads. **Likely Effectiveness: Medium** **Cost: Low**	On a comparative basis, non-urban cities have fewer significant congestion problems. However, the well-established benefits of happier, more productive workers who drive fewer commuter miles, saving fuel and money, would likely apply to TDM participants in non-urban cities.

Mandatory Strategies

Strategy	Recommendations
1. Public-sector employer imposes strategies on employees **Likely Effectiveness: High** **Cost: Low monetary cost, politically medium cost**	• Mandatory strategies are potentially more effective than anything in the voluntary column, but they do require telling people to change their ways. • TxDOT can implement a level of required TDM implementation for all of its roughly 10,000 employees. • One example to consider is the State of Utah, which required all state employees to work a 4/10 compressed workweek schedule. • Research by the Texas Comptroller of Public Accounts showed that compressed workweeks are especially suitable for government employees. • More local government employees in Texas benefit from compressed workweek scheduling than employees in any other employment category. • When implementing required TDM compliance, several dimensions are important to consider when evaluating the effectiveness of a TDM program. TDM offers the potential for reduced overhead costs, increased employee morale, increased employee retention, reduced absenteeism, increased customer service, and reduced congestion.
2. Private-sector employer imposes strategies on employees **Likely Effectiveness: High** **Cost: Low monetary cost; public agencies have no control so costs in terms of implementation difficulty are medium to high.**	• Under current state law, TxDOT cannot require private sector employers to implement TDM strategies. • TxDOT can, however, serve as an example to the private sector.
3. Pricing of transport facility use **Likely Effectiveness: High** **Cost: Low monetary cost; politically difficult to implement so implementation difficulty is medium to high.**	• Where electronic toll collection systems exist, toll rates can vary based on time of day and congestion levels. Some underutilized toll segments with parallel toll-free facilities may need to charge less during the peak hour to encourage drivers to move from the congested toll-free streets onto the less congested toll lanes. This strategy increased truck traffic by 50% when applied to the SH130 toll road, which runs parallel to the perpetually congested IH 35 in Austin.

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