

1. Report No. FHWA/TX-96/1446-1		2. Government Accession No.		3. Recipient's Catalog No.	
4. Title and Subtitle POTENTIAL OF TELECOMMUTING FOR TRAVEL DEMAND MANAGEMENT				5. Report Date November 1995	
				6. Performing Organization Code	
7. Author(s) Katherine F. Turnbull, Laura Higgins, Darryl Puckett, and Carol Lewis				8. Performing Organization Report No. Research Report 1446-1	
9. Performing Organization Name and Address Texas Transportation Institute The Texas A&M University System College Station, Texas 77843-3135				10. Work Unit No. (TRAIS)	
				11. Contract or Grant No. Study No. 0-1446	
12. Sponsoring Agency Name and Address Texas Department of Transportation Research and Technology Transfer Office P. O. Box 5080 Austin, Texas 78763-5080				13. Type of Report and Period Covered Interim: September 1994-August 1995	
				14. Sponsoring Agency Code	
15. Supplementary Notes Research performed in cooperation with the Texas Department of Transportation and the U.S. Department of Transportation, Federal Highway Administration. Research Study Title: Potential of Telecommuting for Travel Demand Management					
16. Abstract This study examines the use of telecommuting on a national and state level. It reviews the issues commonly associated with telecommuting and the approaches employed to address these. The potential benefits of telecommuting for employers, employees, and the transportation system are outlined. Telecommuting programs in Houston, Dallas, and Austin are summarized. Preliminary sketch planning tools are presented for assessing the potential for telecommuting in major Texas cities and for analyzing the impacts on the transportation system. The case studies and work activities for the second phase of the study are also presented.					
17. Key Words Telecommuting, Travel Demand Management, TDM, Telework			18. Distribution Statement No restrictions. This document is available to the public through NTIS: National Technical Information Service 5285 Port Royal Road Springfield, Virginia 22161		
19. Security Classif.(of this report) Unclassified		20. Security Classif.(of this page) Unclassified		21. No. of Pages 45	22. Price

**POTENTIAL OF TELECOMMUTING FOR
TRAVEL DEMAND MANAGEMENT**

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Research Report 1446-1
Research Study Number 0-1446
Research Study Title: Potential of Telecommuting for Travel Demand Management

Sponsored by the
Texas Department of Transportation
In Cooperation with
U.S. Department of Transportation
Federal Highway Administration

November 1995

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IMPLEMENTATION STATEMENT

Addressing concerns related to traffic congestion and air quality is a major focus in many metropolitan areas in Texas and throughout the country. A wide range of travel demand management (TDM) techniques and other strategies are being considered and implemented to help address these issues. Telecommuting is one potential approach to help reduce demand on the transportation system.

This study examines the state and national experience with telecommuting. It includes an assessment of the issues associated with telecommuting, the benefits of these programs, and preliminary sketch planning tools to estimate the potential for telecommuting in Texas and the impacts on the transportation system. The study and this report will be of benefit to the Texas Department of Transportation (TxDOT), other state agencies, metropolitan planning organizations, and public and private sector employers interested in maximizing the benefits of telecommuting programs.

DISCLAIMER

The contents of this report reflect the views of the authors who are responsible for the opinions, findings, and conclusions presented herein. The contents do not necessarily reflect the official views or policies of the Federal Highway Administration (FHWA) or the Texas Department of Transportation (TxDOT). This report does not constitute a standard, specification, or regulation, and is not intended for construction, bidding, or permit purposes.

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SUMMARY

Traffic congestion and air quality are significant concerns in most metropolitan areas throughout Texas and the United States. A wide range of travel demand management (TDM) techniques and other strategies are being considered and implemented to help address these issues.

Telecommuting is one potential technique to help reduce demand on the transportation system. Telecommuting includes a variety of non-standard employment arrangements allowing employees to work at home or at other locations. By removing trips from the roadway system during the peak-periods, telecommuting helps reduce congestion levels, improve air quality, and decrease energy consumption. Telecommuting programs may also benefit employers and employees through reducing office space needs, improving productivity, and allowing greater flexibility for individual workers.

This report examines the current use of telecommuting at the national and state levels. At the national level, numerous public agencies and private businesses have implemented telecommuting programs. The best examples of extensive telecommuting programs are found in Hawaii, California, and the Seattle area. Benefits realized by these and other programs include increases in worker productivity, savings in office space and real estate cost, time and cost savings for employees, and reductions in vehicle kilometers of travel (VKT) and energy use.

Telecommuting is also beginning to be used by public agencies and businesses in Texas. According to the Employer Trip Reduction (ETR) plans submitted by employers in the Houston area, approximately 8 percent of approximately 1,200 employers currently offer telecommuting programs. Businesses in other parts of the state also have telecommuting programs. Surveys of HOV lane users and non-users in Houston and Dallas indicated that telecommuting is supported by 40 to 49 percent of these commuter groups. Thus, the potential for expanding telecommuting programs in Texas appears good.

Elements of successful telecommuting programs include support from top management, the development of clear policies and procedures for telecommuting, and selection of appropriate job tasks, employees, and managers. Successful programs usually require changes in management policies, with performance-based employee measurements replacing visual supervision.

The information provided in this report will assist all groups interested in maximizing the benefits from telecommuting programs. The report also outlines the case studies of selected firms that will be conducted in the second phase of the research.

CHAPTER ONE—INTRODUCTION

Traffic congestion and air quality are significant concerns in most metropolitan areas throughout Texas and the United States. Locations designated by the Environmental Protection Agency (EPA) as air quality non-attainment areas must meet additional requirements to reduce vehicle kilometers of travel and to increase the use of high-occupancy vehicles (HOVs) and alternative commute modes. A wide range of travel demand management (TDM) techniques and other strategies are being considered and implemented to help address these issues.

Telecommuting is one potential technique to help reduce demand on the transportation system. Telecommuting includes a variety of non-standard employment arrangements allowing employees to work at home or at other locations. By removing trips from the roadway system during the peak-periods, telecommuting helps reduce congestion levels, improve air quality, and decrease energy consumption. Telecommuting programs may also benefit employers and employees through reducing office space needs, improving productivity, and allowing greater flexibility for individual workers.

Telecommuting is a relatively new approach to work arrangements. The recent increase in telecommuting is largely attributed to rapid advancements in telecommunications and computer technologies. As a non-traditional work arrangement, a number of concerns are often associated with telecommuting. These include issues related to management, employees, the legal environment, and the transportation system. The successful widespread use of telecommuting will require that these concerns be examined and addressed.

This research study is identifying potential issues with telecommuting and ways to overcome these concerns to help ensure that programs in Texas provide maximum benefits to employers, employees, and the transportation system. It is also examining current and future use of telecommuting in the state and the impact of telecommuting on the transportation system. The research builds on demonstration projects and programs underway throughout the country, as well as previous research conducted by the Texas Transportation Institute (TTI) and other groups.

This report documents the first phase of the research study. It provides an assessment of the current use of telecommuting at the national and state levels. The report also reviews issues commonly associated with telecommuting and the approaches employed to address these, as well as the potential benefits of telecommuting. Sketch planning techniques are presented for use in estimating the potential for telecommuting in major metropolitan areas in the state and the possible impacts of telecommuting on the transportation system.

This report will be of benefit to the Texas Department of Transportation (TxDOT), other state agencies, metropolitan planning organizations (MPOs), and public and private sector employers interested in maximizing the benefits of telecommuting programs. All groups can use the sketch planning tools to help estimate the potential for telecommuting in various metropolitan

areas and the possible impacts on the transportation system. The results also help identify issues that may emerge in implementing telecommuting programs and ways to overcome these concerns.

OBJECTIVES OF RESEARCH STUDY

This research project accomplishes a number of objectives. First, it provides a better understanding of telecommuting on a national and a state level. Researchers examined the current extent of telecommuting, along with the characteristics of successful programs.

Second, the research assesses the advantages and concerns associated with telecommuting from the perspective of employers, employees, and public regulating agencies. It further identifies approaches for addressing potential issues which may limit the effectiveness of telecommuting.

Third, sketch planning tools for analyzing the potential of telecommuting in Texas cities and for assessing the possible impacts on the transportation system are presented. Planners and engineers can use these techniques to estimate the general extent and influence of telecommuting in different metropolitan areas in the state.

The last objective of the research is to conduct more detailed case studies of selected telecommuting programs. Researchers will conduct these case studies in the second year of the project. They will provide a more in-depth assessment of the characteristics of successful programs, including changes in policies, management, and employee reporting requirements. A more detailed analysis will also be made of changes in trip rates and trip distances by telecommuters to better estimate the impact on the transportation system.

RESEARCH ACTIVITIES

Researchers conducted a number of activities to accomplish the previous objectives. A state-of-the-art literature review provided a historical perspective on telecommuting, as well as the current status of programs throughout the country. Documented benefits and issues were examined, along with the impacts of telecommuting on the transportation system, air quality levels, and energy consumption.

Information obtained through other research projects provided additional insight into telecommuting in Texas (2). The Employee Trip Reduction Plans submitted by employers in Houston, surveys of HOV lane users and non-users in Houston and Dallas, and discussion groups in Houston, Dallas, and Austin all helped to further identify the interest of employers and employees in telecommuting. Reports, newsletters, and other information also contributed to the identification of existing programs. Current methodologies for estimating the potential transportation impacts of telecommuting were also reviewed.

ORGANIZATION OF THIS REPORT

This report is divided into four chapters following the introduction. The next chapter provides an overview of the national experience with telecommuting. This includes a discussion of the various approaches to telecommuting, possible issues, potential benefits, and key elements of successful programs. Chapter three summarizes the use of telecommuting in Texas. The sketch planning tools for estimating the potential for telecommuting in major cities in the state and the possible impacts on the transportation system are presented in chapter four. The report concludes with a summary of the major elements covered in the project and the identification of the phase two case studies.

CHAPTER TWO—NATIONAL EXPERIENCE WITH TELECOMMUTING

BACKGROUND

Telecommuting encompasses a wide range of approaches involving non-traditional work arrangements. Rather than moving people to work, telecommuting focuses on moving work to people. Telecommuting is most commonly thought of as employees working full-time or part-time at home. It may also include employees working at a satellite center, conducting sales or services from home or personal vehicles, and working in clients' offices.

Current estimates by the U.S. Department of Transportation and other groups indicate that approximately 30 percent of the American labor force now works at home at least part of the time. While these may not all be telecommuters, some two to seven million workers are estimated to be full-time employees who would otherwise be commuting daily to work (4). Initial telecommuting demonstration projects have been implemented in Hawaii (5), California (6), and the Seattle area (7). Further, private companies and public agencies in different areas have initiated telecommuting programs for various reasons.

The potential of telecommuting has been estimated to reach 15 million workers in the next decade (4). A number of factors will influence the widespread use of telecommuting and the ability to reach this target. These include the nature of businesses, specific work tasks, management structures, employee characteristics, costs, legal issues, traffic congestion levels, air quality concerns, and advances in technologies. This chapter provides an overview of various approaches to telecommuting, potential issues and benefits, keys to successful programs, and examples of existing telecommuting efforts.

APPROACHES TO TELECOMMUTING

Telecommuting involves non-traditional forms of working which eliminates the need for an employee to commute on a daily basis to a central employment location. Telecommuting may involve the use of advanced communications technology, or it may just focus on doing regular work tasks outside the office. Home-based telecommuting is the most familiar form of telecommuting. In this case, a telecommuter is an employee of an organization who completes certain tasks at home and communicates with the organization's main office by telephone, computer modem, or other means. Telecommuting may also involve mobile workers, home-based business owners, and employees working at satellite, local, or neighborhood centers. Examples of the various approaches to telecommuting are summarized next.

- **Telecommuting—Working at Home.** The most common form of telecommuting involves an employee working full-time or part-time at home. Under this approach, an employee may work on a daily basis from home or may work one or two days a week or month from home. This approach may include the use of advanced technologies—such as equipping a home office with a computer, fax, and modem—or

it may simply involve conducting work tasks—such as reading reports or reviewing plan specifications—at home.

- **Telecommuting—Hoteling or Free Addressing.** These are terms used to describe employees who spend most of their time in clients' offices. They may have temporary work space, usually in the form of cubicles or offices that are shared with others, at their own office. Accountants or auditors who spend most of their time in clients' offices provide examples of this form of telecommuting (8).
- **Telecommuting—Mobile Workers or Virtual Offices.** Sales and marketing staff often use these approaches. Using notebook computers, faxes, modems, and cellular telephones, sales personnel may spend most of their time working from home or their automobile, with only periodic trips to their main office for meetings and other business (9).
- **Telecommuting—Home-Based Businesses.** This approach to telecommuting focuses on self-employed or other home-based businesses. Examples include contractors who spend most of their time on site, free lance writers, and desktop publishers (10).
- **Telecommuting—Satellite Centers.** Satellite centers are usually defined as branch offices of a company that are located close to employees' residences. Typically, about 20 to 100 employees from an organization will work out of a single satellite center (6).
- **Telecommuting—Local Centers.** Local centers usually provide office space for employees from multiple organizations. The employees may share space and equipment, and there is generally a site manager in charge of the facility (6).
- **Telecommuting—Neighborhood Centers.** Neighborhood centers are defined as smaller facilities, with usually less than 25 workers from one or several different organizations. Neighborhood centers are often within walking or bicycling distance from workers' homes (6).

The major focus of this research study is on the first group of telecommuters—employees of public agencies or businesses who work at home on a daily or part-time basis. Although the other techniques are examined, the first approach has the greatest potential for widespread use in Texas. As a result, it formed the major focus for the study.

POTENTIAL ISSUES WITH TELECOMMUTING PROGRAMS

A number of possible issues have been identified with telecommuting programs. Potential concerns focus on both employers' ability to manage telecommuting programs and employees' ability to work at home or at remote office sites. Further issues have been raised related to the legal environment and public policies. This section examines some of the potential

issues that may need to be addressed with telecommuting programs and techniques for overcoming them.

- **Selecting Appropriate Businesses and Jobs for Telecommuting.** Not all businesses and jobs are realistic candidates for telecommuting. For example, businesses involved with the manufacturing or production of a product do not appear to be logical choices for telecommuting, nor do jobs that require direct interaction or face-to-face communication. A large number of service, support, and technical jobs may be appropriate candidates for telecommuting. Targeting specific types of businesses and public agencies and realizing that not all jobs within a specific business will be eligible for telecommuting are important first steps to establishing realistic programs. Selecting supervisors and employees for telecommuting is also important.
- **Management Concerns.** A frequently voiced management concern with telecommuting relates to how employees can be monitored and evaluated if they are not in the office and within sight of their supervisors. Telecommuting usually requires changes in management policies and employee supervision. Employee evaluations must be based on performance factors and measures other than just being at work. Changes may be needed in job descriptions, performance appraisals, and career ladders. Other policies may need to be modified, and training for both managers and employees is usually required. Management support appears to be critical to the success of telecommuting programs (4,5,6,7).
- **Conflicts between Telecommuters and Other Employees.** An issue related to the manager/employee relationship is the relationship between telecommuters and their non-telecommuting co-workers. Potential problems may arise over the responsibilities and the expected performance standards of telecommuters as well as ongoing communication between co-workers. Ensuring that all groups have a clear understanding of the responsibilities of telecommuters and that mechanisms are provided for ongoing communication among all groups can help overcome these concerns (11).
- **Difficulties of Working at Home.** Another potential issue relates to the home work environment and ensuring that an employee can work productively at home. Telecommuters may discover that they are distracted more at home than at the office. Family and friends may assume that since a telecommuter is at home, he or she is free to care for children, run errands, do housework, or talk. The relaxed atmosphere may present a temptation to procrastinate on tasks, start work late, or end early. Self-supervision is thus an important attribute of telecommuters (11). Company policies on the home work environment, child care, work hours, and other elements can help address possible concerns in this area. The telecommuting guidelines developed by TxDOT provide an excellent example of a comprehensive policy (12).
- **Employee Isolation.** Some telecommuters cite the lack of interaction and camaraderie with co-workers as a drawback. Others have raised concerns about telecommuting

contributing to overwork or workaholism, and labor unions have suggested that telecommuting could exploit employees (13). Maintaining telecommuters as members of the office “team” through group meetings, regular newsletters, and other approaches may help substitute for some of the day-to-day contact among employees. Rather than a full-time work style, others recommend a balance between telecommuting days and in-office days to ensure professional networks at the office (11,14).

- **Potential Legal Issues.** A number of legal issues have been identified which might impact potential telecommuting efforts. These include the Fair Labor Standards Act, Workers’ Compensation laws, the Occupational Health and Safety Act (OHSA), and the Americans with Disabilities Act (ADA). It appears that all of these potential legal issues can be addressed through policies and procedures relating to telecommuting programs and employees who telecommute. For example, possible concerns relating to the Fair Labor Standards Act can be addressed through clear policies and documentation of telecommuters’ work hours, pay rates, and overtime. Workers’ Compensation concerns can be addressed by ensuring that insurance covers telecommuting employees and satellite offices and by establishing a system for reporting work-related injuries. Further, home and satellite offices must meet OHSA standards for safety and health hazards. While a company cannot control an employee’s day-to-day practices at home, an initial inspection can be conducted at the beginning of the telecommuting program to eliminate existing hazards. Any site maintained by the company for a group of telecommuting employees must conform to ADA standards (15).

POTENTIAL BENEFITS OF TELECOMMUTING

Employers, employees, and the community at large may realize a number of benefits through telecommuting efforts. By removing work trips during the morning and afternoon peak-periods, telecommuting may help reduce traffic congestion, improve air quality levels, and lower energy consumption. The potential benefits of telecommuting are briefly reviewed in this section.

- **Employer Benefits.** The most common benefit cited by organizations with telecommuting programs is an increase in the productivity of their telecommuting workers. Benefits noted include faster completion of assignments, fewer sick and absent days, better time management, and increased morale and commitment to the company. Other benefits realized by some companies include a reduction in office space and its associated costs, reduced turnover, and better customer service. For example, Pacific Bell has estimated a 20 percent increase in productivity and savings of at least \$500,000 in office space costs through telecommuting (14). Other companies have cited similar benefits (13,14).
- **Employee Benefits.** Telecommuting reduces or eliminates the time, stress, and cost of twice-daily commute trips for employees, allowing more time and energy for work.

The absence of office distractions and interruptions and the comfortable atmosphere of a home office aid concentration. Depending on the policy of the organization and the nature of the job, telecommuting may also allow the employee to take advantage of his or her own most productive hours of the day. Telecommuters also have greater flexibility to organize their day and to take care of other responsibilities.

In addition to gasoline and parking costs saved by not commuting to an office, telecommuters can save money on auto insurance premiums, on meals, and in some cases on clothes for the office. Additional benefits mentioned by employees include more flexibility in caring for children and other family members, more free time before and after work, and a greater level of job satisfaction (13,16).

Telecommuting can benefit both companies and workers by allowing retention of employees that are temporarily or permanently unable to commute to the office because of an illness, disability, maternity leave, or relocation. Some companies have been able to retain experienced employees who may have left otherwise due to changes in their family situations (17).

- **Travel Reduction, Air Quality Enhancement, and Energy Reduction.** A significant motivation for many companies to begin a telecommuting program is to reduce employee commute trips in accordance with air quality legislation or other requirements. Since telecommuting removes work trips from congestion peak-periods, it should have positive impacts on traffic congestion, air quality, and energy consumption. This assumes that the telecommuter does not make other trips during the day, however.

One of the best-documented telecommuting programs is the State of California Telecommuting Pilot Project, in which 22 state agencies participated. Travel diaries kept by program participants indicated that they made virtually no work-related trips on telecommuting days. The majority of participants also reduced the number of non-work trips on telecommuting days. Overall, on days they worked at home, telecommuters reduced their peak-period trips by an average of 60 percent, their total vehicle kilometers by 80 percent, and their freeway use by 40 percent. The telecommuting program prompted many participants to seek out shopping, recreation, and other non-work destinations that were closer to their homes, both on telecommuting and non-telecommuting days (19).

Other studies have indicated similar benefits. For example, travel diaries completed by telecommuters and other workers provided a model for trip and emissions reductions during the Puget Sound Telecommuting Demonstration Project. On telecommuting days, telecommuting workers averaged 30 percent fewer trips, 63 percent fewer kilometers traveled, and 44 percent fewer cold starts. These factors resulted in a 50 to 60 percent decrease in individual vehicle emissions per telecommuting day (20). Telecommuting employees at the State of Hawaii's telework center in Mililani, Oahu, saw a gasoline savings averaging 29 percent as well as a 7.4

hour reduction in travel time per week (21). Finally, an average of 50 vehicle kilometers of travel was saved per employee for each telecommuting occasion in a telecommuting test conducted by the Southern California Association of Governments (SCAG). Most participating employees worked from their homes, with one employee working at a satellite center (21).

The reduced number of work and non-work trips resulted in approximately 60 percent fewer automobile “cold starts” for each telecommuter in the program, along with similar decreases in emissions of organic gases, carbon monoxide, and nitric oxides. Travel energy saved averaged 80 kilowatt-hours (21,22).

- **Special Situations.** Telecommuting can help manage response to natural disasters or other emergency situations. The San Francisco earthquake in October 1989 provided an unusual test case for telecommuting programs, as companies in the San Francisco Bay Area searched for ways to continue operating in spite of destroyed roadways that stranded employees at home. Telecommuting was also used after the 1993 Los Angeles earthquake (18).

KEYS TO SUCCESSFUL PROGRAMS

The literature review and telephone conversations with representatives from companies with telecommuting programs provide insight into the components of successful programs. The following elements appear to be important to maximize the potential benefits of telecommuting to all groups.

- **Top Management Support.** The approval and support from top management are critical to the development and implementation of a telecommuting program. Management must be willing to provide any necessary financial support, as well as any changes in policies and procedures for telecommuting.
- **Telecommuting Policies and Human Resource Support.** Clearly articulating the agency or company policies relating to telecommuting is a critical step. These should identify the expectations of both employees and management. They should outline the specific requirements for telecommuters, such as a home work area, work hours, communications with the main office, dress, and other items. Support from the human resource or personnel department is also important to ensure that both supervisors and employees are able to obtain assistance during the implementation of a telecommuting program, as well as on an ongoing basis.
- **Selection of Job Tasks.** Selecting jobs and work tasks that are appropriate for telecommuting should be an initial step in the development of a program. The following characteristics help to identify jobs that may be appropriate candidates for telecommuting.

- Can work tasks be done at home or at a remote work site?
- Can work tasks be done without interaction with customers or co-workers?
- Is the equipment necessary to conduct the work tasks available at home or a remote work site?
- Can the job objectives be identified and measured?

Certain jobs may be better suited to telecommuting than others. Examples of jobs that are good candidates for telecommuting include research, data analysis, communications, writing, programming.

- **Selection of Telecommuters.** Once the general jobs and work tasks appropriate for telecommuting have been identified, the next step is to select the employees to participate in the program. An employee's work habits should be considered in the selection of telecommuters. Employees who complete tasks successfully and reliably, enjoy working independently, and assume responsibility may be good candidates. The following questions can be used to help identify potential telecommuters.

- Are you self-motivated and a self-starter?
- Do you like to work independently?
- Do you work well without supervision?
- Do you have a home office or area where you can work at home without interruption?

- **Selection of Managers and Supervisors.** The selection of managers and supervisors of telecommuters must also be done with care. Telecommuting usually requires managers to adopt new management styles and procedures. Employee productivity must be measured by factors other than direct oversight. The lack of interaction with an employee on a daily basis must also be considered. Making sure that both managers and employees are comfortable with the telecommuting arrangement and have established a good working relationship is important.
- **Ongoing Monitoring.** An ongoing monitoring program should be conducted to ensure that a telecommuting program continues to provide the desired benefits for all groups. A monitoring program can help identify problems so that appropriate actions can be taken.

EXAMPLES OF EXISTING TELECOMMUTING PROGRAMS

A number of public agencies and private businesses throughout the country have implemented telecommuting programs. Highlights of a few examples of these programs follow.

- A combination of public and private sector groups sponsor the Hawaii Telework Center Demonstration Project. The project involves employees from the Bank of Hawaii, IBM Corporation, Inter-Island Legal Services, Hawaii Medical Services Association, and Title Guaranty of Hawaii, as well as a number of state employees. The telework facility is located in the suburb of Mililani, Oahu, approximately 32 kilometers from downtown Honolulu. The companies lease office space and provide computer equipment, telecommunication services, and other related equipment. The Hawaii State Legislature provided \$125,000 to help initiate the project. Employees report reductions in trips, travel time and fuel consumption and an increase in productivity and job satisfaction (23).
- The Harris Bank in Chicago has offered telecommuting as one option in the company Alternative Work Arrangements program. While the formal policy for telecommuting was still under development, some individual managers within the bank started pilot programs within their own departments. Many employees who chose to try telecommuting already owned computers and modems (24).
- Bell Atlantic has conducted two pilot tests to help develop its telecommuting policies. Currently, approximately 500 employees telecommute for one to three days per week. Telecommuting employees are expected to purchase their own computers and related equipment, although in some cases surplus office equipment is available for home use. The company has developed a pre-telecommuting workbook to help employees and their manager decide if telecommuting is a workable option for them, as well as a training program for new telecommuters (25).
- IBM Canada's Flexiplace program combines a variety of telecommuting options. Some employees work at home, coming into the office only for staff meetings; others work "on the road" while traveling among customers; still others work for an extended period at a customer's place of business. Besides the increased employee effectiveness afforded by flexible work arrangements, IBM has been able to reduce its real estate costs (26).

CHAPTER THREE — TEXAS EXPERIENCE WITH TELECOMMUTING

This chapter examines the current use of telecommuting programs by private businesses and public agencies in Texas. It also assesses the interest of employees and employers in telecommuting. This chapter provides an overview of current telecommuting programs, along with selected case study examples. Telecommuting efforts in the planning stage are highlighted, as are some of the organizations and activities promoting telecommuting within the state.

The information presented in this chapter comes from a number of sources. First, researchers examined available reports, documents, and newsletters from agencies and businesses throughout the state. Second, a review of the Employer Trip Reduction (ETR) plans submitted by employers in Houston to the Texas Natural Resource Conservation Commission (TNRCC) helped identify companies with existing and planned telecommuting programs. Third, discussion groups and surveys of HOV lane users and freeway motorists conducted as part of another research project provided further information on telecommuting programs and commuter preferences in Houston, Dallas, and Austin (2). Finally, follow-up telephone calls to representatives of public and private sector groups provided current information on various programs.

An overview of these information sources follows, along with a summary of the procedures used for the various data collection activities. The preliminary assessment of employee interest in telecommuting is then described. The chapter concludes with a discussion of employer interest in telecommuting and selected case studies of existing programs.

INFORMATION SOURCES AND DATA COLLECTION PROCEDURES

Information from a wide range of sources was examined to help identify the current interest in telecommuting and existing programs in Texas. These included available reports, as well as results from related research projects. The major sources of information are briefly summarized in this section.

- **Reports, Documents, and Newsletters.** Available reports addressing telecommuting in Texas were reviewed as a first step in this research study. These included a preliminary report conducted for TxDOT through the Oil Overcharge Program (3), related research projects (1,2), and newsletters and bulletins from public agencies and private businesses. Additional information was also obtained from the Texas Telecommuting Advisory Council, a part of the National Telecommuting Advisory Council. The Texas Council has chapters in Houston, Austin, Dallas, and San Antonio.
- **Employee Trip Reduction Plans.** Houston is classified as a severe ozone non-attainment area by the Environmental Protection Agency (EPA). The 1990 Clean Air Act Amendments require employers with over 100 employees to develop, implement,

and monitor plans and programs to increase vehicle occupancy levels and to reduce the number of commuters driving alone. To meet these requirements, companies in Houston conducted surveys of employees to identify current commute modes and travel preferences, and developed plans outlining how they would meet the required average vehicle occupancy (AVO) levels. These plans were submitted to TNRCC on various dates in 1994 depending on the size of the company.

TTI was able to make copies of approximately 1,200 of the 1,400 plans submitted to TNRCC.¹ Researchers are analyzing the information in the plans to assist with a number of research efforts, including this study. Although the regulations governing the employee trip requirements are being reevaluated, the plans contain a wealth of information on the alternate mode preferences of approximately 400,000 employees in the Houston area and the programs proposed by employers to increase the use of alternative commute modes.

Two parts of the ETR plans are of interest to this study. First, the general level of employee interest in telecommuting is identified by the response to questions on current commute modes and future commute and work schedule preferences. Second, the plans indicate companies which currently allow employees to telecommute, as well as those planning to implement future programs.

- **HOV Lane User and Non-User Surveys and Discussion Groups.** TTI researchers conducted surveys of bus riders, carpoolers, and freeway motorists on two HOV lanes and freeways in Houston and one in Dallas in 1995 for another research project (2). The surveys included questions to help gauge the support for several employer-based strategies, including telecommuting. Commuters on the Katy (I-10 West) and Northwest (U.S. 290) freeways in Houston and the East R. L. Thornton (I-30 East) freeway in Dallas were involved in the survey. The same study also involved discussion groups with representatives from the public agencies and private businesses in Houston, Dallas, and Austin. The survey and discussion group results help identify the current interest in telecommuting on the part of employees and employers, as well as current programs.

EMPLOYEE INTEREST IN TELECOMMUTING

The ETR plans in Houston and the surveys of HOV lane users and non-users in Houston and Dallas provide an indication of employees' interest in telecommuting. Although this information focuses on Houston and Dallas, the results assist in developing parameters that may be transferable to other metropolitan areas in the state.

¹The approximately 200 plans submitted to Independent School Districts (ISDs) were not included in this study or the other research projects. Thus, the ETR plans examined and the information presented in this report focus on the some 1,200 non-ISD employers in the Houston area with over 100 employees.

Approximately 800 or 67 percent of the 1,200 non-ISD employers required to submit ETR plans in Houston included telecommuting as an option on their employee surveys. Some 74,000 employees, or 19 percent of the total 400,000 employees covered in the ETR plans, responded positively to telecommuting as a future work schedule alternative. Although not all employees were asked about their preferences concerning telecommuting, these results indicate that telecommuting is viewed as a favorable alternative to driving alone by at least some 20 percent of employees in Houston.

The results from the surveys of bus riders, carpoolers, and freeway motorists in Houston and Dallas indicate an even higher level of support for telecommuting. As illustrated in Figure 1, telecommuting was supported by 40 to 49 percent of the bus riders, carpoolers, and freeway motorists on the East R. L. Thornton, Katy, and Northwest HOV lanes and freeways. This response is slightly lower than other employer-based incentives, such as employer subsidies of bus passes and flexible work hour arrangements.

EMPLOYER INTEREST IN TELECOMMUTING AND EXISTING PROGRAMS

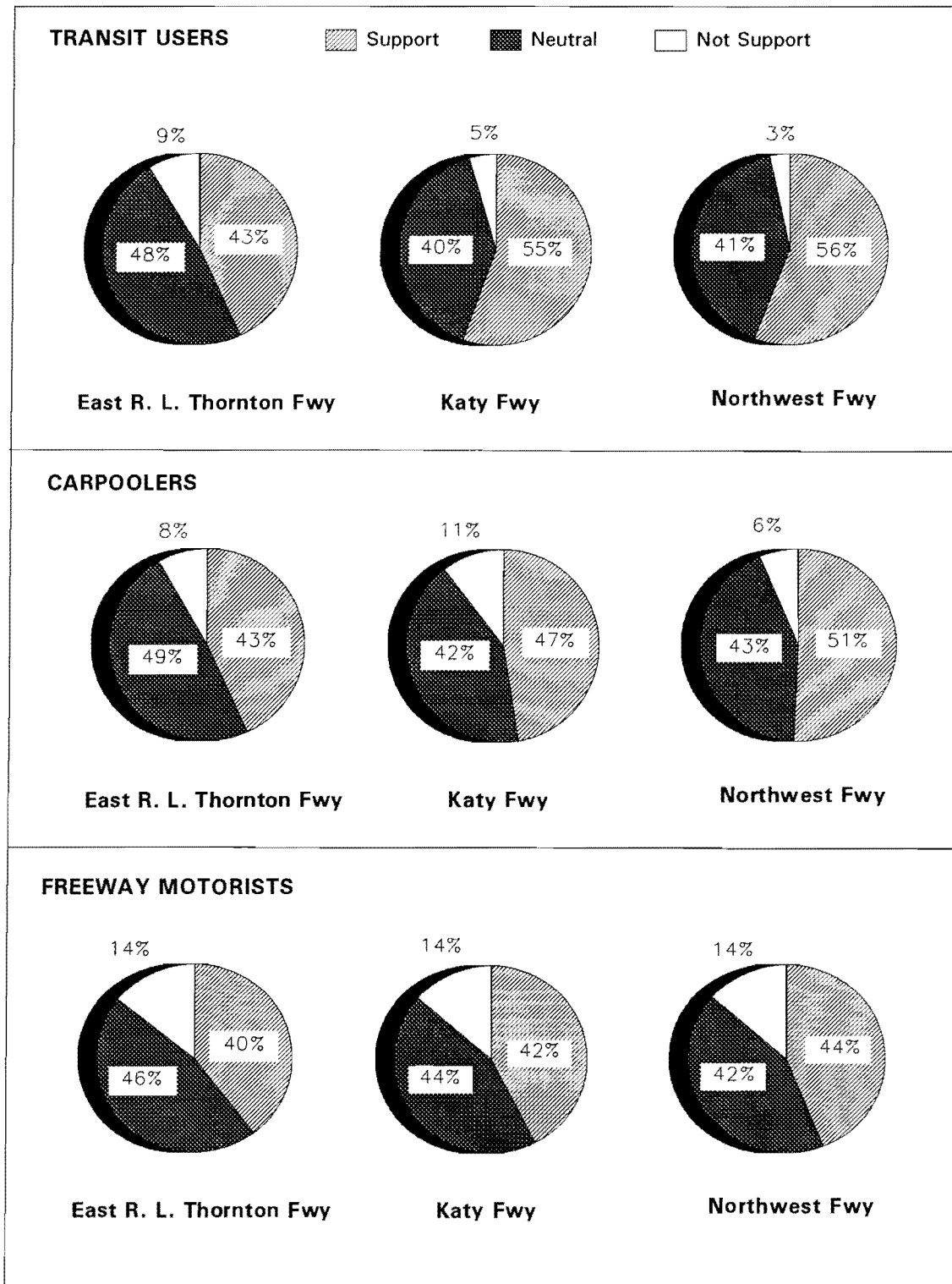
The ETR plans in Houston, the discussion groups, follow-up telephone calls, and other available information provide a good indication of the current extent of telecommuting programs in Texas. For example, 22 percent of the Houston ETR plans include telecommuting programs as a trip reduction measure. Only 8 percent, or approximately 94 employees, however, identified existing telecommuting programs. The remaining 172 companies or agencies indicated that new programs would be developed.

Follow-up telephone calls were made to a number of the companies with current telecommuting programs. The results indicate that many existing programs are very informal. A number of representatives indicated that employees are allowed to telecommute in special cases, such as maternity or medical leaves, or that some staff have flexibility to work at home periodically. Public and private sector representatives in the telephone surveys and in the discussion groups identified a number of management concerns which may be limiting the use of telecommuting. The issues raised are similar to those described in chapter two relating to monitoring employees at home.

EXAMPLES OF EXISTING TELECOMMUTING PROGRAMS

The sources described previously were used to identify telecommuting programs within the state. Additional information was obtained on some of these programs through telephone conversations with agency and company representatives. A few examples of current and planned telecommuting programs follow.

Figure 1. Degree of Support for Telecommuting



Note: Respondents were asked: "A number of ideas have been suggested for addressing traffic congestion and air quality concerns. Which of the following approaches would you support to help address these concerns?"

Source: (2)

- **National Energy and Water Management Center, Fort Worth.** The National Energy and Water Management Center moved its seven employees into home offices in October 1995. The Center estimates that it will cost approximately \$20,000 to equip the home offices, and another \$5,000 annually to maintain the communications equipment and other items. Even with these costs, the Center estimates a savings of \$30,000 annual rent and maintenance on their current office space.
- **Mobil Oil Company, Dallas.** Mobil does not currently have a company-wide telecommuting program. Rather, each division is responsible for determining if telecommuting is appropriate and for implementing pilot programs and policies. The Exploration and Producing Division recently conducted a 90-day telecommuting pilot program in which 5 employees telecommuted 1 to 2 days per week. Some of the employees already had their own computers at home, while the others used surplus computers from the office. In either case, Mobil paid to have modems and dedicated phone lines installed. Some of the division employees in the program are continuing to telecommute after the initial test.
- **Environmental and Conservation Services Department, City of Austin.** The City of Austin has permitted telecommuting on a case-by-case basis, usually for employees with health problems or those on maternity leave. Based on recommendations from the Employee Commute Options (ECO) team, the Environmental and Conservation Services Department is planning a 6-month formalized telecommuting pilot project. The pilot is scheduled to begin in January or February of 1996. The demonstration will include employees with varying job types and job situations, with selection based on the suitability of the workers' job tasks to part-time telecommuting. This information has been collected through a survey, which also asked each employee if he or she already owned a computer and related equipment. Some surplus office equipment will be made available to the telecommuters. The pilot will include training for the telecommuters and their supervisors, as well as before-and-after surveys and ongoing monitoring. Approximately 15 to 20 workers will be selected to participate in the pilot, and will telecommute 1 to 2 days per week. The City will use the pilot project results to help formulate a formal telecommuting policy for all divisions.
- **Methodist Hospital, Houston.** Approximately 50 employees in the Information Service and Nursing Support and Training Departments at Methodist Hospital currently telecommute. The hospital has a formal telecommuting policy. Among other requirements, the policy states that employees must be reachable by telephone during normal work hours. No formal evaluation of the program has been conducted.
- **Deloitte & Touche, Houston.** Deloitte & Touche has a "work at home" program which allows some employees to work a day or two a week from their homes. Participating employees are primarily client service staff rather than administrative personnel. Approximately 100 employees are currently eligible to participate, with

some 80 telecommuting during a typical week. Most eligible employees work at home approximately one day a week.

- **Internal Revenue Service (IRS), Houston.** A pilot telecommuting project at the IRS office in Houston allows some employees to work at home a few days a week. Currently, approximately 25 percent of the office staff, or about 200 workers, are participating in the program. Eligible employees must have at least two years experience, and the current program focuses on revenue agents.
- **British Airways, Houston.** Account managers and sales personnel for British Airways conduct most of their business out of the office using laptop computers and telephones. Most sales personnel average four days telecommuting and one day in the office for meetings and coordinating projects.
- **Texas Instruments, Houston.** Texas Instruments has a formal telecommuting policy and program. The Houston facility participates in this program, although only non-manufacturing personnel are eligible. Participation is dependent upon approval from supervisory personnel. Currently, approximately 20 to 30 employees telecommute on a regular basis, with most averaging two days a week.
- **Aetna Life and Casualty, Houston.** Aetna Life and Casualty has an optional telecommuting program for approximately 140 employees in the claims area. Aetna does not have a formal policy on telecommuting. On average, it appears that participating employees telecommute one to two days a week.
- **City of Houston, Houston.** Although the City does not have a formal policy, City employees may currently telecommute at the discretion of their immediate supervisor. A policy is being developed, but formal adoption by the City will take time. Approximately 50 employees currently telecommute an average of one day a week.
- **Compaq Computers, Houston.** Compaq Computer utilizes telecommuting on a national basis, including its Houston office. Sales representatives and other employees work from home on a regular or part-time basis. Telecommuters are linked to the main office by computer modems and may have portable computers, laser printers, cellular telephones, and other items. Company-wide, Compaq has made a significant investment in telecommuting. This investment has resulted in both increased sales and reduced office costs.

CHAPTER FOUR—PRELIMINARY SKETCH PLANNING TOOL

One of the objectives of this research project is the development of sketch planning tools for assessing the potential of telecommuting in Texas cities and for analyzing the possible impacts on the transportation system. This chapter presents the preliminary outline of these sketch planning tools. Researchers will test and refine these techniques during the second phase of this study based on information obtained from the more detailed case studies of selected telecommuting programs in Texas.

ASSESSING THE POTENTIAL FOR TELECOMMUTING IN TEXAS CITIES

Other studies (3,27,28) have examined the extent of telecommuting in specific areas and the types of jobs most suitable for telecommuting. Building on these efforts and the information obtained through the Houston ETR plans, this research developed a sketch planning tool for identifying the general potential for telecommuting in Texas cities. The steps in the development of the sketch planning tool and the use of the technique are described next.

Researchers first reviewed the 1990 Census employment data and the number of home-based workers in the major metropolitan areas in Texas. The percent of employees working at home ranged from a low of 1 percent in Houston to a high of 2.8 percent in Austin. These figures should be used with caution, as they may reflect not only telecommuters but also self-employed individuals and contract workers. Also, some individuals who actually telecommute part-time may not list themselves as working from home.

The Houston ETR plans include the standard industrial code (SIC) for each employer. The SIC is a general classification system that is used by the U.S. Census Bureau and other groups to categorize different types of businesses. The percent of companies reporting telecommuting programs, and the percent of workers in those firms, were identified.

The breakdown, which is provided in Table 1, gives a general indication of the types of public agencies and private businesses within the broad SIC codes that may be realistic candidates for telecommuting. This information indicates that the general SIC codes with greatest potential for telecommuting include manufacturing, health services, educational services, other professional and related services; finance, insurance and real estate; business and repair services, and public administration,

Although these categories are similar to those identified in other studies (3,27,28), caution must be noted in their application. The information in the ETR plans reflect large employers in the Houston area. Biases may exist in the data. The information can be used to identify general trends, however, and SIC categories that may be more appropriate for telecommuting.

Table 2 identifies the number and percent of companies by SIC for Austin, Corpus Christi, Dallas, El Paso, Fort Worth, and San Antonio. This information can be used to provide an indication of the potential for telecommuting within the different sectors of the economy in these areas. For example, both Austin and San Antonio have larger numbers of firms or agencies in the public administration category than the other cities.

This sketch planning tool will be refined in the next phase of the research study.

Table 1. Percent of Houston Companies with Telecommuting Programs by Standard Industrial Code*

SIC Name	SIC Number	Percent of Total Companies
Manufacturing, Durable Goods Mining	2800-3999	13
Health Services	8000-8099	7
Educational Services	8200-8299	26
Other Professional and related services	8300-8999	5
Finance, Insurance, and Real Estate	6000-6799	5
Business and Repair Services	7300-7699	10
Public Administration	9000-9899	7
Mining	1000-1499	10
Communications and other Public Utilities	4800-4999	8
Wholesale Trade	5000-5199	5
Manufacturing, Non-Durable Goods	2000-2799	2
Personal Services	7200-7299	2
Entertainment and Recreation Services	7800-7999	2
Transportation	100-999	0
Retail Trade	1500-1799	0
Construction	4000-4799	0
Agriculture, Forestry, Fisheries	5200-5999	0

*Information from 1,200 non-ISD Houston ETR plans. Represents employers with over 100 employees in the Houston area.

Table 2. SIC Information for Other Texas Cities

Census Group	SIC No. Range	Austin Companies	% of Total	Corpus Christi Companies	% of Total	Dallas Companies	% of Total
Agriculture, forestry, fisheries	100-999	521	2	164	1	569	1
Mining	1000-1499	139	0	338	3	731	1
Construction	1500-1799	2,021	6	946	7	2,576	4
Manufacturing, non-durable goods	2000-2799	765	2	186	1	1,896	3
Manufacturing, durable goods	3800-3999	803	2	360	3	1,986	3
Transportation	4000-4799	603	2	340	3	1,440	2
Communications and other public utilities	4800-4999	263	1	114	1	394	1
Wholesale trade	5000-5199	2,522	8	1,307	10	7,521	0
Retail trade	5200-5999	2,022	6	1,959	15	6,215	10
Finance, insurance, and real estate	6000-6799	3,834	12	1,282	10	7,526	12
Personal services	7200-7299	1,613	5	660	5	3,001	5
Business and repair services	7300-7699	4,318	13	1,844	14	7,761	12
Entertainment and recreation services	7800-7999	751	2	280	2	1,063	2
Health services	8000-8099	2,814	9	1,198	9	4,435	7
Legal and related services	8100-8199	2,512	8	760	6	6,021	9
Educational services	8200-8299	555	2	218	2	789	1
Other professional and related services	8300-8999	4,317	13	435	3	6,770	11
Public administration	9000-9899	828	3	304	2	508	1
Unclassifiable	9999	931	3	435	3	2,456	4
TOTALS		32,132	100	13,130	100	63,658	100

Table 2. SIC Information for Other Texas Cities, Continued

Census Group	SIC No. Range	El Paso Companies	% of Total	Fort Worth Companies	% of Total	San Antonio Companies	% of Total
Agriculture, forestry, fisheries	100-999	218	1	316	1	548	1
Mining	1000-1499	15	0	218	1	265	1
Construction	1500-1799	1,163	6	1,632	7	1,191	3
Manufacturing, non-durable goods	2000-2799	459	2	683	3	903	2
Manufacturing, durable goods	3800-3999	677	3	1,018	4	1,079	3
Transportation	4000-4799	597	3	523	2	899	2
Communications and other public utilities	4800-4999	148	1	150	1	286	1
Wholesale trade	5000-5199	2,406	12	2,381	10	4,100	10
Retail trade	5200-5999	2,209	11	2,477	10	5,680	14
Finance, insurance, and real estate	6000-6799	1,833	1	2,280	9	4,266	10
Personal services	7200-7299	1,054	5	1,414	6	2,188	5
Business and repair services	7300-7699	2,610	13	3,132	13	5,586	13
Entertainment and recreation services	7800-7999	379	2	409	2	920	2
Health services	8000-8099	1,470	7	2,066	9	3,986	10
Legal and related services	8100-8199	837	4	1,236	5	2,358	6
Educational services	8200-8299	407	2	410	2	808	2
Other professional and related services	8300-8999	1,924	10	2,752	11	4,485	11
Public administration	9000-9899	413	2	358	1	676	2
Unclassifiable	9999	893	5	620	3	1,191	3
TOTALS		19,712	100	24,075	100	41,415	100

ASSESSING THE POTENTIAL IMPACTS ON THE TRANSPORTATION SYSTEM

As discussed in chapter two, a number of studies have attempted to quantify the travel, air quality, and energy related impacts of telecommuting (19,20,21,22). These studies have focused on determining the number and length of peak-period trips removed from the roadway system through telecommuting. Estimating these is not easy, as information is needed on the trip length of telecommuters, the number of days they telecommute, and trips made on telecommuting days. These are key questions, and the answers will determine the impact of telecommuting on the transportation system.

Experience to date indicates that telecommuting does reduce peak-period trips, and that non-work trips do not increase significantly (19,20,21,22). These observations are based on somewhat limited data, however, and no detailed analysis has been conducted in Texas. One study did estimate that telecommuting has the potential to reduce peak-period commute trips in metropolitan corridors in the state by 10 percent (3).

One objective of this study is to develop a sketch planning tool for use in estimating the potential impact of telecommuting on the transportation system. To help accomplish this objective, researchers reviewed previous research projects and existing sketch planning methods. A 1993 TTI research study (29) evaluated sketch planning tools for evaluating travel demand management (TDM) and strategies and transportation control measures (TCMs). This project reviewed available techniques and recommended the use of the Systems Application International (SAI) spreadsheet methodology. Rather than developing a new tool, this research project utilized the SAI spreadsheet for the preliminary analysis presented in this section.

A number of variables on trip length, number of participants, and other elements are needed for the SAI spreadsheet. These factors are used to determine changes in vehicle kilometers of travel (VKT) to analyze the impact of different TDM and TCM measures. The impact on emissions is then calculated based on the changes in VKT. In order to determine changes in VKT, the number of telecommuters must be determined, along with their frequency of participation, the average number of commute days, and other trips made on telecommuting days. For purposes of this analysis, the national average of 1.75 days per week for telecommuters was used (30).

The following was used to estimate the impacts of telecommuting at various levels of participation. $H(D \times F \times L \times T \times R) + S(D \times F \times L \times T \times R) + N(D \times F \times L \times T \times R)$ where

Description	Default Values		
	(H) Home	(S) Satellite	(N) Non-T/C days
D = Days per year	250	250	250
F = Frequency of participation in percentage of days per day	0.35	0.35	0.65
L = Percentage of participants at the site	0.80	0.20	0.80
T = Trips per day	2.00	1.50	2.00
R = Reduction factor for savings in distance	0.75	0.67	0.10

This equation was then applied using a 5 percent participation rate. Other rates could be used, but this provides a conservative estimate of the potential impact of telecommuting in seven metropolitan areas in Texas that have been examined in previous congestion studies (31). Table 3 provides a summary of the results of this preliminary analysis.

Table 3. Estimated Impact of Telecommuting at 5 Percent Participation Rate

Location	Austin	Corpus Christi	Dallas	El Paso	Fort Worth	Houston	San Antonio	Total
Workers	244258	109254	500566	199385	204846	772957	395551	2426817
Avg person per vehicle	1.09	1.11	1.10	1.11	1.11	1.11	1.10	1.10
Percent SOV	74%	76%	72%	74%	77%	72%	73%	74%
Avg trip length	14.0	12.7	16.9	14.8	14.6	16.9	16.6	15.3
Base VKT (millions)	1569.1	625.9	3828.0	1331.3	1356.2	5889.1	2968.1	17567.5
Base SOV work trips (millions)	90	41	181	74	79	277	145	887
Annual VKT saved (millions)	23.3	9.3	57.0	19.8	20.1	87.5	44.1	261.0
SOV Work trips saved (millions)	1.2	0.5	2.4	1.0	1.0	3.62	1.9	11.6

Using the SAI spreadsheet sketch planning tool, a preliminary estimate of annual emission reductions at a five percent level of telecommuting can be estimated. Table 4 provides this analysis.

Both of these estimates are based on general information and national trends. As such, the information should be considered a very preliminary indication of the potential impact of telecommuting. The case studies conducted in phase two of the study will provide more detailed information on the characteristics of telecommuters in Texas. The case study results will be used to refine this analysis and finalize the SAI sketch planning method for use with telecommuting.

Table 4. Preliminary Analysis of Annual Emission Reductions
from a 5 Percent Level of Telecommuting¹

	HC ²	CO ²	Nox ²	HC ²	CO ²	Nox ²
Austin	17.6	177.5	11.4	12.2	113.9	10.2
Corpus Christi	7.0	71.0	4.6	4.9	45.5	4.1
Dallas	42.9	433.2	27.9	29.8	277.6	25.0
El Paso	14.9	150.5	9.7	10.3	96.4	8.7
Fort Worth	15.2	153.0	9.9	10.5	98.0	8.8
Houston	65.9	665.8	42.9	45.7	426.6	8.3
San Antonio	33.2	335.3	21.6	23.0	214.8	19.3
Total	196.7	1,986.3	128.0	136.4	1,272.8	114.4

¹ Using the SAI spreadsheet sketch planning method.

² in metric tons.

CHAPTER FIVE—PHASE TWO WORK TASKS

This report provided an overview of the current use of telecommuting at the national and state levels. The issues commonly associated with telecommuting programs were reviewed, along with approaches to address these concerns. The potential benefits of telecommuting were examined, including those relating to employers, employees, and the transportation system. The report further provided an assessment of telecommuting programs in Texas and preliminary sketch planning tools for estimating the potential for telecommuting in Texas cities and for assessing the transportation impacts of these programs.

This report documents the first phase of the research study. The second phase will examine selected Texas telecommuting programs in more detail. The major elements of the phase two research follows.

PHASE TWO CASE STUDIES

The second phase of this research study will examine four telecommuting programs in more detail. These case studies will provide an in-depth analysis of the approaches utilized with the specific programs, as well as the impacts on telecommuters, management personnel, and the transportation system. The case studies have been selected to provide a mix of public agencies and private businesses, work tasks, and geographical locations. The following four agencies and businesses will serve as the case studies for phase two of the research study.

- TxDOT—Houston District, Houston.
- City of Austin—Department of Environmental and Conservation Services, Austin.
- Compaq, Houston.
- Mobil Oil Company, Dallas.

The case studies will comprise four basic components. These include a more detailed review of the background and nature of the telecommuting program, interviews with management personnel, interviews with telecommuters, and travel diaries of telecommuters. A description of each of these activities follows.

- **Review of Telecommuting Programs.** The first step in the case studies will assess the nature of the telecommuting programs. The objectives of the programs, policies,

and requirements, changes in management and organizational structures, monitoring procedures, and experience to date will be assessed.

- **Interviews with Management Personnel.** Researchers will conduct interviews with management personnel at each of the case studies. The interviews will focus on obtaining additional information on management changes necessitated by the telecommuting program, supervisory or management problems encountered and the approaches used to address these concerns, the general impact of the programs on the daily operations of the work units, and the benefits of the programs. A more detailed assessment will also be made of the keys to successful programs.
- **Interviews with Telecommuters.** Interviews will be conducted with telecommuters at each of the case studies. These interviews will provide more detailed information on the characteristics of telecommuters, their home work environment and work habits, their experience with telecommuting, and the benefits and limitations of the programs.
- **Travel Diaries of Telecommuters.** Telecommuters at each of the case studies will be asked to fill out travel diaries on days they telecommute and days they work in the traditional office environment. The travel diaries will be used to identify trip frequency and trip length on telecommuting and non-telecommuting days. The results will provide a better assessment of the impact of telecommuting on the transportation system.

A common interview format will be developed and used with the management and telecommuter interviews. Travel diaries will also be developed for use with the case studies. Interview questionnaires and travel diaries used on other research projects will be used to develop the specific instruments for the case studies.

A final report will document the results from the case studies. The information obtained from the case studies will provide a better indication of the potential for telecommuting in the state, the characteristics of successful programs, key elements to implementing telecommuting, benefits to employers and employees, and the impact of telecommuting on the transportation system, air quality levels, and energy consumption.

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