



---

*NOT FOR DISTRIBUTION – NOT FOR REPRODUCTION*

*DRAFT FOR REVIEW*

**Employer-Based Emissions Reduction  
Programs**

---

**TEXAS TRANSPORTATION INSTITUTE  
THE TEXAS A&M UNIVERSITY SYSTEM  
COLLEGE STATION, TEXAS**

Prepared for the Texas Department of Transportation

August 2011

*NOT FOR DISTRIBUTION – NOT FOR  
REPRODUCTION*

***DRAFT FOR REVIEW***

# **Employer-Based Emissions Reduction Programs**

**Task 2.8, FY 2011**

**Transportation Air Quality Policy Analysis**

***Prepared for***

**Texas Department of Transportation**

***Prepared by***

**Texas Transportation Institute**

**August 2011**

©2011 by Texas Department of Transportation.

All rights reserved. Any sale or further use is strictly prohibited without written permission of the Texas Department of Transportation. This material may not be reproduced or transmitted in any form by any means, electronic or mechanical, including photocopying, recording, or by any information and retrieval systems without the written consent of the Texas Department of Transportation, 125 East 11th Street, Austin, TX 78701, (512) 416-2055.

# TABLE OF CONTENTS

List of Tables.....	iv
List of Figures .....	iv
Executive Summary.....	1
Chapter 1: Introduction.....	4
Chapter 2: Employer-Based Programs .....	5
Strategies for Reducing Trips.....	5
Ride Matching.....	5
Mass Transit Pass Programs .....	5
Walking and Cycling Programs .....	6
Combined Deliveries.....	6
On-Site Dining Facilities and Other Services .....	6
Employers Operation Plan to Reduce Emissions .....	7
Strategies for Reducing Emissions per Trip .....	8
Electric Car Charging Stations .....	8
Alternative Work Schedules.....	9
Optimum Work Location.....	9
Off-Peak Delivery (OPD).....	9
Employer Incentive Programs .....	10
Shuttles for Inter-Campus Trips .....	10
Alternative Vehicles for Mid-Day Work Travel .....	11
Chapter 3: Utilizing New Technologies .....	12
Strategies for Reducing Trips.....	12
Video Conferencing .....	12
Web Conferencing (Webinars).....	13
Cloud Computing .....	13
Collaborative File Sharing.....	13
Telecommuting .....	13
Smart Phones and Applications .....	15
Strategies for Reducing Emissions per Trip .....	16
Remote Work Centers .....	16

Electric Vehicle Rental Programs.....	17
Higher Fuel Efficiency and Alternative Fuel Vehicles .....	17
Alternative Fuel Vehicles .....	17
Idle Reduction Technologies for Heavy-Duty Vehicles.....	18
Chapter 4: Other Options .....	19
Combining Data Collection Efforts .....	19
Partnership: Combining Personal, Business and Government Efforts.....	19
Laws and Ordinances .....	21
Chapter 5: Summary and Conclusions .....	22
References .....	23

## **LIST OF TABLES**

Table 1. Matrix of Costs and Benefits for Employer-Based Programs. .... 2  
Table 2. Matrix of Costs and Benefits for Technology-Oriented Programs. .... 3

## **LIST OF FIGURES**

Figure 1. Example of a Video Conferencing Solution. .... 12

## EXECUTIVE SUMMARY

Work-related travel constitutes a significant portion of transportation activity, and consequently, transportation related emissions. Employers can have an impact on how and when their employees report for work as well as travel during the work day. This report discussed options for employer-based strategies such as alternative work schedules, remote work locations, and other means of reducing emissions from work-related activities. The report also explores new technologies that can be used now and in the future to support such employer based programs.

Following are some of the findings of this study;

- Alternative transportation, such as ridesharing, mass transit, and bicycling/walking programs can be encouraged by employers to help reduce transportation-related emissions.
- Employers can support the use of electric vehicles by installing charging stations and using electric vehicle rental programs.
- Current technologies can be utilized to cut the amount of travel and resources needed for organizations' activities.
  - In-house resources such as video-/teleconferencing and better network capabilities can be used to support telecommuting and reduce work-related trips.
  - Employers can support the use of co-located teams through mobile devices and safe data share systems, and community work centers.
  - Smart Phones open a world of applications to more efficiently optimize time and travel. Smart Phones also allow communications and data transfer regardless of the location of the users.
  - Telecommuting and remote work centers can benefit both employers and employees by reducing the need to commute to the work site.
  - Electric car sharing and electric car charging stations promote using low emissions transportation modes and can significantly lower emissions from work-related trips.
- Cities can support public and private organizations and employees by providing better transportation systems.
- Organizations can consider developing technologies to further their environmental improvement agendas. Collecting data on employee trip behavior and transportation resources usage can be a key to identify and implement new opportunities for reducing the total emissions impact of an organization.
- Organizations can embrace the ideas of the future and encourage change throughout the company to accompany these new ways of business.

Tables 1 and 2 provide a summary of benefits and cost-related effects of each program. The programs are grouped based on their scope (employer-based or technology-oriented) and their impact (reducing trips or reducing emissions per trip). For strategies that fall into more than one group, they are grouped based on their most dominant characteristics.

**Table 1. Matrix of Costs and Benefits for Employer-Based Programs.**

Effect	Program	Air Quality Effects	Monetary Effects
Reduces Trips	Ride Matching	<ul style="list-style-type: none"> <li>• Reduces emissions from people traveling alone</li> <li>• Reduces idle times due to less traffic</li> <li>• Limited by vehicle capacity</li> </ul>	<ul style="list-style-type: none"> <li>• Inexpensive for employees, can reduce travel cost per trip</li> <li>• No cost to employers</li> </ul>
	Transit Passes	<ul style="list-style-type: none"> <li>• Can combine greater number of riders than personal vehicles</li> </ul>	<ul style="list-style-type: none"> <li>• Pre-tax deductions for employees</li> <li>• May require matching contribution from employer</li> <li>• Can reduce costs of providing employee parking</li> </ul>
	Walking and Cycling	<ul style="list-style-type: none"> <li>• Eliminates vehicle emissions for trip</li> </ul>	<ul style="list-style-type: none"> <li>• Travel cost less than driving or transit</li> <li>• Employer may need to supply bike parking and shower facilities to have significant impact</li> </ul>
	Combined Deliveries	<ul style="list-style-type: none"> <li>• Reduces number of trips for deliveries and pickups</li> </ul>	<ul style="list-style-type: none"> <li>• Initial cost for consolidating different delivery systems</li> <li>• Can lower costs of delivery and pick up</li> </ul>
	On-site Eating Facilities and Other Services	<ul style="list-style-type: none"> <li>• Eliminates trips for mid-day services; e.g., lunch, laundry, etc.</li> </ul>	<ul style="list-style-type: none"> <li>• Initial cost for setting up on-site facilities</li> </ul>
	Employers Operation Plan to Reduce Emissions	<ul style="list-style-type: none"> <li>• Can reduce trips as well as emissions per trip</li> </ul>	<ul style="list-style-type: none"> <li>• Can lower cost of energy and fuel for organizations</li> <li>• Initial costs of planning and strategy implementation</li> </ul>
Reduces Emissions Per Trip	Electric Car Charging Stations	<ul style="list-style-type: none"> <li>• Promotes use of electric vs. petroleum fuels to reduce emissions</li> </ul>	<ul style="list-style-type: none"> <li>• Greater cost to cities and business for installing stations</li> <li>• Greater cost to employee for vehicle and charging fees</li> <li>• Anticipated to become more affordable as locations increase</li> </ul>
	Alternative Work Schedules	<ul style="list-style-type: none"> <li>• Reduces driving during peak hours</li> </ul>	<ul style="list-style-type: none"> <li>• Inexpensive for employees, can reduce travel cost per trip</li> <li>• No cost to employers</li> </ul>
	Optimum Work Location	<ul style="list-style-type: none"> <li>• Reduces the total driving by employees</li> </ul>	<ul style="list-style-type: none"> <li>• Low-cost to employers</li> </ul>
	Off-Peak Delivery	<ul style="list-style-type: none"> <li>• Reduces driving during peak hours</li> </ul>	<ul style="list-style-type: none"> <li>• Low-cost to employers</li> <li>• Can lower cost of energy and fuel for organizations</li> </ul>
	Employer Incentives	<ul style="list-style-type: none"> <li>• Promotes less emissions transportation options</li> </ul>	<ul style="list-style-type: none"> <li>• Low to medium cost to employers</li> <li>• No cost to employees</li> </ul>
	Shuttles for Inter-Campus Trips	<ul style="list-style-type: none"> <li>• Reduces drive-alone mid-day trips</li> </ul>	<ul style="list-style-type: none"> <li>• Medium to high costs to employees</li> <li>• Requires well-organized plans and operations</li> </ul>
	Alternatives for Mid-Day trips	<ul style="list-style-type: none"> <li>• Promotes less emissions transportation options</li> <li>• Reduces drive-alone mid-day trips</li> </ul>	<ul style="list-style-type: none"> <li>• Medium to high costs to employees</li> <li>• Medium to high initial and recurrent cost of implementation</li> </ul>

**Table 2. Matrix of Costs and Benefits for Technology-Oriented Programs.**

<b>Effect</b>	<b>Program</b>	<b>Air Quality Effects</b>	<b>Monetary Effects</b>
<b>Reduces Trips</b>	Tele-/Video-Conferencing	<ul style="list-style-type: none"> <li>• Eliminates trips to attend meetings or training to reduce travel related emissions</li> </ul>	<ul style="list-style-type: none"> <li>• Reduces time and expenses associated with trips to meetings and training</li> </ul>
	Webinars for Trainings and Meetings	<ul style="list-style-type: none"> <li>• Eliminates trips to attend trainings and conferences</li> </ul>	<ul style="list-style-type: none"> <li>• Reduce time and expenses associated with trips to training and conferences</li> </ul>
	Cloud Computing	<ul style="list-style-type: none"> <li>• Lessens travel for employees</li> </ul>	<ul style="list-style-type: none"> <li>• Reduced cost of employee time to travel to meetings or remote sites</li> </ul>
	File Sharing	<ul style="list-style-type: none"> <li>• Reduce the trips necessary for collaborative group tasks</li> </ul>	<ul style="list-style-type: none"> <li>• Reduce the cost of employee time to travel for collaboration on different tasks</li> </ul>
	Smart Phones and Applications	<ul style="list-style-type: none"> <li>• Provides information on alternative travel options</li> <li>• May reduce need to attend meetings or conduct work in field</li> <li>• Reduces travel related emissions</li> <li>• Help optimize travel when it cannot be avoided</li> </ul>	<ul style="list-style-type: none"> <li>• Provider fee will cost the employee or the employer if providing reimbursements</li> <li>• Most applications are free or inexpensive for employers to provide their workers</li> </ul>
<b>Reduces Emissions Per Trip</b>	Electric Car Rental	<ul style="list-style-type: none"> <li>• Promotes use of electric vs. petroleum fuels to reduce emissions</li> </ul>	<ul style="list-style-type: none"> <li>• Convenient and feasible for shorter trips</li> <li>• Expected to be less expensive than normal car rental</li> </ul>
	Remote Work Centers	<ul style="list-style-type: none"> <li>• Reduces need for long commutes</li> <li>• Can avoid congestion-related delays and associated emissions</li> </ul>	<ul style="list-style-type: none"> <li>• Added business expense for use fees if central and remote work locations must be provided; negligible incremental cost if only single work place is needed per person</li> </ul>
	Higher Efficiency Vehicles	<ul style="list-style-type: none"> <li>• Promotes use of lower emission vehicles to reduce emissions</li> </ul>	<ul style="list-style-type: none"> <li>• Lower fuel costs</li> </ul>
	Alternative Fuel Vehicles (electric, CNG, Hybrid, etc.)	<ul style="list-style-type: none"> <li>• Promotes use of alternative fuel vehicles to reduce emissions</li> </ul>	<ul style="list-style-type: none"> <li>• Greater costs of purchasing vehicles</li> <li>• Lower fuel costs</li> </ul>
	Idle Reduction Technologies (TSE, APU, etc.)	<ul style="list-style-type: none"> <li>• Reduces emissions through reducing idling by heavy-duty vehicles</li> </ul>	<ul style="list-style-type: none"> <li>• Greater costs of installing idle reduction technologies</li> <li>• Lower fuel costs</li> </ul>



## **CHAPTER 1: INTRODUCTION**

Commuting to and from work accounts for a large portion of transportation-related emissions in urban areas. There are many options that an employer can use to encourage employees to reduce the negative impact of their travel on the environment. Options such as ride sharing, mass transit passes, and walking/bicycling programs are relatively easy for an employer to implement without much investment. An employer can also provide incentives to encourage employees to drive low emissions vehicles such as fuel efficient, low emissions, or electric vehicles.

New advancements in technology also provide alternatives to traditional methods companies have used to conduct business. With the constant connectivity of the internet and Smart phones, people are no longer required to be in the same place to conduct business with each other. Through utilizing technologies such as video conferencing and electronic data exchange systems, many businesses and agencies can avoid a large part of business-related travel. When this is combined with employees being able to telecommute and use community work centers, the drop in pollution could be considerable on a daily basis. Furthermore, the future of sustainable renewable energy appears promising. Technologies such as high-efficiency solar panels, large-scale wind farms, and fusion nuclear power can drastically change how the transportation system is fueled in the future. Some scientists forecast that by the end of this century people will be using driverless vehicles and magnetized propulsion trains that are powered by clean energy.

The purpose of this task was to identify methods and technologies that employers can use to encourage their employees to be more environmentally conscious. These methods and technologies will help to reduce local emissions and are relatively easy to implement. The authors have compiled a group of alternative transportation options and alternative work schedule programs that employees can utilize. They have also presented new technologies that can reduce travel needs and conduct routine functions more efficiently while also being cost efficient.

The programs are grouped based on their scope (employer-based or technology-oriented) and their impact (reducing trips or reducing emissions per trip). For strategies that fall into more than one group, they are grouped based on their most dominant characteristics. The organization of this report follows this grouping scheme. The report has been divided into six chapters. Chapter 1 provides an introduction into the subject covering methods and programs that will be presented, and the organization of the report. Chapter 2 includes employer-based programs that can be used for reducing trips as well as emissions per each trip by employees. Chapter 3 focuses on technology-oriented programs that can be utilized to reduce company-related emissions outputs through reducing the number of trips or amount of emissions per each trip. Chapter 4 presents other options and programs that can help developing company and community involvement in local environmental policies. Chapter 5 explains several of the future possibilities that are expected to be available in the coming decades, providing a glimpse into what future organizational functions. Finally, Chapter 6 provides an overall summary and conclusions.

## **CHAPTER 2: EMPLOYER-BASED PROGRAMS**

Flexibility of employers can be the first step to encouraging employees to reconsider how and when they get to work. This section covers a set of employer-based programs for reducing trips or emissions per trips. Some of these programs can be easily implemented with minimal cost while the others need more elaborate planning and resources.

### **STRATEGIES FOR REDUCING TRIPS**

Employers can utilize a variety of strategies with the goal of reducing of work-related trips by their employees. These strategies include easy and low cost strategies such as ride matching programs as well as more elaborate strategies such as providing on-site eating facilities and developing an operation plan to reduce emissions.

#### **Ride Matching**

Ride sharing combines single passenger trips, making use of vehicle space that would otherwise be empty. The per trip cost of ride sharing tends to be lower because travelers will split the cost of the shared trip instead of paying for individual transportation costs. Additionally, internet resources are available where people can find others in their area to share rides with. Larger metropolitan areas have many people commuting for hours every day and can achieve significant emissions reductions through combined travel. There also can be financial advantages from reduced vehicle insurance and fare subsidies by employers and transit authorities. Through education and encouragement, it is estimated that 5-15% of people will be attracted to ridesharing. If financial incentives are available, the number can jump to 10-30% (VTPI, 2010). To date, ride sharing has proven it can be very effective and the most popular mode of alternative transportation methods. This is especially true in areas that have limited or no public transportation.

One popular example of ride sharing, vanpooling, typically uses leased vehicles that can be organized by employers to combine multiple employee trips, and are generally suitable for longer commutes. Some services, such as Star Vans in Houston, can vanpool people from the suburbs of big cities to major business destinations. These can also be arranged by employers to pick up their employees for group travel, or to shuttle people between business meetings. Since this program targets employees with longer commutes than average, combining trips can reduce peak period vehicle miles of travel (VMT) by 10%. This can lead to reductions of 8.3% of commute VMT, up to 3.6% of total regional VMT, and up to 1.8% of regional vehicle trips (VTPI, 2010). It also reduces congestion, road and parking facilities cost, and crash risk along with the emission rates.

#### **Mass Transit Pass Programs**

In areas that have a well-developed mass transit system, employers can provide passes directly to the employees, so there is no out of pocket cost to the employees. Many of these programs also

allow the company tax benefits. Established in 1993 as part of the federal tax code section 132(f), commuter benefits were meant to provide tax incentives to employees to encourage their use of mass transportation to reduce congestion and improve air quality. The monies spent by employers for employee transportation is not counted in the person's gross income, which reduces their taxes. Employers can also take advantage of this pre-tax program by setting up a spending account for their employees, such as many have with matching healthcare costs. Companies, such as SunLine Transit Agencies, support such Employer Pass Programs that allow businesses with a certain amount of riders the ability to purchase passes for as little as \$24 a month for unlimited ride services to work (SunLine, 2010).

### **Walking and Cycling Programs**

In urban areas, where employees do not have to drive in from suburban areas, cycling/walking programs can fully reduce a person's emissions footprint. There are many strategies for businesses to promote such a program. Business groups can begin with bicycling or walking campaigns to see who can have the highest non-motorized commute rate. Many countries in Europe have installed public bike rental stations, similar to programs for strollers in the U.S. Businesses can also provide secure storage areas. Some companies, such as Nabisco, have rewards programs and give a new bike to every employee that commutes by bike for a certain number of days (VTPI, 2011). Other companies have gone the route of giving bikes on loan to people that are willing to commute, helping bridge the cost gap for people that could not afford a bike otherwise. Another approach is to reimburse employees for expenses in non-motorized travel. Employers can set a mileage reimbursement rate per mile. Nationally, the federal government has established the month of May as the National Bike Month to encourage more travel by bicycle. Many towns and employers also have Bike to Work weeks.

### **Combined Deliveries**

A combined delivery program refers to establishing a shared delivery system between different delivery services. This can be achieved through forming a neutral service that can collect item from multiple shippers and deliver them as a single delivery. These programs reduce the number of delivery trips in a region. This in turn will reduce the amount of fuel and emissions.

### **On-Site Dining Facilities and Other Services**

On-site amenities encompass cafeterias, recreational facilities, laundry, and conference rooms. These amenities can be planned and organized effectively to reduce employees' trips to outside the work site. When combined with other programs such as alternative transportation and alternative work schedules, this strategy can encourage people to use alternative modes on campus and to minimize automobile trips for various activities outside campus.

The Google campus, or Googleplex, is an example of an effective implementation of on-site amenities. It is the company headquarters for Google, Inc., located in Mountain View, California. The Google campus accommodates some essential components that define a Google

workspace. Recreation facilities include a workout room, locker rooms, laundry rooms, a massage room, assorted video games, foosball, ping pong, etc.. Other facilities include 11 cafeterias, snack rooms, a 24-hour doughnut shop, and an on-site dentist.

### **Employers Operation Plan to Reduce Emissions**

A successful employer-based emissions reduction program begins with progressive and comprehensive planning that integrates organizational resources with provisions for employee activities. Similar to other planning strategies, it is very important not only to have a plan but also to establish effective planning processes and implementation strategies.

A comprehensive plan considers additional costs from trips made by employees and benefits of emissions reduction strategies that improve mode choices and increase efficiency of the employees and the organization. Such a plan can provide mobility and support employees mobility needs to and on a work site. It also should provide access to the work site while maintaining the environment and minimizing the financial burden on the system and employees. Therefore, a comprehensive planning practice identifies and recommends prioritized parking facility, transit, bicycle, pedestrian, and emissions reduction programs for employees and visitors.

An example of these programs is the Texas Department of Transportation's (TxDOT) Clean Air Plan. The Clean Air Plan is TxDOT's internal effort to reduce emissions by implementing strategies that lower emissions from activities that fall under TxDOT authority. The following are a few examples of TxDOT's initiatives that fall under this program:

- Use low-emission diesel fuel;
- Avoid refueling vehicles between 6 - 10 a.m.;
- Limit vehicle idling;
- Avoid mowing TxDOT property on Ozone Action Days;
- Encourage contractors to use new equipment to mow the right of way;
- Encourage contractors to avoid mowing the right of way on Ozone Action Days;
- Purchase solar-powered light and sign boards;
- Use only LED signal bulbs;
- Use only low-emission/spill-proof gas cans;
- Encourage contractors to apply for Texas Emissions Reduction Plan grants;
- Send Ozone Action Day notifications;
- Encourage car- and vanpooling;
- Give priority parking to car- and vanpools;
- Provide DCAT training for new and current employees;

- Hold DCAT workshops and other clean air events;
- Use hybrids, dual-fuel and other alternative-fueled vehicles; and
- Allow flexible and compressed work schedules.

## **STRATEGIES FOR REDUCING EMISSIONS PER TRIP**

In addition to reducing the number of work-related trips, employers can use strategies to reduce the amount of emissions per each work-related trip by their employees. These strategies usually achieve the stated goal of emissions reduction using lower emissions transportation modes and shifting trips to off-peak periods.

### **Electric Car Charging Stations**

With close to half of the world's oil production going to fuel vehicles, trains, and airplanes, there is a rapidly increasing interest in electric vehicles. The new commercial production of these electric vehicles, such as the Nissan Leaf and Chevrolet Volt, has created a need for charging stations. Many people worry about traveling in public places with a short range charge. Cities, such as Austin, Texas have been the leaders in installing public charging areas. Coulomb Technologies Inc. is at the forefront of manufacturing these machines and is working with several private companies and city governments to install these charging stations.

Advanced Micro Devices Inc., for example, has installed electric vehicle charging stations at its Austin campus. The company's 2,200 Austin employees will be able to use the charging stations, which will also authenticate users and measure electricity usage. The charging stations can support six vehicles simultaneously and are powered by 100% renewable energy (ABJ, 2010). Whole Foods Markets and Dell Computers have also begun providing access to their employees. Austin and eight other cities were chosen as a pilot program to receive charging stations as part of a federal grant. Austin Energy is also working with the city council to combine efforts to place charging stations at various points around town. These pilot areas are working very closely with automobile manufactures on the availability of cars and with local companies to determine which businesses would get the most use out of this initial trial (Gaar, 2010). The Austin City Council has also proposed to have a \$50 annual pass for people to charge their vehicles at any public station (Cholia, 2011).

Houston will also get a new grid of charging stations. In an area that is centered on oil production, companies will have new cost saving options for their employees. NRG Energy is spending \$10 million to install charging stations all over the city. NRG will partner with other companies such as TXU to expand operations in the Dallas and Fort Worth areas within the next year. They will also have flat payment plans for use of private and public charging stations. By having stations more widely available and keeping the charging cost low, businesses will be more likely to make this option available to their employees.

### **Alternative Work Schedules**

Alternative work schedules, also known as flextime, imply that people may have some flexible daily work schedules. The employees' regular work time, 8:00 a.m. to 4:30 p.m., can be rescheduled to different time periods, such as 7:30 a.m. to 4:00 p.m. for some and 9:00 a.m. to 5:30 p.m. for others, based on circumstances. The flexible work time can be different on a daily, weekly, or monthly basis.

Flextime produces some positive effects, including reduced congestion during the peak time and increased alternative travel modes such as share-ride and transit. Picado (2000) explains that flexible work schedule programs help people to reduce seven minutes from their commute time on average a day. Flextime may decrease the number of trips to and from the work location during the peak period.

### **Optimum Work Location**

The work location is one of the major factors determining the length of the commute by employees. When seeking a new office location, employers can incorporate the length of the commute by their employees as one of the deciding factors. An optimal work location will ideally minimize the total length and duration of commuting by employees of an organization. This will in turn minimize the total emissions resulting from commuting trips.

### **Off-Peak Delivery (OPD)**

Off-peak delivery refers to policies and programs that would induce a shift in commodity deliveries in urban areas to off-peak hours. These policies and programs can include:

- Tax deductions and lower shipping costs for receivers willing to accept OPD;
- A request from receivers;
- Providing timely security clearances at bridges, tunnels, and other facilities;
- Toll savings to carriers doing OPD;
- Financial rewards for each mile the carrier traveled during the off-peak hours; and
- An off-peak delivery permit that enables trucks to double park during the off-peak hours.

New York City implemented an OPD program in Manhattan as part of an effort to help clear traffic jams. The program paired more than 30 truckers and receivers who agreed to shift deliveries to between 7 p.m. and 6 a.m. Drivers were able to make deliveries on-time and be much more fuel-efficient, while receivers experienced shorter waiting times for deliveries. Specifically, trucks reached their first stop 75% more quickly in off-peak hours, and following stops 50% more quickly.

## **Employer Incentive Programs**

Employers can use incentives to reduce automobile trips, encourage their employees to use more fuel-efficient vehicles or alternative transportation modes such as transit and car pooling.

Incentives by employers can come in different forms. The following are a few examples of incentives by employers:

Guaranteed ride home (GRH) – GRH programs give an instant ride in case of an emergency to individuals who use alternative travel modes. GRH programs work if a non-driving employee has to rush into an emergency room, or if a bus rider has to stay late for work. To provide a solution for these unexpected situations, GRH programs offer taxis, company vehicles, or rental cars for free or with a low payment. The total cost of GRH programs tends to be modest due to their occasional uses.

Commuter club – refers to programs that urge employees to use alternative transportation modes, such as transit, carpools, and vanpools, instead of driving alone, while providing the participants with financial and institutional advantages. It can be expected that successful commuter club programs reduce congestion and traffic volume generated to and from campuses and increase alternative transportation mode choices.

Financial incentives – financial incentives encourage people to take alternative travel modes by giving them financial benefits in the form of tax benefits or direct payments. Pre-tax transportation expense allocations and tax-free transportation benefits are the most popular forms of financial incentives. The Commuter Choice Program established by the U.S. Department of Transportation and U.S. Environmental Protection Agency is an example of the tax-free transportation benefits. This initiative is intended to promote employers to prepare various travel choices for their employees. The program permits the employers to offer tax-free benefits to their employees who commute to work by alternative transportation modes (other than single-occupancy vehicles). Participant employees do not pay Federal Insurance Contributions Act (FICA) or federal and state income taxes on the benefits.

## **Shuttles for Inter-Campus Trips**

Organizations that have multiple campuses within a small geographical area can establish shuttle services for their employees inter-campus trips. Inter-campus shuttle services are very effective in reducing mid-day drive-alone trips by employees who need to go to other campuses. Heavy investments are usually required to provide a successful transit service. An effective shuttle service needs to have the following characteristics:

- A good coverage of the desired destinations;
- High enough service frequencies;
- Easy-to-understand bus routes;
- Fast and direct routes, with a low number of transfers; and

- A pleasant experience for the riders.

### **Alternative Vehicles for Mid-Day Work Travel**

Employers with a high amount of mid-day work travel can provide alternative means of transportation for these trips. Low-emissions vehicles such as hybrid or electric vehicles, and bicycles are the most popular forms of transportation that are implemented for employer-owned or –operated transportation alternatives. These usually come in the form of a car or bicycle sharing program. Car2go and ZipCar are examples of such car-sharing services.

The City of Austin and the Car2go (Daimler’s smart car car-share initiative) pilot program began on November 17, 2009 to test car-sharing uses for City of Austin business trips using smaller 2-door vehicles versus the standard 4-person gasoline-powered sedan. The service was well received by the employees and became available to the public in May 2010.



## **CHAPTER 3: UTILIZING NEW TECHNOLOGIES**

Technology has changed the way we conduct business and the ways we travel. Taking advantage of the following options can help organizations reduce their impact on the environment and efficiently use their available resources. The internet, computing power, mobile devices, and other technology yet to reach production will play increasing roles in future business.

### **STRATEGIES FOR REDUCING TRIPS**

This section provides an overview of strategies that utilize new technologies to reduce the number of work-related trips.

#### **Video Conferencing**

Video conferencing has become an easily accessible tool. The value of web and video conferencing is becoming increasingly hard to ignore. The reduction of business travel and associated costs, the ability to meet and interact in real-time with customers, business partners and employees located in other states or countries are just a few of the business and financial benefits (Nefsis, 2010). Additionally, with the addition of Smart phones, video chat capabilities are available just about anywhere. Companies such as Cisco (WebEx programs) have been developing life size video and sound technologies that create a conference room between two sides of the world. Employees can now meet without having to travel and be able to have life size pictures and surround sound to make it seem like the meeting is in person (Nefsis, 2010), helping to eliminate the personal disconnect that most people felt with the old style of teleconferencing. Any travel that can be reduced by such technologies will help reduce emissions outputs. Some future technologies will provide thin enough LED screens that entire rooms can be covered with screens to make the experience almost completely lifelike.



**Figure 1. Example of a Video Conferencing Solution.**

## **Web Conferencing (Webinars)**

Web conferencing or a webinar refers to a service that allows conferencing events to be shared with remote locations using an internet connection. The service allows information to be shared simultaneously, across geographically dispersed locations in nearly real-time. Applications for web conferencing include meetings, training events, lectures, or short presentations from any computer. A participant can be either an individual person or a group. The Webinar format allows attendees to ask questions and give feedback in real time. Webinars are usually archived so anyone who isn't available during the event can review them at a later time. The main benefit of webinar format for employers and their employees is that it allows them to share information, perform training, and learn about topics relevant to their work, without having to spend time and money traveling.

## **Cloud Computing**

John McCarthy in the 1960s theorized an internet based business model where resources could be "outsourced" or shared (Answers, 2009). "Cloud" computing is a way of using internet-based resources and sharing IT resources of other organizations' resources. This can provide smaller organizations with a virtual business set-up, allowing their resources to be accessed anywhere. Common server centers are hosted by technology companies, such as Google and Amazon, and have secure sites for their users to access their individual company's resources. This allows smaller organizations to avoid the capital cost of hardware and software. This in turn will allow the organizations to lower their energy use which accounts for a large portion of their emissions footprint (LaMonica, 2010). With the advancement of such technologies, even smaller companies can now have the power to run their businesses web-based, remotely from their offices.

## **Collaborative File Sharing**

Collaborative file sharing is the practice of distributing or providing access to digitally stored information, such as computer programs, multimedia, and documents over the internet. These services provide a simple, scalable and affordable solution to manage electronic resources in a collaborative way. The service enables organizations to create project folders and assign access to the team members. As files are uploaded, downloaded, or edited, everyone on the team gets notified through the Updates tab and email, increasing response time and streamlining the work flow. Using collaborative file sharing, organizations can reduce the need for face to face meetings and work related trips.

## **Telecommuting**

Telecommuting uses telecommunication devices (email, telephone, video, etc.) and computing power to allow work to be done anywhere, eliminating the need to travel to an office location. Years ago, the advent of conference calls became an early step to reduce work-related travel. Today, that technology has morphed into video conferencing and instant contact with people

across the world. Not having to physically travel long distances saves time, money and the environmental impacts caused by related travel. Travel impacts and the amount of teleworking can be affected by the type of work, work quality, employer support, and people's needs. Some studies have shown that nearly 50% of job positions would qualify for telecommuting. Since teleworking can be very appealing to people with longer commutes, a 10% drop in vehicle trip numbers can amount to 15% of VMT reduced because of the longer miles, in turn a larger than normal VMT reduction (VTPI,2010).

Cisco revealed it has garnered more than \$277 million in productivity savings by letting employees work from home using the company's own virtual office technology. Cost saving, however, was not the primary goal of the survey, according to Cisco executives. "Our main intent was to really evaluate the social, economic and environmental impacts associated with telecommuting," says Rami Mazid, vice president of global client services and operations at Cisco. Today nearly 80,000 employees and clients have installed the Cisco Virtual Office software and telecommute an average of two days per week, cutting the company's employee travel by about 40% (Dubie, 2009). When companies can reduce the number of people coming into the office, the amount of traffic congestion, VMT, and parking cost are reduced.

Collaboration Software also gives employers the ability to not require all of their employees to be in the same office and can greatly reduce travel times. With online collaboration software, such as Yammer.com and Socialtext, people can talk and exchange resources online. These so called "Business Social Networks" were derived from the extensive use of social networks in people's personal lives. These sites are fully secure for only employees to access and provide safe data exchange. These sites include functions such as blogging, direct messaging, file sharing, Groups/communities, directories, archives of previous messages, administrative tools, applications, and mobile tools for personal devices (Yammer, 2010). Free applications, such as Google Groups, are now available to allow chats and discussion boards online. Many companies have now even turned to applications like Facebook and Twitter for their marketing schemes. These applications provide contact with a broad base of customers and most are free.

Organization such as International Telework Association can help companies organize a teleworking program. The following provides a few examples of cost savings that organizations and incorporations could achieve through implementing teleworking.

- An organization could save one office for every three teleworkers – about \$2,000 per teleworker per year, or \$200,000 per 100 teleworkers. (IVC-Cost,2011)
- With Telecommuting, ATT was able to reduce its office space cost by 50% and has saved approximately \$550 million by consolidating space that is no longer needed. By 1998, the company had 30745 managers telecommuting at least once a month. (IVC-Cost,2011)
- About 25% of IBM's 320,000 workers worldwide telecommute from home offices, saving \$700 million in real estate costs. (IVC-Cost,2011)

- Telework allowed IBM to drastically reduce the need for office space and save \$56 million per year across the company. After two years with telework, the company negated the need for 2 million square feet of office space (IVC-Office,2011)
- Sage Research (2000) reported that 30% of corporations with telecommuters agreed that having telecommuters helps reduce real estate costs. (Sage research,2000)
- Merrill Lynch reported saving \$5000 to \$6000 for each office space eliminated through the use of telecommuting. (American demographic, 1999)
- The Texas Workforce Commission Appeals Department reduced the required rent-able square feet of office space by 1,824 square feet by having 19-22 attorneys telecommute. (US, 1999)
- Georgia Power reported a savings of \$100,000 annually, with office space needs reduced by two-thirds. (Computerworld,1998)
- Of Nortel's 13,000 teleworkers, 4,000 no longer need dedicated office space in a Nortel building. Overall, telecommuting allows the company to save \$20 million dollars a year on real estate costs — equivalent to two 20-story office buildings of 40,000 square feet per floor. (IVC-Office,2011)

### **Smart Phones and Applications**

The smart phone is a combination of a phone and a personal digital assistant (PDA). They have developed into full functioning mini computers. These new smart phones were also developed with their own internal operating system, so users do not solely rely on the phone provider. Most cell phone carriers now have a version of the Smartphone. Blackberry was one of the first phones to have wireless email capabilities, and was generally marketed to the business population. Now BlackBerrys can be used within almost any carrier's network. The widespread use of the Smartphone came when Apple released the iPhone. With only a touch screen, it was capable of running many more application choices and functioned at a much higher speed. The iPhone was originally paired with ATT services but has now been picked up by Verizon. Verizon's initial answer to the ever popular iPhone was the Android system. They were able to solve some of the bugs that were discovered in the original iPhone and offer it at a competitive price, creating a way to spread these Smartphones to new customers.

With the widespread use of smart phones, widely available wireless internet, and integrated operating systems there has been a mass production of applications that can be downloaded and can even be programmed by the user. Many of these applications have made transportation more efficient through GPS tracking and route optimization, therefore providing a higher reduction in emissions outputs. Cities are working with public transit authorities to provide the most up to date travel information. Employers can now encourage their employees to use public transportation or their own vehicles more efficiently. Most of these applications are free or very

low cost, saving their employees valuable time while helping the air quality in their areas. The following are a few examples of such applications.

- Inrix (Android and iPhone) - This free app provides congestion predictions and best/shortest routes to the desired destination (Vanderbilt, 2009).
- Greenmeter (iPhone) – This new programming technology uses an accelerometer to record at what point the driver is driving most efficiently.
- CommutePro (Android) - Allows the user to save Google map navigations to a Smartphone and combines it with city data to map the best route (Commute, 2011).
- Cabulous (All models) – This app was developed by the City of San Francisco paired with the City Wide Dispatch Center to connect all cab systems within the city and enable the user to reserve and pay for a cab from their phone.
- Avego (iPhone) – This was created to promote ride share programs. It uses the phones GPS system to allow members to see where other people are and to schedule a ride. Users are charged a flat mile fee to “help with the gas money.” The rider can screen drivers and accept or deny once they have met them (Garthwaite, 2008).

Some well known GPS makers (e.g., Tom Tom) now have more advanced phone programs. These are more costly to purchase but carry much more detailed maps and routing capabilities.

## **STRATEGIES FOR REDUCING EMISSIONS PER TRIP**

Technology-oriented strategies such as remote work centers and electric car rental programs can be leveraged to reduce the amount of emissions per each work-related trip. The emissions reductions are obtained either as a result of reduced distance traveled or reduced per distance emissions from cleaner transportation alternatives.

### **Remote Work Centers**

Some cities that have large number of commuters entering central districts have begun running pilot programs for community work centers. These centers allow people to stay in the suburbs but have access to high-speed internet, computer access, high-definition video conferencing, and even child care services. This can make telecommuting possible even to those who may not have the means for communication at home (Lohr, 2009). Studies have shown that neighborhood work centers can reduce commute VMT up to 50% (VTPI, 2010). Cisco and the city of Amsterdam have recently put this concept in place in the city of Almere. Residents who routinely had to commute into Amsterdam for work now have public offices that offer high-tech resources available for telecommuting. Cisco has had dozens of cities following the project and are proposing that these “smart city” projects be brought to their area. Cisco has also partnered with Tata Communication to set up *TelePresence* rooms for public use in the U.S. and United Kingdom, as well as rooms in Mumbai, Bangalore, and Chennai, India (VTPI, 2010). These are more advanced to provide a better connection and accommodate larger meetings.

## **Electric Vehicle Rental Programs**

With the rising popularity of electric vehicles, rental companies are also moving that direction. Companies such as Zipcar and Car2go have begun appearing in large metro areas, such as Austin, to provide cleaner running electric vehicles to rent. Businesses can now have an account set up to let their employees check out a car automatically at any of the locations and return to any marked locations in the area. This eliminates the need for public and private organizations to have their own fleet of vehicles. It is also cleaner running than renting a normal car. These companies provide flexible payment options by hour or day and are only restricted by their service area. Some local meeting locations even have designated reserved parking spots for these specific cars.

## **Higher Fuel Efficiency and Alternative Fuel Vehicles**

Institutions and private companies can provide many types of incentives to their employees to encourage them to be more environmentally friendly. Employers can make a list of approved vehicles or set criteria for vehicles to qualify for the incentives. Topics Entertainment Inc., in Washington, has established an incentive program that offers its employees \$1,000 to trade in their automobiles for ones with fewer cylinders in the engine, or \$2,500 to buy a hybrid or biodiesel vehicle. Clif Bar & Co. of California offers a forgivable loan of \$5,000 to employees who buy vehicles that get at least 40 miles per gallon. Employees do not have to pay back any of the money if they stay with the company for five years (Spors, 2008).

## **Alternative Fuel Vehicles**

Liquefied petroleum gas (LPG), liquefied or compressed natural gas (LNG or CNG), biodiesel, ethanol, and hybrid electric vehicles are the most popular currently-available alternative fuel technology options for transportation purposes. Hydrogen internal engines, fuel cells, electric cars, and methanol are the other available options.

Large organizations such as TxDOT are a distinct market for alternative fuel vehicles because they are often centrally fueled and their operation is usually limited to the surrounding communities. Many organizations, such as TxDOT, are currently using mixes of biodiesel in their diesel-powered equipment and vehicles. B20, a mix of 20% biodiesel and 80% regular diesel, is the most popular biodiesel mix used for large organizations.

There are a number of factors affecting emissions reduction of alternative fuel vehicles: fuel type, engine type, fuel production system, and consideration of full lifecycle emissions. Some studies have suggested that alternative fuels may decrease some types of emissions; however, other types of pollutions increased and total reduction effects were not significant in many cases.

Employers can offer a variety of incentives to support people who buy low/zero-emission vehicles. These incentives can include cash incentives, zero percent and forgivable loans, preferred parking permits, and discounted parking permits.

## Idle Reduction Technologies for Heavy-Duty Vehicles

Heavy-duty truck drivers idle their vehicles to operate heating systems and air conditioners, generate electricity, charge the vehicles' batteries, and warm up the engines. In addition to emissions, extended idling also results in a considerable waste of fuel and can cause wear on the truck engines. Several methods have been developed to reduce truck idling. These methods can be divided into stationary and mobile technologies. The former refers to stationary equipment that can connect to the truck and is widely known as truck stop electrification (TSE), and the latter refers to equipment onboard the truck, both reducing the need for extended idling.

Mobile idle reduction technologies are location-independent, have relatively low fixed capital cost (less than \$10,000) and low fuel consumption rates. These technologies can be divided into the following four categories:

- **Diesel-Powered Auxiliary Power Units (APUs):** A diesel-powered APU is comprised of a small diesel generator and an auxiliary air conditioning and heater system. Diesel APUs also provide power for in-cab appliances, the truck's main battery charging, and engine block heaters.
- **Battery-Powered APUs:** Similar to diesel APUs but instead of a generator, a battery pack provides the power. The battery pack is charged during normal truck operation taking the electricity from truck's electrical circuit.
- **Direct-Fired Heaters (DFHs):** These systems can be used to heat up both the sleeper cabin and the engine. DFHs cannot provide air conditioning, power for appliances, or charge the truck's batteries.
- **Thermal Storage Cooling (TSC) Units:** A TSC unit consists of a phase-change material that stores cooling energy transferred from the vehicle air conditioning system while the vehicle is operating. TSCs can only provide cooling to the sleeper compartment. A small amount of electrical power is required to operate the fans.

## **CHAPTER 4: OTHER OPTIONS**

There are several other efforts that can be made to reduce negative emissions effects. With widespread technology, there is a mass of data that can be studied for travel patterns of any area. This can be combined with employer and city cooperation to create environmentally friendly policies, laws and area improvements.

### **COMBINING DATA COLLECTION EFFORTS**

With the development of cell phone and personal devices, the potential of data mining using real time data has arrived. While maintaining the privacy of users, providers can now use personal data to provide information on travel patterns and life habits. Databases with this information could develop a large scale picture of how people operate and help determine the most traveled routes and how to best use resources available. Many Smartphones come equipped with sensors to record movements, sense its proximity to other people with phones, detect light levels, and take pictures or video. They usually also have a compass, gyroscope and an accelerometer to sense rotation and direction (Hotz, 2011).

With the advance data collections of each phone and three fourths of the world carrying cell phones, the magnitude of the information that can be analyzed about travel patterns is immense. At Northeastern University in Boston, network physicists discovered just how predictable people could be by studying the travel routines of 100,000 European mobile-phone users. After analyzing more than 16 million call records (including call date, time, and location), the researchers were able to determine predictable patterns in people's travel. The scientists said that, with enough information about past movements, they could forecast someone's future whereabouts with 93.6% accuracy. The pattern held true whether people stayed close to home or traveled widely, and was not affected by the phone user's age or gender (Hotz, 2011).

This approach to assembling travel data can determine what types of transportation are the most efficient, areas that need better traffic planning, and where people are idling in traffic the longest. It can also be used to help determine where companies should focus their efforts on employee programs, such as road routes or mass transit programs. In addition, this approach to data collection can also reduce or almost eliminate the need for personal interviews (home or in field) to obtain trip data. The result is a reduction in vehicle emissions associated with survey staff travel.

### **PARTNERSHIP: COMBINING PERSONAL, BUSINESS AND GOVERNMENT EFFORTS**

Generating a safe and environmentally friendly city can benefit all community members. Moreover, actions or programs that reduce vehicle emissions while providing additional economic or personal benefits are easier to gain acceptance among business and individual members of the community. Combined personal, business and government efforts can be used to



develop and implement effective emissions reduction programs. This multi-level approach enables the participating parties to leverage the strengths and supports of the other parties in a mutually-benefiting partnership. At a regional level, local governments and cities are usually the best candidates to coordinate and assist in building these partnerships. Education, continuing program promotions, and public outreach are the key to getting the public involved in the community and to center the transportation goals in the community.

In the long run, continuous promotion programs, when combined with available alternative modes, stimulate people to change their travel behaviors significantly. There are a wide variety of programs offered in terms of public outreach and promotion strategies. Successful programs include transportation fairs and displays, biking and walking days, support groups for transit, alternative transportation guides, and emails informing people of travel modes available near their homes. Promotion of emissions reduction programs should be continuous so they can provide continual support and encouragement, and respond to future opportunities and changes in individuals' travel needs and preferences. It is claimed that continuous marketing programs can lead to an increase in alternative mode choices by 10-to-25% as well as a decrease in SOVs by 5-to-15%.

Seattle Climate Partnership (SCP) is a good example of such partnership. The City of Seattle initiated this partnership program in 2005 with the goal of meeting or beating the greenhouse gas emissions (GHG) reduction target of the Kyoto Protocol. The SCP is a voluntary pact among Seattle-area employers (160 members in 2009) to take action to reduce their own emissions, and to collaborate to help meet the community-wide GHG reduction goal. The participating employers are using their resources to reduce GHG not only from their own operations but also from their suppliers, customers, and employees. In exchange for this commitment, partner organizations receive a host of benefits, including high-quality technical assistance, access to utility incentive programs, opportunities for cost-saving collaborations such as joint purchasing arrangements, and recognition for their efforts. The following are some of the strategies that have been promoted as part of Seattle's efforts to reduce GHG emissions:

- More bus service provided;
- More miles of bike lanes;
- Development of a Pedestrian Master Plan;
- Getting Ready for Plug-In Hybrid (PHEV) and Electric Vehicles (EV) programs;
- City fleet fuel reduction;
- Energy conservation;
- Home energy audits; and
- Energy requirements for new buildings.

## **LAWS AND ORDINANCES**

Some laws have been passed that make these options more broadly used. The Transportation Equity Act for the 21<sup>st</sup> Century provided ways for employers and employees to save money while helping reduce congestion and decreasing air pollution. The law helped the employers underwrite a partial amount or the full cost of the workers transportation cost for vanpooling or public transit passes. Employees were also allowed to have pre-tax dollars deducted from their salary to pay for transportation costs. This became a tax plus and emissions reduction strategy all in one. In October of 2008, President Bush signed a bill that allowed employers to reimburse employees pre-tax for using a non-motorized form of travel, and the reasonable cost associated with it (Fritz, 2008). The City of Madison, Wisconsin enacted a supporting ordinance and also helped create a Ride share matching service for their community. The program has reduced the traffic on their roads (Madison, 2010).

The National Center for Transit Research has also compiled a database of Ordinances for Trip Reduction Programs (USF, 2011). Many examples are from California and Washington. These can provide examples for other state or local jurisdictions.

## CHAPTER 5: SUMMARY AND CONCLUSIONS

The purpose of this task was to identify strategies, including new technologies, that employers can use to reduce emissions from business-related activities of their employees. The following are the main task findings:

- The strategies identified in this report are grouped based on their scope (employer-based or technology-oriented) and their impact (reducing trips or reducing emissions per trip).
- Most notable employer-based strategies that can be utilized to reduce the number of business related trips are: ride matching services, providing transit passes, promoting and supporting walking and cycling, using combined delivery systems, providing on-site dining and other amenities, and developing an organizational operation plan to reduce emissions.
- Employers also can use the following strategies to promote the reduction of emissions per business-related trip: providing electric car charging stations, offering alternative work schedules, considering employees commuting as a decision factor for office location, using off-peak delivery programs, establishing employer-sponsored incentive programs, and providing shuttles and alternative vehicles for inter-campus and mid-day work travel.
- Technology-oriented strategies can be used at organizational or individual levels to promote emissions reduction from work-related activities. Similar to employer-based strategies, technology-oriented strategies can be divided into strategies that help reducing travel and strategies that result in fewer amounts of emissions per trip.
- Technology-oriented solutions that can help reduce the number of trips are: tele/video conferencing, webinars, cloud computing, collaborative file sharing services, and smart phone application.
- The following technology-oriented strategies can be utilized to reduce emissions per trip: electric car short-term rental, remote work centers, higher efficiency vehicles, alternative fuel vehicles, and idle reduction technologies such as APUs and TSE.
- Many of the technology-based programs for reducing emissions are easily implemented with the technology that most companies already have. For example, many employees have smart phones and computer access at home which can easily and securely connect to organizations' networks. Additionally, with the rising quality of video conferencing, companies can now avoid travel and still be able to connect with business around the world.
- Smart phones and other mobile devices are also effective in encouraging employees to utilize best route practices and to create better driving habits. These options are especially valuable to organizations such as state departments of transportation that have many employees in the field.
- Community, business and government partnership is an effective way to leverage the strengths of each party to achieve the region-wide emissions reduction goals. By developing more pedestrian and mass transit facilities and services serving major business areas governments are a significant factor to facilitate the adoption of further employer-based emissions reduction programs.

## REFERENCES

- Victoria Transport Policy Institute. Ridesharing: Carpooling and Vanpooling, Accessed March 2011, <http://www.vtpi.org/tdm/tdm34.htm>, updated on Updated 15 December. 2010.
- SunLine Transit Agency. Coachella Valley Employer Pass Program, accessed December 14, 2010, <http://www.sunline.org/employer-pass-program>.
- Victoria Transport Policy Institute. Walking and Cycling Encouragement: Strategies That Encourage People To Use Non-motorized Transportation, accessed March 2011, <http://www.vtpi.org/tdm/tdm3.htm>. Updated May 10, 2011.
- Austin Business Journal. AMD installs electric car charging stations in Austin, Accessed March 2011, <http://www.bizjournals.com/austin/news/2010/11/23/amd-installs-electric-car-charging.html?page=2>. Updated November 23, 2010.
- Gaar, Brian. American Statesman. More electric car charging stations for Austin?, Accessed March 2011, <http://www.statesman.com/business/more-electric-car-charging-station-for-austin-724130.html>. Updated June 3, 2010.
- Cholia, Ami. Alt Transport. Austin Proposes \$50 Annual Unlimited Electric Car Charging Scheme, Accessed March 2011 <http://alttransport.com/2011/02/austin-considers-50-a-year-unlimited-electric-car-charging-service-read-more-austin-considers-50-a-year-unlimited-electric-car-charging-service/>. Updated February 17, 2011.
- Picado. R. A Question of Timing, *Access*, No. 17, Fall 2000, pp. 9-13. University of California Transportation Center, Berkeley, California.
- Answers.com, Who Invented Cloud Computing, Accessed March 2011, [http://wiki.answers.com/Q/Who\\_invented\\_cloud\\_computing](http://wiki.answers.com/Q/Who_invented_cloud_computing). Updated July 14, 2009.
- LaMonica, Martin. Study: Cloud computing for business uses less energy, Green Tech-CNET, November 9, 2010, Accessed December 10<sup>th</sup>. [http://news.cnet.com/8301-11128\\_3-20022227-54.html?part=rss&tag=feed&subj=GreenTech#ixzz14sxfBaqH](http://news.cnet.com/8301-11128_3-20022227-54.html?part=rss&tag=feed&subj=GreenTech#ixzz14sxfBaqH).
- VTPI, Telework: Using Telecommunications To Substitute for Physical Travel, Accessed in March 2011, <http://www.vtpi.org/tdm/tdm43.htm>. Updated January 26, 2010.
- Spors. K.K. *Workers Get Incentives to Live Greener*. The Wall Street Journal, February 26, 2008. Dow Jones & Company, Inc. New York, New York.
- Dubie, Denise. IT World Canada, Cisco saves \$277 million through telework strategy, Accessed December 2010, <http://www.itworldcanada.com/news/cisco-saves-277-million-through-telework-strategy/136017>. Updated June 25, 2009.
- Yammer.com. Accessed December 8, 2010, <https://www.yammer.com/about/product>.

InnoVisions Canada, Cost-Benefits, Accessed July 2011. <http://www.ivic.ca/costbenefits.htm> (IVC)

InnoVisions Canada, Office Space & Innovative office Strategies, Accessed July 2011. <http://www.ivic.ca/officing/index.html> (IVC)

Sage Research (2000), Opportunities in Telecommuting: A Quantitative Analysis of Drivers, Deterrents and Deployment Patterns. Sage Research, Jan 2000.

"Who's in the Home Office?" American Demographics, June 1999.

Workplace Evaluation Study. U.S. General Services Administration, Office of Government wide Policy, Sept 1999.

"Telecommute leaves road less traveled." Computerworld, Mar 1998.

Nefsis.com. Future of Video Conferencing, Accessed December 2010, <http://www.nefsis.com/Best-Video-Conferencing-Software/future-of-video-conferencing.html>.

Nefsis Commentary, Cisco TelePresence versus Standards-Based Video Conferencing, March 31, 2009, accessed December 10<sup>h</sup> 2010, <http://www.nefsis.com/Telepresence/index-cisco-telepresence.html>.

Lohr, Steve. Bringing Efficiency into Infrastructure, New York Times, April 29, 2009, Accessed December 2010, <http://www.nytimes.com/2009/04/30/business/energy-environment/30smart.html>. Updated April 29, 2009.

Vanderbilt, Tom. Slate.com. Could iPhone apps change the way we travel?, Accessed March 2011, <http://www.slate.com/id/2228109/>. Updated September 15, 2009.

Commute Android Apps. Accessed March 2011, [http://www.androidzoom.com/android\\_applications/commute](http://www.androidzoom.com/android_applications/commute).

Garthwaite, Josie. Huffpost Green, New and Next Big Things in Ridesharing, Accessed December 2010, [http://www.huffingtonpost.com/josie-garthwaite/new-and-next-big-things-i\\_b\\_125820.html](http://www.huffingtonpost.com/josie-garthwaite/new-and-next-big-things-i_b_125820.html). Updated September 15, 2008.

Hotz, Robert. Wall Street Journal, The Really Smart Phone, accessed April 2011, <http://online.wsj.com/article/SB10001424052748704547604576263261679848814.html>. Updated April 23, 2011.

Fritz, Yokota. Cyclelicio.us, Bike Commuter Benefit Now Law, Accessed December 2011, <http://www.cyclelicio.us/2008/10/bike-commuter-benefits-act-passes.html>. Updated October 30, 2008.

City of Madison, Wisconsin, accessed December 13, 2010,  
<http://www.cityofmadison.com/rideshare/employersCommuter.cfm>.

University of South Florida, List of Trip Reduction Ordinances, accessed March 2011,  
<http://www.nctr.usf.edu/clearinghouse/tro/trolist.htm>.