Texas Transportation Institute

Heavy-Duty Diesel Vehicle (HDDV) Idling Activity and Emissions Study: Phase 1 - Study Design and Estimation of Magnitude of the Problem

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

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TECHNICAL NOTE
HEAVY-DUTY DIESEL VEHICLE (HDDV) IDLING ACTIVITY AND EMISSIONS STUDY: PHASE 1 - STUDY DESIGN AND ESTIMATION OF MAGNITUDE OF THE PROBLEM

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INTRODUCTION

Heavy-duty diesel vehicle (HDDV) emissions contribute to the production of NOx, a precursor of ozone formation. The emissions associated with extended idling by HDDV are not accounted for by current procedures. This emissions source may be significant. The purpose of this analysis was to develop an estimate of the emissions associated with extended idling by HDDV, propose a study design for accurately quantifying extended truck idling emissions, and to propose control procedures or measures to reduce or eliminate these emissions. The emissions associated with diesel idling that occurs while the vehicle is in transit are part of the driving cycle and are included in current emissions factors.

An emissions inventory requires an accurate estimate of extended diesel truck idling (typically in hours per day). Currently, there are no studies that comprehensively address the extent of diesel truck idling. Therefore, the development of an appropriate procedure to estimate this activity is an important component of this study. The study design and estimation of the magnitude of the problem were based on methods agreed upon between the Texas Transportation Institute (TTI) and the Texas Commission on Environmental Quality (TCEQ) task manager. The following were included:

- ***Establish working group:*** During the development of the study design, a working group was established and consulted to make decisions about the conduct of the study.

- ***Determine the scope of the study:*** Several issues regarding scope were resolved during the development of the study design. For example, the definition of a truck (all on-road HDDV trucks or only the vehicles in the higher weight categories) and idling (all diesel idling or only extended diesel idling).

- ***Literature review:*** A comprehensive literature review of completed research in HDDV truck idling studies was performed. Information on studies that are in progress was obtained through personal contact or other means and included in this Technical Note.

- ***Assess current diesel idling emissions factors:*** Current estimates of NOx emissions factors reported for truck idling vary from 80 grams per hour to 250 grams per hour. The validity and reliability of the various idling emissions factors developed by existing and on-going studies were assessed and a recommended idling emissions factor for use in developing emissions for both short-term and long-term truck idling is provided.

- ***Assess methods and technologies to measure diesel idling activity:*** Various methods are available to estimate idling activity, based upon the different characteristics for different types of idling. These various methods and approaches were assessed and evaluated.

- ***Assess the estimation methods for use in determining the impact of diesel idle activity controls including the idling restriction rule:*** A critical aspect of the study design was the feasibility of its implementation, specifically its ability to determine the effectiveness of the diesel idle activity controls including the idling restriction rule. This requires that suitable data be available (of cost effectively and accurately collectable) upon which to base any

activity estimation method or procedure proposed. The method assessment analysis includes an explicit evaluation of the availability of suitable data.

- ***Develop procedure to expand sample data:*** Since the complete enumeration of all diesel truck activity is not feasible, the relation of sample data to the universe of trucks was examined. On-road classification data is available as is registration data. This aspect of the analysis is critical and the related procedures were carefully developed.

- ***Determine appropriate level of disaggregation for emissions calculation:*** Typically, emissions are the product of an emissions factor (grams per hour) and an activity measure (hours of idling). However, issues of aggregation and disaggregation are addressed explicitly.

- ***Prepare a study design:*** A detailed study design including schedule of activities and cost was prepared. The study design describes what will be done, how it will be done, when it will be done, and how the analyses will be performed. Methodological issues are resolved to the extent possible. Where new methods are proposed, provision is made to ensure that the proposed methods perform as expected.

- ***Estimate relevant truck population:*** An initial estimate of the relevant truck population was developed in the nonattainment and near nonattainment areas as well as the other metropolitan areas of Texas.

- ***Estimate unit emissions:*** A preliminary order of magnitude estimate of the emissions associated with truck idling in Texas is provided. The purpose is to provide a basis for assessing the relative magnitude of the contribution of diesel idling to overall emissions.

ACKNOWLEDGMENTS

Josias Zietsman, Ph.D., P.E., of TTI, was responsible for the execution of this project. Dennis Perkinson, Ph.D., was the principle investigator for this project. This work was performed by TTI under contract to TCEQ. Anusuya Iyer was the TCEQ project technical manager.

The research team would like to thank the project working group for providing critical input during the course of the project. The working group was comprised of the following members (excluding the project director and the project team):

Bill Gill (Capital Area Planning);
Cathy Stephens (Capital Area Metropolitan Organization);
Chris Klaus (North Central Texas Council of Governments);
Dan Middleton (Texas Transportation Institute);
Eve Hou (Texas Commission for Environmental Quality);
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In addition, the project leaders would like to thank the following TTI researchers for their assistance with the literature review and data collection effort: Erik Guderian, Laura Higgins, Juan Villa, and Mark Ojah.

Deliverables

Interim deliverables are an informal Technical Note (a narrative in memorandum format that explains the task, the approaches used, and the findings) provided to the Project Manager in WordPerfect 6/7/8 format, and supported by electronic document files. All pertinent data are being submitted in specified electronic format. (There is no FORTRAN source code or executable files developed under this task.) CD-ROM is used to record the final data and supporting documentation. TTI is providing five copies of the final report. One of the copies is an unbound original suitable for copying. Electronic copies of all materials related to the task report to document results and conclusions (e.g., data, work files, text files, etc.), or developed as work products under this contract are provided as requested by the TCEQ staff.

SCOPE OF THE STUDY

Defining the Problem

In the past, the effect of idling was totally overshadowed by on-road mobile sources. As vehicle and fuel technologies improved over the past decade, the relative contribution of truck idling to mobile source emissions have increased substantially, potentially making it an important contributor to the overall emissions inventory. In addition, the U.S. Environmental Protection Agency (EPA) expects that truck idling emissions rates will not reduce at the same tempo as on-road truck emissions during the next few decades.

Currently states do not account for extended truck idling emissions in their inventories. It is unknown exactly how many HDDVs idle for extended periods each day. National estimates show that between 458,000 trucks (Stodolsky, et al. 2000) to 1,300,000 trucks (Lambert, et al. 2001) idle for extensive periods of time daily. This is a known weakness in emissions modeling and the EPA plans to include idling emissions in their new generation emissions model (MOVES), which is not due for release for several years.

The emissions associated with HDDV idling occurring while the vehicle is in transit are part of the driving cycles used to develop the emissions factors in the MOBILE6 model. This type of idling is considered non-discretionary and is included in the emissions inventories prepared for nonattainment areas. The emissions associated with discretionary idling occurring at the beginning and end of trips, however, are not included in the emissions inventories. This type of idling often occurs over extended periods of time and could be a significant source of emissions.

The procedure used with MOBILE 6 to estimate the non-discretionary idling is to assume that the emissions rate is the same as a truck running at 2.5mph (the lowest speed category in the model). This process has been found to underestimate the actual amount of emissions released by an idling truck. There is, therefore, a need to obtain accurate estimates of the idling emissions rates. In addition, it is necessary to obtain information on the following aspects that are related to discretionary (extended idling):

- number of trucks idling;
- times of the day that they are idling;
- days of the year that they are idling;
- length of time that they are idling;
- locations where they are idling;
- extent of engine loading when idling occurs (use of heaters, air conditioners, or other equipment); and
- use of idling elimination equipment such as on-board power units.

Trucks generally idle at the following locations:

- public rest areas along interstates and major highways;
- truck stops;
- interchanges;
- industries that have drop-off/pick-up points; and
- intermodal facilities.

While there are a known number of spots for trucks in rest areas and truck stops, there are an unknown number of trucks idling at interchanges and locations nearby their destination (Stodolsky, et al., 2000). It is unknown how many of these exist and their location.

Definition of a Truck

The MOBILE 6 model has eight heavy-duty vehicle categories ranging from 8,500 lbs. gross vehicle weight rating (GVWR) to greater than 60,000 lbs. GVWR. Research pertaining to the area of extended idling has focused on diesel-powered, tractor-trailer combination trucks weighing 26,001 lbs. and more (Class 7 and 8). This class of truck is considered a long haul, heavy-duty vehicle that will travel distances greater than 500 miles from its base of operations. Truck drivers traveling these distances will need to stop for minimum rest periods. It was, therefore, decided that this study should focus on these larger categories of trucks.

Definition of Extended Idling

As mentioned above, the emissions associated with HDDV idling occurring while the vehicle is in transit are part of the driving cycle used to develop the emissions factors, whereas the emissions of extended idling, occurring at the beginning and ending of a trip, is not. It was, therefore, decided to view extended idling as idling occurring outside of the normal driving portion of the trip.

Previous research has shown that extended idle time was determined to be greater than 30 minutes because after 30 minutes the emissions factors stabilize on an idling vehicle and it is long enough to be considered not part of the driving cycles (Lambert, et al. 2001). It was found that most drivers operate the truck engine at higher than minimum operating speed during the extended idle. During the winter months drivers idle their trucks to keep both the truck fuel and engine warm, making it easier to start the vehicle.

A survey sent to truck drivers and fleet operators determined that the average idle truck engine operation was at 965 rpm (Irick and Wilson, 2002). During extended idling conditions, there is additional loading placed on the engine. This loading comes from a variety of sources, that includes:

- heating;
- air conditioning;
- electricity use; and/or
- battery charging.

Survey results directed toward the trucking industry conclude that truck drivers idle their engines from six to 10 hours per day while on the road (Stodolsky, et al., 2000, Irick and Wilson, 2002). Trucks are on the road for an estimated 250-300 days per year (EPA, 2002). From these values, total annual idling time estimations range from 1,500-3,000 hours per truck per year.

Approach

The study objective is to develop a study design for quantifying truck idling emissions in Texas and to produce initial estimates of the magnitude of truck idling emissions in Texas. The approach followed in this study was comprised of a number of steps that lead to the development of a study design for quantifying truck idling emissions in Texas. The approach was comprised of the following steps.

Literature Review

The literature review focused on obtaining knowledge about aspects such as:

- reasons for extended truck idling;
- extent of extended truck idling;
- approaches followed by other states to reduce extended truck idling;
- technologies available to measure and reduce truck idling; and
- available truck idling emissions factors.

The bulk of the literature review is contained in the main text, however, Appendix A contains a summary of relevant previous work.

Case Study

A case study of the Beaumont/Port Arthur (BPA) area was performed to develop a methodology on quantifying extended truck idling. Researchers used the following approach during the case study:

- performed interviews with truck drivers, carriers, truck stops, rest areas, terminals, ports, and Metropolitan Planning Organization (MPO) officials;
- determined the extent of truck idling at truck stops, rest areas, and terminals;
- estimated the emissions associated with extended idling;
- investigated disaggregation effects such as vehicle categories, types of idling, times of day, times of week, and seasonal variation; and

- developed a methodology to extend the procedure to the other metropolitan areas in Texas, whether they are in attainment or not.

Develop the Study Design
A study design was prepared that can be used to estimate the extent of truck idling in Texas. Following are the key components of the study design:

- the product that can be expected from the study;
- the feasibility of its implementation;
- the methodology to be followed. Aspects such as interviews, surveys, emissions measurement, data extrapolation, etc. were included;
- schedule of activities;
- resources required such as personnel, equipment, and material; and
- cost estimate of the study.

Actions Taken by Other States
State governments have realized the air quality problems associated with extended truck idling. For example, in July 2003, California will begin to fine container terminal operators $250 for every truck that idles at the terminal gate for more than 30 minutes (the law covers only ports that handle at least 100,000 containers a year) (Mongelluzzo, 2002). Other states are contemplating similar legislation. There are 16 states that have instituted rules (statewide or local) with regard to extended idling. All these rules are related to limiting or eliminating extended idling. A summary of these rules is included in Appendix B.

Technologies to Measure and Reduce HDDV Idling
Technologies for Measuring Extended Idling
Tools for collecting data on extended truck idling fall into two categories. The first category is equipment that can be used to measure the amount of emissions being produced by an idling HDDV. The second is equipment that can be used to track the location and movement of the trucks so that the extent and location of idling can be monitored. The appropriate technologies involve portable emissions measurement system (PEMS) and global positioning system (GPS) technology, respectively. In addition, newer engines with electronic modules store parameters such as idling time.

The EPA is conducting a major effort to advance the development of on-board emissions analysis equipment (i.e., PEMS). PEMS will ultimately allow gathering of instantaneous exhaust emissions data for a wide array of pollutants. The system will also include GPS to allow linkage of emissions measurements to vehicle location and speed. Vehicle operating information will be monitored as well, and for vehicles equipped with on-board diagnostics systems (OBD), the OBD stream will provide engine and vehicle operation data. This system will enable the gathering of in-situ emissions across all mobile sources in several geographic locations, for a relatively low cost. On-board emissions measurement technology is the focus of EPA's future emissions factor testing program, and will provide the opportunity for a significant shift in how emissions modeling is approached. (EPA 2001, Koupal, et al., n.d.)

Following is a brief description of each of these technologies.

PEMS. PEMS consists of a probe that is inserted into the exhaust stack of the truck and a computer that connects to the truck's engine control unit (ECU) diagnostic port. Real-time emissions of hydrocarbon (HC), carbon monoxide (CO), oxides of nitrogen (NOx), particulate matter (PM), toxics, and greenhouse gases can be collected with PEMS. The PEMS equipment can be used in the field to measure truck emissions at roadside locations such as rest stops and truck terminals as well as during normal operations (Lambert, et al., 2002).

GPS Technology. The majority of fleet trucks today are equipped with GPS tracking devices. The on-board GPS device allows fleet operators to know the locations of their trucks at pre-determined intervals. It should be noted that the location of each truck is not updated instantaneously, but a reading is taken at a specified interval, usually hourly, to update the truck's position. Access to the data collected from this technology would provide better knowledge of the location and duration of truck idling.

OBD. Modern vehicles are largely electronically controlled. Sensors and actuators sense the operation of specific components and actuate others to maintain optimum engine operation. An on-board computer, known as the "engine control unit," controls all these systems. This computer, with the appropriate software, is capable of monitoring all of the sensors and actuators to determine whether they are working as intended. When the OBD system determines that a problem exists, a corresponding diagnostic trouble code is stored in the computer's memory. The sensors, actuators, and the diagnostic software in the on-board computer, make up the OBD system (EPA 2000). The OBD system can tell when a vehicle's engine is not working properly and can result in high idling emissions rates. The OBD system is also used in conjunction with the PEMS system to track engine activities during emissions estimation.

Technologies for Reducing Extended Idling

Operating heavy-duty diesel engines at idle to provide heating, ventilation, and air conditioning (HVAC) in the sleeper compartment is very inefficient. Over 85 percent of the energy in diesel fuel is wasted as heat and atmospheric pollutants (Hunts Point, 2003). In addition to the emissions problems, extended idling can cause uncomfortable and harmful noise and vibration levels for people nearby. Recent research has explored various technologies that can be used to reduce the amount of HDDV idling. Although these technologies may reduce the amount of emissions released by each truck, they also have certain drawbacks. The following is a brief description of these technologies.

Electric Hookups. It is estimated that using electric power to provide HVAC releases 70 percent less carbon dioxide (CO_2), 95 percent less NOx, 98 percent less PM, and 99 percent less volatile organic compounds (VOC) (Hunts Point, 2003). IdleAire Technologies Inc. developed electric hookups for trucks that can eliminate truck idling at truck stops. The company would install an external HVAC unit at each truck parking space. HVAC is delivered to the truck by a microprocessor-controlled system that mounts in a window on either side of the truck. The unit contains temperature controls, credit card reader, display, and keypad. Temperature control is provided through an air conditioner duct. The unit also provides 110 volts of electric power for

appliances inside the cab as well as television, local telephone, and internet service. An additional 110-volt outlet mounted on the outside of the control console provides external power hookup for engine block heating (Stodolsky, et al., 2000 and Hunts Point, 2003). A potential challenge, however, is that the initial physical installation of these hookup units is expensive (Drake, 2002).

Auxiliary Power Units (APUs). APUs are mounted externally on the truck and consist of an internal combustion engine equipped with a generator to provide electricity and heat to the truck cab. An air conditioning unit is usually installed within the sleeper area and is powered by electricity. APUs are usually diesel powered, but have lower emissions rates than idling diesel engines. The APU units are an option for new trucks or can be retrofitted onto existing trucks. Commercial APU units include an option that warms battery and engine coolants to provide easier start-up. APU technology is a proven technology and is sold by many companies (Stodolsky, et al., 2000). The cost and added weight are potential drawbacks of this technology.

Direct-Fired Heaters. Direct-fired heaters provide heat to both the cab and engine or just one of them during the wintertime. Heat is supplied to the cab and engine from a small heat exchanger that is connected to the engine. Equipped with an automatic engine-starting device, direct-fired heaters use engine power for its energy source. While the heater is in use the HDDV will be idling. Direct-fired heaters have a low market share because of safety concerns, reliability factors, retrofitting costs, and noise. To reduce engine noise from the start-up and stopping of these devices, a gradual start/stop has been proposed and is being developed (Stodolsky, et al., 2000).

Current Diesel Idling Emissions Factors

There has been little research performed with regard to the air quality effects of extended idling by HDDVs. Recent research has focused on the amount of NOx, CO, and PM emissions produced and the amount of fuel consumed by an individual truck idling over an extended time period. The results of these studies have produced varied emissions rates. No research, however, has attempted to model the number and/or location of HDDV idling within a given region.

There are two types of idling that should be considered when modeling the emissions factor for HDDV. The first type is idling occurring while the driver is resting or sleeping. The U.S. Department of Transportation (USDOT) mandates that a truck driver must rest for eight hours after 11 hours of driving. During this time, many truck drivers leave the truck idling to provide air conditioning or heat to the sleeper cab, to keep the engine and fuel warm in cold weather, to operate appliances, and to maintain vehicle battery charge while appliances are in use. The EPA often refers to this form of idling as “hotelling.”

The other type of idling occurs when trucks are waiting to either pick-up or drop-off a load. Sometimes drivers have to wait several hours to perform this task while the engine is idling. In the case of refrigerated trailer units, the trucks must idle to keep the cargo cool. These locations include ports, railroad yards, distribution centers, industrial parks, etc. Even though the location of these facilities are known, the extent and times of extended idling at such facilitates have not yet been comprehensively studied.

In addition to emissions, extended idling can result in fuel waste and wear on the engine. Studies have shown that a truck idling at 1,200 rpm and under 10 brake horsepower (BHP) load consumes approximately 1.5 gallons of fuel per hour (Wilson, 2002).

Factors From the Literature

There are a wide range of results concerning the estimation of NOx emissions factors for idling diesel trucks. These factors vary depending on engine size, idle speed (rpm), and engine loading. Results from previous tests have shown results that varied from 80 grams per hour (g/hr) to 250 g/hr for different engine loads (Lambert, et al., 2001). Emissions rates might rise as high as 325 g/hr for short periods of time when a truck has a high idle speed and the HVAC unit just started to operate (Irick and Wilson, 2001).

The EPA estimated an average NOx emissions rate of 144 g/hr for all tested trucks, loadings, and temperature conditions (EPA, 2002). All these estimates are higher than the MOBILE5b estimate of 56.7 g/hr NOx released due to extended truck idling (EPA, 1998). No research results have included a recommended emissions factor for extended idling of HDDVs. It should be noted that none of the past research efforts reported on the statistical significance of their results. The past studies have typically performed between 40 and 53 tests to ascertain their findings. The following is a summary of idling emissions rates for long haul truck idling (EPA, 2002 and Hunts Point, 2003):

- NOx = 144 g/hr;
- PM = 2.19 g/hr;
- VOC = 36.4 g/hr;
- CO = 118 g/hr; and
- CO_2 = 10.07 g/hr.

Factors from PEMS Measurements

Recent PEMS measurements by Clean Air Technologies International, Inc. (CATI) of Buffalo, New York illustrates both the overall magnitude of HDDV extended idling emissions and some key differences in idling emissions across segments of the U.S. trucking fleet (CATI, 2003). CATI measured emissions and fuel consumption during extended idle operation from 55 trucks in Tennessee, New York, and California. Across all trucks studied, the average NOx emissions during extended idling were 172 g/hr. This is substantially greater than might be calculated from the MOBILE6 model when it is based on a speed of 2.5 mph.

CATI's testing found considerable differences in emissions between trucks sampled in California versus Tennessee or New York. Trucks in California averaged 148 g/hr, versus 205 g/hr in New York and 197 g/hr in Tennessee. Within California, trucks registered in California had lower NOx emissions levels (132 g/hr) than out-of-state trucks (177 g/hr).

There were three factors — vehicle set-up (long-haul vs short-haul), engine displacement, and fuel consumption — found to explain most of the variance between the California trucks and those from Tennessee and New York. The California sample included a number of short-haul trucks used in local and regional operation. These trucks lacked sleepers and had smaller, lower

horsepower engines than the interstate long-haul trucks. The California-registered day-cabs averaged 115 g/hr NOx, versus 166 g/hr for California-registered long-haul sleepers. Out-of-state long-haul trucks operating in California had emissions patterns consistent with the Tennessee and New York samples.

The dramatic difference in emissions rates between long-haul and short-haul trucks points out the importance of clearly specifying the target population when estimating HDDV emissions levels. It is also important to clearly specify the extended idle duty cycle. When a driver is running the HVAC system to provide comfort in the sleeper compartment, this additional engine load (along with the operation of other accessories such as a refrigerator, stereo, computer, etc.) increases fuel consumption and results in greater NOx emissions.

CASE STUDY

Introduction

The overall goal of the case study was to develop and refine a methodology to estimate truck idling emissions. It sets the stage for Phase 2 by providing a methodology that can be used to estimate statewide truck idling emissions. The specific objectives of the case study were to:

- confirm that the major generators of truck idling are truck stops, rest areas, industries, ports, and intermodal facilities;
- develop a methodology to estimate truck idling activity and emissions;
- determine the extent of truck idling per generator for the BPA area;
- determine emissions associated with truck idling for the BPA area;
- determine parameter values for the equations used to perform an order-of-magnitude calculation for the entire state;
- perform a preliminary investigation of the disaggregation effects such as vehicle categories, types of idling, times of day, days of week, seasonal, etc.; and
- learn more about the behavior of truck drivers leading to the extended truck idling.

The methodology used for the case study involved two days of intensive surveys, personal interviews, meetings, and observations performed in the Beaumont/Port Arthur area. Additional information was obtained through studying various reports, Internet searches, and telephone interviews.

Study Area

The BPA area was selected as a case study because it is relatively small and still experiences considerable truck traffic. The BPA area holds nonattainment status for ground-level ozone only. This is due primarily to point sources and some pollution blown in from the Houston/Galveston area (HGA) (Revisions, 2002). Counties affected under this status are Jefferson, Orange, and Hardin. The BPA area is currently classified “moderate” by the EPA and must attain the one-hour ozone standard by November 15, 2007. To reach attainment, BPA must reduce NOx emissions by approximately 31 percent to 164 tons/day (tpd). The BPA area has also been proposed as non-attainment under the new eight-hour ozone standard.

Truck Stops and Rest Areas

There are three main truck stops and two rest areas in the BPA area. All of these stops are located along the I-10 freeway.

Petro Stopping. Petro Stopping is the largest truck stop in the BPA area. It is located at the I-10/Walden Road interchange just south of Beaumont. It has approximately 250 parking spots for trucks. The truck stop includes a gas station, convenience store, restaurant, restroom with showers, game room, computer terminals, wash bay for trucks, and a small motel.

Flying J. Flying J is located just west of Orange on the northern side of the I-10/Highway 62 interchange. It has 150 parking spots for trucks. The truck stop includes a gas station, convenience store, restaurant, and restroom with showers.

Pilot. Pilot is also located just west of Orange but on the south side of the I-10/Highway 62 interchange. It has 120 parking spots for trucks. The truck stop includes a gas station, convenience store, restaurant, and restroom with showers.

Texas Department of Transportation (TxDOT) Rest Areas. In addition to the truck stops, there are two public rest areas operated by TxDOT. These are also located along I-10, one approximately five miles southwest of Beaumont and the other in the Vidor area east of Beaumont. Both these rest areas are located on either side of I-10 and have about 24 parking spots for trucks each. There are also very limited amenities, which include restrooms and vending machines.

Industries

Trucks often idle for extended periods of time during loading and offloading at industries (manufacturers and wholesalers). The industries can be classified according to two categories - industries that would require trucks to shut off their engines while on their premises and those that would allow idling. Industries that would prohibit idling are mostly those that produce flammable materials such as chemicals, petroleum, and rubber products.

Ports

There are four ports in the BPA area — Port of Beaumont, Port of Port Arthur, Port of Orange, and the Port of Sabine Pass. Idling would typically occur when the trucks are loading and offloading cargo.

Observations and Interviews

Members of the study team performed observations and interviews at the truck stops, rest areas, some industries, and the Port of Beaumont during a site visit to the BPA area. Appendix C contains examples of the questions used for interviewing the various groups. Appendix G contains the actual responses from the truck drivers and carriers, industries, and managers at truck stops and rest areas. The following is a summary of the observations and interviews.

Truck Stops

The occupancy and idling rates of the three truck stops were determined during Thursday, July 10 and Friday, July 11, 2003. It was found that the Petro Stopping was most popular with an average occupancy rate of 61 percent, whereas the Flying J and Pilot truck stops had much lower average occupancy rates at 45 percent and 23 percent, respectively. The popularity of the Petro Stopping could be attributed to its extensive amenities and the quality and variety of its food. The weighted average of the occupancy rates (based on truck stop capacities) was found to be approximately 50 percent for the three truck stops.

The idling rates were more similar for the three truck stops and were mostly a function of driver comfort (to keep the cab temperatures comfortable during resting and sleeping). The average idling rates for the Petro Stopping, Flying J, and Pilot were 67, 64, and 80 percent, respectively. The weighted average of the idling rates (based on truck stop capacities) was found to be approximately 70 percent for the three truck stops.

For illustration purposes, the daily variation in occupancy and idling rates for the Petro Stopping are shown in Figure 1 (similar patterns were observed for the other two truck stops). This figure shows that the occupancy rate is very high during the evening and it then drops off during morning and early afternoon after which the trucks begin to fill in the spaces again. The idling rate does not show a clear pattern although it was mentioned by the drivers that it is very related to the cab temperature. It should be noted that during the two-day survey the afternoon and evening temperatures were relatively mild — 70^{O}F to 85^{O}F.

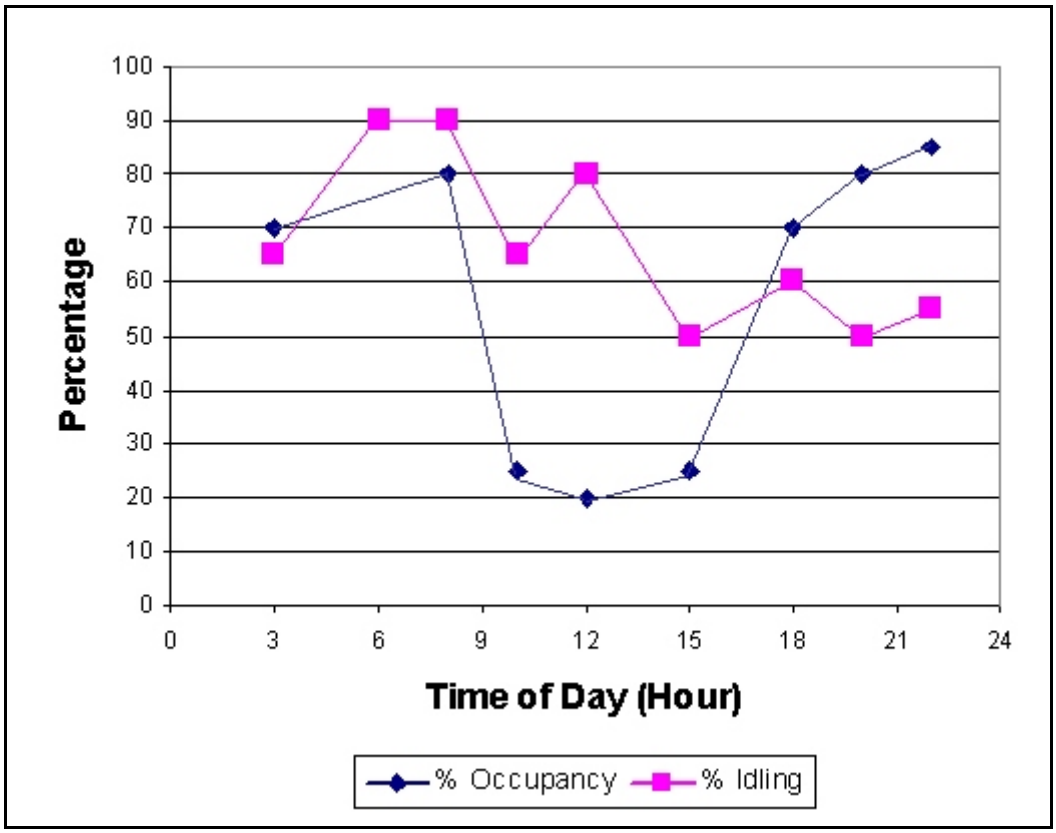

Figure 1. Percentage Occupancy and Idling per Time-of-Day for Petro Stopping.

Public Rest Areas

The two public rest areas are very small (total of 24 bays each). Observations showed that the occupancy rates of the rest areas follow similar patterns as those shown in Figure 1. The idling rates at the public rest areas were also found to be in the order of 50 to 60 percent as observed at the truck stops.

Industries

The research team made site visits to several industries to obtain information on the extent of truck idling that occurs at the various facilities. These industries included several petroleum tank farms between Beaumont and Port Arthur, and industries such as A. Schulman Inc., Bayer, Firestone, Chevron, Honeywell, and Du Pont. Several trucks were observed at the petroleum tank farms but no idling is allowed for safety purposes. Some of the other industries reported idling whereas others prohibit idling for safety and security reasons. According to information provided by the Chamber of Commerce, there are 242 industries in the BPA area of varying, types, sizes and numbers of employees. Idling characteristic of 22 companies were obtained through the site visits and telephonic interviews. Table 1 contains a summary of the idling characteristics of the companies interviewed.

Table 1
Industries Interviewed in the Beaumont/Port Arthur Area

Company	Employees	Trucks per day	Idling Duration (minutes)
ACME Skid and Plug	80	10	0
Bayer Corporation	373	90	30
C&D Robotics	80	2	0
Chevron Chemical	250	20	0
Citation Mabry	150	8	0
Ellerbee Brothers	90	5	45
Firestone Synthetic Rubber	335	20	0
Groves Pallet Company	60	10	75
I-Corp	55	11	45
J&J Manufacturing	60	6	0
M&I Electric Industries	250	7	30
Newark Paperboard	25	4	0
Orange Shipbuilding	100	2	45
Phoenix Manufacturing	85	4	30
Printpack Inc	206	15	20
Quality Mat Company	50	1	0
R&R Marine Maintenance	150	2	20
Schulman A	140	12	150
Superior Energies	50	1	0
Texas Thermowell	60	5	30
Honeywell	100	16	60
West Waco	1,150	90	120
Average	**177**	**16**	**51***

Note: Average based on industries allowing idling.

Ports

Port of Beaumont. Researchers visited and toured the Port of Beaumont and found that long-haul cargo is typically shipped from the port by both truck and rail. The long-haul cargo included bulk cargo such as soda ash, pot ash, grain, aggregate and rock; imported forest products including lumber, plywood, and veneer; and soybeans during the three-month soybean season. A private terminal located at the port loads aggregate and rock. The port has been a primary shipping point for military cargo over the past several months, but most of that cargo has been

moved by train. Approximately 200 trucks per week load or unload at the port, varying between 35 and 50 trucks per day from Monday through Friday, with an increase during the soybean season. Each truck spends one-half to two hours loading or unloading, depending on the cargo. Most trucks are observed to idle for that entire time. There are limited cases where trucks spend the night to be loaded the next day. These trucks would typically idle all night.

Other Ports. The other ports, Port Arthur, Orange, and Sabine Pass, were interviewed via telephone. At Port Arthur there are typically between 60 and 70 truck movements per day. These trucks idle when they are loading and offloading. The duration of idling is up to two hours. The trucks operating at the port are mostly long-haul trucks with sleeping cabins. As in the case with the Port of Beaumont, limited overnight stays occur. The truck movements at the Port of Orange are more limited at 25 trucks per day and at the Port of Sabine Pass there are only two visits per day.

Carrier Companies

Researchers interviewed five carrier company representatives, either in person or by telephone. Engines used by the drivers and carriers interviewed were manufactured by Freightliner, Cummins, Caterpillar, Detroit Diesel, Mack, Peterbilt, and International. Vehicle ages ranged from less than one to 10 years old, with an average reported age of five years.

Researchers found that four of the companies surveyed have small fleets, ranging from six to 10 vehicles. The fifth has a fleet of 350-400 trucks. They found that two of the fleets handle only local hauling; one performs both short and long-haul service, and two handle primarily long-haul shipping. There were three of the fleets that use teams of drivers for a significant portion of their trips. The same three fleets have sleeper compartments in some or most of their trucks. The large fleet also uses GPS satellite tracking.

Idling Practices. The interviews showed that four of the five carriers encourage or require their drivers to shut off engines while loading or unloading cargo. The fifth carrier's drivers have to idle while loading and unloading, because the truck engines also power the loading system.

Idling policies for rest stops varied between companies. The two local carriers required engines to be shut off when the trucks are stopped for extended periods, as did one of the companies that performs some long-haul trips (that company's drivers stay in motels overnight). The other two carriers, whose trips are primarily long-haul, permit idling for driver comfort, though one of these encourages drivers to shut down engines during meal breaks and other non-sleeping rest breaks.

Only one of the carriers (local hauling) uses an automatic idling shut-off on its trucks, with a two-to-three minute delay. Another carrier purchased a truck with the shut-off feature, but had the feature disabled at the dealership as idling is necessary for its loading and unloading operation.

Reasons for Idling. The two companies who allow driver discretion for extended idling say that driver comfort is the primary reason for idling while parked. Heat and air conditioning are the top concerns. The respondent from one of these companies remarked that some drivers have become accustomed to the hum and vibration of the engines at night, so they idle the engines while sleeping even if air conditioning or heating is not required. The respondent from the other company, whose trucks often operate in very cold climates, said trucks must be kept running in very cold weather, as diesel engines may not start if they have become too cold. Additionally, quick start-ups without idling to warm the engine create wear and tear and increases maintenance costs for the company.

Alternatives to Idling. Few alternatives to idling were deemed feasible by the respondents. Electric hook-ups at truck stops, which provide air-conditioning or heating plus other electrical power, were the most promising option, mentioned by three of the five respondents. External batteries or generators carried in the trucks to power systems without idling engines were not considered feasible by carriers, as the added weight (which may total several hundred pounds) would reduce the weight of cargo that could be transported. Motel stays, while an option for one carrier, were not considered practical by another — in addition to the added expense, most motel parking lots are not designed to accommodate trailer trucks.

Reducing Idling. Carrier policies discouraging idling might be the most effective idling reduction method according to two of the respondents. One said that anti-idling policies from clients might be effective at reducing idling at terminals. Respondents did not think state or local laws restricting idling would be effective. One respondent was firmly against idling restrictions, as such restrictions would adversely affect the comfort and health of drivers, and would be outweighed by safety concerns, as drivers who are too hot or too cold will not sleep adequately, and will be less alert on the road.

Drivers

Of the 19 drivers interviewed, five (26 percent) owned their trucks, while 14 (74 percent) worked for carrier companies. All were long-haul drivers, with seven (37 percent) specifying that they spent five or more nights per week on the road. Duration of resting/sleeping stopovers ranged from three to 12 hours. Not all of those interviewed answered all of the questions, generally due to time constraints.

Idling at Terminals. A total of 10 (53 percent) of the drivers responding do not usually idle their engines while loading or unloading at terminals. Reasons included no-idling policies imposed by ports or clients, safety and security, and the desire to save fuel. Researchers found that seven (37 percent) of the drivers usually or occasionally idle engines at terminals if policies do not prohibit it, generally to keep cool while waiting.

Of the five respondents who own their trucks (and pay for their own fuel), three seldom or never idle at terminals. A fourth will idle sometimes in hot weather. The fifth did not respond to this question.

Idling at Rest Stops. For meal stops, nine (47 percent) of the drivers responding usually turn off their engines, while five (26 percent) usually leave the engines idling and five (26 percent) will idle in extreme weather conditions. For longer stops, while sleeping or resting in the truck cab, nine (47 percent) of the drivers usually leave the engines running to run air conditioning or heat. One driver seldom idles, even at night, and seven others idle sometimes, depending on weather and, in one case, fuel prices. One of those seven idles for two or three hours at night to cool the cab, then turns off the engines for the rest of the night. Of the five owner/operators, four seldom idle for meal breaks and one usually does to keep the cab cool. There were three drivers who usually idle for overnight stops, and the remaining two will idle sometimes, depending on weather.

The average idling duration of the drivers interviewed was 4.5 hours. See Appendix D for a table containing the idling durations of the individuals interviewed.

Alternatives to Idling. Electric hookups at truck stops were mentioned by four drivers (21 percent) as potential alternatives to idling. There were seven other drivers (37 percent) who had seen these hookups at some rest stops, but considered them too expensive compared to the cost of idling. External generators were considered viable options by only two drivers (11 percent), while two more considered them to be both too expensive to purchase and too heavy (displacing a significant amount of cargo weight). One driver's company will pay for him to stay at a hotel at night, but this was not considered a viable option by other respondents.

Anti-Idling Policies. Besides the alternatives mentioned above, drivers did not know of anything that would reduce truck idling at rest stops. (No-idling policies exist and are followed at some terminals.) One driver had seen anti-idling policies at one truck stop, but noted that the stop had fewer customers than those with no such policy. Idling is regarded currently as the best option for keeping drivers comfortable during long rest stops.

Emissions Estimation

With the available information, an "order of magnitude" emissions estimation was performed. Following are the components of the total emissions.

Truck Stops and Rest Areas

The extent of truck idling was estimated based on the capacities of the truck stops and rest areas, average occupancy rates, and the average percentage of vehicles idling. The final NOx emissions were determined as the product of the truck-hours of idling at the three truck stops and the two rest areas and the NOx emissions rate. Table 2 shows the capacities, average occupancies, and average idling durations for the three truck stops and two rest areas.

Table 2
Observed Occupancy and Idling Percentages

Truck Stop	Capacity	Average Occupancy (%)	Average Percentage Idling (%)
Petro Stopping	250	61	67
Flying J	150	45	64
Pilot	120	23	80
Rest Areas	48	50	70
Weighted Average	**-**	**48**	**69**

The weighted averages (based on the capacities) were found to be approximately 50 percent for the occupancy rate and approximately 70 percent for percentage idling. A NOx emissions rate of 144 g/hr was used based on the literature from the EPA as discussed in an earlier section. This rate is lower that the ones found by Clean Air Technologies and can, therefore, be regarded as a conservative estimate. The following equation was used to estimate the total NOx emissions per day for the three truck stops and the two rest areas. It was found that the stops and rest areas produce approximately 0.76 tpd of NOx due to truck idling.

$$TS = R \sum_{i=1}^{n} 24 \times C_i \times \overline{O} \times \overline{I}$$

Where:

TS = total truck stop idling emissions (tpd);
C_i = capacity of truck stop *i;*
$\overline{O}$ = average occupancy rate (percentage);
$\overline{I}$ = average idling rate (percentage); and
R = NOx emissions rate (tons per hour).

Industries
As mentioned above, 22 companies in the BPA area provided information on the number of trucks visiting their facilities and the average duration of idling occurring during those visits. The number of employees at each of these terminals was obtained from the interviews and information provided by the Beaumont Chamber of Commerce (Chamber, 2001). The relationship between number of employees and number of trucks visiting on a daily basis was plotted and it was possible to fit a linear regression line through the data points. A good fit was achieved with an R^2 value of more than 0.5. It was found that on average 8.75 trucks visit these industries for every 100 employees at the location. In addition, it was found that on average only

about 60 percent of the industries interviewed actually allow idling. Finally, the average duration of idling was found to be approximately 50 minutes.

The method for determining the extent of truck idling at all the industries was based on the number of employees, percentage of industries allowing idling, and the average duration of idling. Researchers used the following equation to determine the total NOx emissions as a result of extended idling at the 242 industries in the BPA. It was found that these industries produce approximately 0.24 tpd of NOx emissions due to truck idling.

$$TI = R\sum_{i=1}^{n} 0.50 \times (0.0875\, e_i)$$

Where:

TI	=	total industry truck idling emissions (tpd);
0.50	=	average duration of idling (50 minutes or 0.833 hours) times 0.60; (percentage of industries allowing idling); and
e_i	=	number of employees for industry *i*.

Ports

As previously mentioned, there are four ports in the BPA area. It was found that the Port of Beaumont has approximately 45 truck visits per day, Port Arthur has 65, the Port of Orange has 25, and the Port of Sabine Pass has only two. The average duration of idling was found to be 75 minutes. The method for determining the extent of truck idling at the ports was based on the number of daily truck visits and the average duration of idling. Researchers used the following equation to determine the total NOx emissions as a result of extended idling at the four ports. It was found that the four ports produce approximately 0.027 tpd of NOx emissions due to truck idling.

$$TP = R\sum_{i=1}^{n} 1.25 \times t_i$$

Where:

TP	=	total port truck idling emissions (tpd);
1.25	=	average idling duration (1.25 hours); and
t_i	=	number of truck visits per day at port *i*.

The total NOx emissions due to extended truck idling for the BPA area is, therefore, the sum of the emissions for the truck stops, industries, and ports, which is just over 1.0 tpd.

Level of Disaggregation

Vehicle categories

Truck idling emissions rates vary depending on engine size, idle speed (rpm), engine loading, and vehicle age. The trucks that are "hotelling" for example, experience higher engine loads and typically idle at higher rpm as compared to trucks loading and offloading goods. Long-haul trucks are also typically equipped with stronger engines than short-haul trucks, resulting in higher idling emissions rates. It was found that almost all of the trucks at the truck stops were long-haul trucks. Almost all of the trucks at the truck stops and ports were long-haul trucks, whereas the trucks observed at the industries were a mix between long- and short-haul trucks.

Time-of-Day Variation

It was found that there is a very strong correlation between the extent of truck idling and the ambient temperature. The air conditioner is turned on when the temperature in the cab rises above a comfortable level and likewise the heating system is turned on when the temperature drops below a comfortable level.

It was found at the truck stops that at any time of the day or night there are a certain number of trucks present and a certain percentage of them are idling. Figure 1 shows that more trucks are present during the night than during the day. Most trucks leave the stops early in the morning and new ones begin to fill in again in the late afternoon.

At the industries and ports, however, the truck activities occur during normal business hours, i.e., from 8 a.m. to 5 p.m. It is only the occasional sleepover trucks that produce idling emissions during the evenings at these facilities.

Day of Week Variation

Long-haul truckers prefer to plan their trips such that they can be home on weekends. Truck stops are, therefore, less occupied during weekends than on normal weekdays. In the case of industries and ports, there is very little, if any, trucking activity on the weekends.

Seasonal Variations

Public holidays and certain vacation periods have a direct impact on the extent of trucking activities. In addition, the ambient temperatures as it relates to the change in seasons have a direct impact on the extent of truck idling because the drivers want to keep the cab temperatures comfortable.

The agricultural season has a direct impact on the port activities and hence the trucking activities at the ports. For example, the summer and early fall are typical grain seasons resulting in increased trucking activity at the ports.

Technologies

There are several technologies used to reduce truck idling. Some trucks have on-board systems, whereas others rely on systems provided at truck stops.

Idling Policies
Some carriers have very strict idling policies to reduce the amount of truck idling. For example, idling can be monitored with special equipment such as on-board GPS units.

Some industries that produce volatile and dangerous substances enforce a no-idling rule for safety purposes. Other industries might have rules (not necessarily enforced) to limit idling for air quality and other reasons.

Some states have stringent statewide or local rules with regard to truck idling as outlined in Appendix B.

Conclusions
The case study was an essential component of Phase 1 to determine how information on extended truck idling can be obtained and to set-up the algorithms for the order-of-magnitude calculations. It also developed the methodology to be used during Phase 2 of this study.

Similar data collection methods will be used in Phase 2, although some methodologies will be changed at a detailed level. For example, new streamlined questionnaires will be used, special documents will be obtained from the chambers of commerce, site visits will be used for specific generators, and a specific mix of personnel will be used to execute the project.

It was found during this case study that a combination of several methods (site visits, personal interviews, meetings, observations, telephone interviews, Internet searches, and reviewing reports) have merit in calculating the extended truck idling activities. It was shown that there is no substitute for actual observations of extended truck idling activities at key locations (some behaviors were observed that could not be obtained through interviews).

Because the BPA case study was focused on the BPA area, the parameter values determined were geared toward the BPA area. For example, the number of employees per industry, number of truck visits per 100 employees, idling at the ports, and number and duration of visits at the truck stops are all BPA-specific. In addition, the BPA area did not have any intermodal facilities such as rail-truck terminals and no first-hand knowledge could be obtained for such facilities. The algorithms (equations) developed for the BPA case study could be used to develop the order-of-magnitude estimates for the entire state as discussed in the following section.

INITIAL EMISSIONS ESTIMATES

Introduction
The methodology developed for the BPA area was used to perform an order-of-magnitude estimation of truck idling emissions for the other metropolitan areas in Texas. Care was taken to include all the nonattainment and near-nonattainment counties in the metropolitan areas currently designated nonattainment and near-nonattainment in terms of the one-hour ozone standard and recommended for nonattainment in terms of the new eight-hour standard. It should also be noted that the numbers produced here are only estimates and Phase 2 of this project would provide a more accurate estimate of statewide truck idling emissions.

The truck idling emissions rate used for the BPA area — 144 grams of NOx emissions per hour — was also used for the other metropolitan areas. Idling activities were assessed for each of the five most important contributors to truck idling emissions in Texas: trucks stops, rest areas, industries, ports, and intermodal facilities such as rail-truck terminals. The following sections describe how the idling emissions for each of these components were estimated.

Trucks Stops

Information on the addresses and telephone numbers of truck stops in Texas was obtained through Internet searches. The truck stops were telephoned and asked to provide information on their total number of truck parking spots as well as an estimate of the average occupancy rates during the day and night. Information regarding the capacities was easier to obtain than the occupancy rates. Some respondents were able to provide information on the occupancy rates during the night, whereas others could not provide that information. A total of 93 truck stops were identified statewide at an average capacity of 85 truck parking spaces per truck stop and an average occupancy rate during the night of approximately 80 percent. This occupancy rate is very similar to what was found in the BPA area and the same model as described in the first equation (average occupancy rate of 50 percent during the day and an average idling rate of 70 percent) was used to calculate idling emissions at the other truck stops statewide. Table 3 shows the truck idling emissions at truck stops in Texas. Appendix E contains a description of the truck stops in Texas, their capacities, and occupancy rates.

Table 3
NOx Emissions Due to Truck Idling at Truck Stops

Metropolitan Area	Number of Truck Stops	Number of Spaces	Total NOx Emissions (ton/day)
Austin	2	42	0.06
Beaumont/Port Arthur	3	520	0.69
Dallas/Fort Worth	39	3,165	4.22
Houston/Galveston	54	2,941	3.92
San Antonio	8	615	0.82
Tyler/Longview	4	165	0.22
Abilene	2	225	0.30
Amarillo	9	669	0.89
Brownsville	0	0	0.00
Bryan-College Station	0	0	0.00
Corpus Christi	1	50	0.07
El Paso	14	1,538	2.05
Killeen/Temple	1	24	0.03
Laredo	1	280	0.37
Lubbock	2	155	0.21
McAllen	1	300	0.40
Odessa/Midland	3	109	0.15
San Angelo	2	175	0.23
Sherman/Denison	0	0	0.00
Texarkana	4	81	0.11
Victoria	0	0	0.00
Waco	2	330	0.44
Wichita Falls	1	15	0.02
Total	**153**	**11,399**	**15.20**

Rest Areas

Information on the number of public rest areas that allow trucks to park was obtained from the Facilities Management Section of the Maintenance Division of TxDOT. There are 10 newly upgraded rest areas that have capacities of approximately 50 trucks each. The other rest areas were assumed to have capacities of 15 trucks if it is located on one side of the road and 30 if it is located on both sides. TxDOT's website that contains information on the public rest areas was used to determine whether it is a one or two-sided facility.

It was found that there are a total of 57 TxDOT rest areas. The BPA model for truck stops was again applied to the rest areas and the truck idling emissions could be determined for the public rest areas. Table 4 shows the summary for rest areas in the major metropolitan areas and the estimated NOx emissions due to truck idling. Appendix F contains more detailed information on the rest areas in the major metropolitan areas in Texas.

Table 4
NOx Emissions Due to Truck Idling at Public Rest Areas

Metropolitan Area	Number of Rest Areas	Number of Spaces	Total NOx Emissions (ton/day)
Austin	4	90	0.12
Beaumont/Port Arthur	1	15	0.02
Dallas/Fort Worth	6	185	0.25
Houston/Galveston	2	60	0.08
San Antonio	6	205	0.27
Tyler/Longview	4	125	0.17
Abilene	6	120	0.16
Amarillo	2	65	0.09
Brownsville	0	0	0.00
Bryan-College Station	1	50	0.07
Corpus Christi	3	30	0.04
El Paso	4	110	0.15
Killeen/Temple	1	30	0.04
Laredo	0	0	0.00
Lubbock	1	15	0.02
McAllen	1	15	0.02
Odessa/Midland	4	165	0.22
San Angelo	4	110	0.15
Sherman/Denison	0	0	0.00
Texarkana	3	60	0.08
Victoria	2	60	0.08
Waco	0	0	0.00
Wichita Falls	2	45	0.06
Total	**57**	**1,555**	**2.07**

Industries

Electronic yellow pages were used to determine the number of manufacturers and wholesalers in each of the metropolitan areas. It should be noted that due to the large variation in the types and sizes of manufactures and wholesalers and their varied relationships to truck activities, an estimate of truck idling based on industries is a very coarse approximation. Regardless, the BPA model was again applied by assuming an average of 118 employees per industry and wholesaler, an average of 8.75 trucks per 100 employees, 60 percent of industries allowing idling, and an average idling duration of 50 minutes. The total NOx emissions could, therefore, be estimated for each of the metropolitan areas based on trucks idling at industries. Table 5 shows the summary of the truck idling emissions as a result of industries in the major metropolitan areas.

Table 5
NOx Emissions Due to Truck Idling at Industries

Metropolitan Area	Number of Industries	Number of Employees	Trucks per Day	Total NOx Emissions (tpd)
Austin	792	93,503	8,182	0.650
Beaumont/Port Arthur	242	28,556	2,499	0.198
Dallas/Fort Worth	4,316	509,312	44,565	3.539
Houston/Galveston	2,255	266,055	23,280	0.185*
San Antonio	1,004	118,448	10,364	0.823
Tyler/Longview	501	59,059	5,168	0.410
Abilene	215	25,358	2,219	0.176
Amarillo	344	40,557	3,549	0.282
Brownsville	155	18,337	1,605	0.127
Bryan-College Station	292	34,444	3,014	0.239
Corpus Christi	304	35,848	3,137	0.249
El Paso	739	87,143	7,625	0.606
Killeen/Temple	282	33,288	2,913	0.231
Laredo	249	29,406	2,573	0.204
Lubbock	665	78,470	6,866	0.545
McAllen	251	29,571	2,587	0.205
Odessa/Midland	381	44,934	3,932	0.312
San Angelo	160	18,833	1,648	0.131
Sherman/Denison	281	33,123	2,898	0.230
Texarkana	198	23,376	2,045	0.162
Victoria	169	19,989	1,749	0.139
Waco	257	30,314	2,652	0.211
Wichita Falls	182	21,476	1,879	0.149
Total	**14,232**	**-**	**-**	**10.006**

* The Houston/Galveston area has a rule that limits idling for all vehicles over 14,000 pounds to five consecutive minutes. The rule is effective in the summer months from April 1 through October 31. The idling duration for industries in Houston was, therefore, taken as five minutes instead of the 50 minutes for the other metropolitan areas.

Ports

As previously mentioned, researchers visited the Port of Beaumont. The other 12 ports in Texas were telephoned to determine the number of daily truck visits and the average idling duration. It was evident that all the ports operate differently and the Port of Beaumont model could not be generally applied. Several of the ports had no trucking activities, whereas others reported that no idling occurs. Table 6 shows a summary of the trucking and idling activities at the Texas ports.

Table 6
NOx Emissions Due to Truck Idling at Texas Ports

Port	Truck Visits per Day	Average Idling Duration (minutes)	NOx Emissions (pounds/day)	NOx Emissions (tons/day)
Port of Beaumont	45	75	18	0.009
Port of Brownsville	70	0	0	0.000
Port of Corpus Christi	200	30	32	0.016
Port of Freeport	150	0	0	0.000
Port of Galveston	60	30	10	0.005
Port of Houston	3,100	30	492	0.246
Port of Isabel	0	0	0	0.000
Port of Mansfield	0	0	0	0.000
Port of Orange	25	75	10	0.005
Port of Port Aransas	0	0	0	0.000
Port of Port Arthur	65	75	26	0.013
Port of Sabine Pass	2	75	1	0.000
Port of Texas City	0	0	0	0.000
Total	**3,717**	**-**	**588**	**0.294**

Table 6 shows that only three metropolitan areas (Beaumont/Port Arthur, Houston/Galveston, and Corpus Christi) are affected by idling at ports and the total NOx emissions due to truck idling at ports for these metropolitan areas are:

- Beaumont/Port Arthur: 0.027 tpd;
- Houston/Galveston: 0.251 tpd; and
- Corpus Christi: 0.016 tpd.

Intermodal Facilities

The intermodal facilities in Texas (in addition to the ports) that could potentially have extended truck idling are mainly the intermodal rail-truck terminals. There were 14 such facilities identified in Texas. The main railway companies operating these terminals are Union Pacific (UP) and Burlington Northern and Santa Fe Railway Company (BNSF). Kansas City Southern (KCS) operates one facility. Table 7 shows a summary of the trucking and idling activities at the Texas intermodal facilities. This information is based on personal interviews with most of the facilities and information on the number of annual lifts as contained in the Rail Intermodal Terminal Directory (Rail Intermodal, 1997). Appropriate growth factors suggested in the directory were used to estimate current annual truck visits. The average idling duration for 12 of the 14 facilities was found to be 25 minutes and it was decided to use 25 minutes as the idling duration for all the facilities.

Table 7
NOx Emissions Due to Truck Idling at Intermodal Facilities

Intermodal Facility	Owner	Truck Visits per Day	NOx Emissions (pounds/day)	NOx Emissions (tpd)
Fort Worth (Haslet)	BNSF	1,000	132	0.066
Amarillo	BNSF	500	66	0.033
Houston (Brisbane Road)	BNSF	800	106	0.053
Houston (Barbours Cut)	BNSF/UP	250	33	0.017
El Paso	BNSF	50	7	0.003
Dallas	KCS	500	66	0.033
Dallas	UP	950	126	0.063
Dallas	UP	750	99	0.050
Houston (Englewood)	UP	1,000	132	0.066
Houston (Kirkpatric)	UP	700	93	0.046
San Antonio	UP	350	46	0.023
San Antonio	UP	250	33	0.017
Laredo	UP	500	66	0.033
McAllen	UP	10	1	0.001
Total	**-**	**7,610**	**1,007**	**0.504**

Table 7 shows that seven metropolitan areas are affected by idling at intermodal facilities and the total NOx emissions due to truck idling for these metropolitan areas are:

- Amarillo: 0.033 tpd;
- Dallas/Fort Worth: 0.212 tpd;
- El Paso: 0.003 tpd;
- Houston/Galveston: 0.182 tpd;
- Laredo: 0.033 tpd;
- McAllen: 0.001 tpd; and
- San Antonio: 0.040 tpd.

Combined Emissions

Table 8 shows the extended truck idling emissions for the major metropolitan areas in Texas at truck stops, rest areas, industries, ports, and intermodal facilities. The table shows that truck stops and industries produce the most truck idling emissions. Ports and intermodal facilities contribute only slightly over 3 percent to the total truck idling emissions. Truck stops produce approximately 10 tpd of NOx emissions (45 percent) and rest areas produce approximately 2 tpd of NOx emissions (9 percent). Industries produce 10 tpd (43 percent) of the total NOx emissions due to truck idling. This sector is also the most uncertain in terms of truck idling activities.

Table 8
NOx Emissions per Sector Due to Truck Idling (tpd)

Metropolitan Area	Truck Stops	Rest Areas	Industries	Ports	Intermodal Facilities	Total NOx Emissions (tpd)
Austin	0.06	0.12	0.650	0.00	0.00	0.83
Beaumont/Port Arthur	0.69	0.02	0.198	0.03	0.00	0.94
Dallas/Fort Worth	4.22	0.25	3.539	0.00	0.21	8.22
Houston/Galveston	3.92	0.08	0.185	0.25	0.18	4.62
San Antonio	0.82	0.27	0.823	0.00	0.04	1.96
Tyler/Longview	0.22	0.17	0.410	0.00	0.00	0.80
Abilene	0.30	0.16	0.176	0.00	0.00	0.64
Amarillo	0.89	0.09	0.282	0.00	0.03	1.29
Brownsville	0.00	0.00	0.127	0.00	0.00	0.13
Bryan-College Station	0.00	0.07	0.239	0.00	0.00	0.31
Corpus Christi	0.07	0.04	0.249	0.02	0.00	0.37
El Paso	2.05	0.15	0.606	0.00	0.00	2.81
Killeen/Temple	0.03	0.04	0.231	0.00	0.00	0.31
Laredo	0.37	0.00	0.204	0.00	0.03	0.61
Lubbock	0.21	0.02	0.545	0.00	0.00	0.77
McAllen	0.40	0.02	0.205	0.00	0.00	0.63
Odessa/Midland	0.15	0.22	0.312	0.00	0.00	0.68
San Angelo	0.23	0.15	0.131	0.00	0.00	0.51
Sherman/Denison	0.00	0.00	0.230	0.00	0.00	0.23
Texarkana	0.11	0.08	0.162	0.00	0.00	0.35
Victoria	0.00	0.08	0.139	0.00	0.00	0.22
Waco	0.44	0.00	0.211	0.00	0.00	0.65
Wichita Falls	0.02	0.06	0.149	0.00	0.00	0.23
Total	**15.21**	**2.07**	**10.00**	**0.29**	**0.50**	**28.09**

STUDY DESIGN

Title

Heavy-Duty Vehicle Idling Emissions Activity and Prediction Model.

Introduction

The emissions associated with extended idling of heavy-duty vehicles (trucks and buses) are not accounted for by current emission modeling procedures. Specifically, the emissions associated with heavy-duty vehicle idling that occurs while the vehicle is in transit are part of the normal driving cycles and are included in current emissions factors, whereas the emissions of extended idling occurring at the beginning and ending of a trip, is not. The emissions produced by the latter source can be significant. For example, an order-of-magnitude estimate performed under Phase 1 of this investigation showed that extended idling by heavy-duty tractor-trailer diesel trucks can result in approximately 28 tpd of NOx emissions in Texas. The additional impact of buses and other categories trucks is totally unknown.

In addition to understanding the magnitude of the extended idling emissions of trucks and buses, it would be very useful to have a predictive tool that can be used to predict extended idling emissions for future years and other possible changes in activities. The overall purpose of Phase 2 of this research project is two-fold:

- to develop an estimate of the activity and associated emissions of all categories of trucks and buses in Texas; and
- to develop a predictive model that can be used to estimate extended idling emissions for both trucks and buses.

Product

Firstly, the study will produce an inventory of extended heavy-vehicle idling emissions for all the counties in Texas. The inventory will address heavy-trucks, light trucks, and buses and will be based on estimates produced for all the major generators of heavy-vehicle idling emissions. The inventory also will address temporal aspects such as seasonal variations, diurnal (time-of-day variations), and day of week variations.

The study also will produce a predictive model that can be used to estimate extended heavy-duty vehicle idling emissions at the county level. This model will be calibrated based on the information collected for the major generators as well as other significant independent variables. It will be capable of predicting changes in heavy-vehicle idling activities and emissions at a county level as a result in changes in the independent variables. For example, it would be ideal for predicting future-year heavy-duty vehicle idling emissions.

Scope of the Study

Spatial Coverage

The study will cover the entire state of Texas and will use the county as the smallest level of spatial aggregation. The information will be collected at the county level and it will also be predicted at the county level.

Temporal Coverage
The study will consider (where applicable) the effects of seasonal variations, time-of-day variations, and day of week variations.

Types of Vehicles
The study will cover heavy-duty vehicles as defined by the 16 truck categories and three bus categories defined by the EPA and used in the MOBILE6 model. The categories cover diesel and gasoline trucks from 8,500 pounds GVWR to more than 60,000 pounds GVWR. It also covers diesel- and gasoline-fueled school buses, transit buses, and urban buses. The 16 truck categories will be grouped to facilitate data collection and analysis.

Types of Generators
There are several generators that can result in extended heavy-duty vehicle idling. These generators are somewhat different for heavy-duty trucks and light trucks, and considerably different for buses.

<u>Trucks</u>
- Truck stops
- Public rest areas
- Ports
- Intermodal facilities
- Industries
- Warehouses
- Retail
- Airports
- Construction sites

<u>Buses</u>
- Schools
- Depots
- Terminals
- Attractions

Pollutants
The study will focus on NOx emissions although VOC and CO emissions can also be estimated by using their respective rates.

Emissions Rates
There is limited documented emissions rates for extended truck and bus idling. It is not in the scope of this study to estimate emissions rates or collect emissions rate data. Instead, a review and evaluation will be made of the available emissions rates for NOx, CO, VOC, and PM. Emissions rates for current and future year scenarios will be selected based on these available rates, current EPA guidance on idling emission rates, and discussions with EPA technical staff.

Methodology

Task 1: Truck Idling Inventory and Model Development

Truck Idling Inventory. This research project is large in scope and involves numerous counties, generators, and role players. The planning and preparation for this initiative is a large and important undertaking. The truck idling inventories will be estimated for all the counties in the state although the six largest urban counties (Bexar, Dallas, Harris, El Paso, Tarrant, and Travis) will be analyzed in detail. In addition to the selected urban counties, three rural counties will also be selected to be analyzed in detail. This approach will make it possible to obtain detailed information in the selected counties and apply the appropriate ratios in other counties for generators that have limited information. The more detailed information will also be useful in developing the prediction models. The following approaches will be used for each of the major generators.

- **Truck Stops.** A more accurate estimate of the number and sizes of truck stops will be obtained through additional telephone interviews and site visits. Average occupancy rates and idling durations will be confirmed during the site visits.

- **Rest Areas.** More accurate information on the public rest areas will be obtained through discussions with the individual TxDOT districts, reviewing TxDOT plans and maps, and site visits of a few new improved facilities.

- **Industries.** Industries will be categorized into types based on similarities of idling characteristics at the facilities. For example, petrochemical industries generally do not allow truck idling on their premises for safety considerations. The following are some examples of industry types:

    - heavy industries;
    - light industries; and
    - petrochemical or other producers of flammable materials.

  Although industries represent a very large portion of truck idling emissions in Texas, they are also one of the most uncertain generators in terms of the truck idling activities that they generate. The number, types, sizes and other characteristics will be determined through a variety of sources (e.g., chambers of commerce, existing Census data, etc.). A representative group of industries will be identified for interview by telephone. Researchers will visit a subset of the group.

- **Warehouses**. The large warehouse operations will be similarly identified in the various counties. A representative group will be interviewed by telephone and a subset will be visited.

- **Retail.** As in the case with warehouses, the major locally significant retail stores will be identified, a representative group identified and a subset selected for telephonic interviews. A subset will be visited.

- **Ports.** Texas ports vary considerably (some have average idling durations of more than an hour, whereas others reported no idling). Both the numbers of truck visits per day and the average idling durations will be determined. The focus will be on the large locally and regionally significant ports that have considerable truck volumes per day. Personal interviews and site visits will be used to confirm the truck activities and idling durations at the main Texas ports.

- **Intermodal Facilities.** Preliminary estimates of truck idling activities at the major intermodal facilities in Texas were collected during the study design phase. The character and intensity of these operations varies considerably by location. Fortunately, the number of these facilities is relatively small. Using the existing inventory of intermodal facilities, augmented by additional information obtained since the initial study design, the operational characteristics of these facilities will be determined. All will be interviewed by telephone. Researchers will visit a subset of this group.

- **Airports**. Texas has approximately 300 airports in the state system. Of these, 27 are commercial service airports. The investigation will focus on these commercial airports because of the large amount of freight that is shipped via road to these airports. All these airports will be contacted via telephone and some will be visited as deemed appropriate based on the interviews.

- **Construction Sites.** Construction sites have the potential of generating considerable truck idling activities. Apart from the idling due to construction equipment, there are several categories of trucks that operate and idle on construction sites. These trucks include, for example, cement trucks, water trucks, and tipper trucks (dump trucks). TTI has a long standing and positive relationship with the construction industry, including previous air quality projects. These contacts will be utilized to identify key resources and provide interview access. The objective is to obtain sufficient information about general construction site operations vis-a-vis on-road vehicle idling to develop reliable indices for estimating idling based on readily available measures of construction activity (e.g., construction dollars by type of project, fuel consumption, etc.). Construction site visits are problematic and will be avoided if possible and minimized if required. The focus will be on highway and commercial construction, because of the magnitude of these activities. However, residential construction will not be ignored.

- **Package Distribution.** Package distribution operations such as Federal Express and United Parcel Service generate considerable truck movements. The extent of truck idling activities associated with these activities is believed to vary widely by location and is generally not well understood. However, the fleets that comprise these operations constitute a substantial asset and are closely monitored by company management. The distribution facilities in Texas will be identified and the management of the relevant organizations will be interviewed to determine the truck idling associated with these types of facilities. Site visits may be conducted at selected facilities.

Truck Idling Model Development

The truck idling inventory will yield an extensive array of truck idling data. The database will be linked to the various generators and other independent variables. Relationships will be defined and equations developed for truck idling activities for each of the generator categories. These equations will be based on the most appropriate independent variables for that generator, in the context of the anticipated application. As in past analyses of this type, researchers anticipate a strong preference for robust models and parameter estimates, as well as a reliance on readily available official parameters (e.g., employment). While a formal determination of statistical significance may be neither appropriate nor possible in many cases, an indication of relative reliability and confidence associated with each measure and relationship will be provided.

The final model will, therefore, consist of a set of equations (one for each generator) that can be used to predict countywide truck idling emissions. Locational information is provided by the known location of identifiable generators or other sites and is not part of the predictive model. This model can be used to predict future truck idling emissions, once the future values for the independent variables are determined.

For example, in the case of warehouses the relationship might be truck hours of idling per square feet of warehouse area. Other examples of independent variables that exist at the county level and might be usable for establishing relationships are:

- VMT;
- VMT mix;
- gross domestic product;
- income;
- age distribution; and
- lane miles per function classification.

Task 2: Bus Idling Inventory and Model Development

Bus Idling Inventory. There are four clearly identifiable major bus activity segments. These are over-the-road (intercity), charter (tourist and special event), transit, and school. Each has its own unique fleet and idling behavior.

- **Intercity Bus Idling.** Intercity bus idling occurs at terminals and intermediate layovers for scheduled commercial intercity operations. A profile of idling behavior for these activity scenarios will be developed (e.g., frequency, duration, number of vehicles involved, range of location, etc.). Terminal and layover locations are relatively permanent and activity well known. Operator data may be available for this purpose, though additional information may be required. Activity-related estimation parameters will be identified and predictive indices developed and validated.

- **Charter Bus Idling.** Extended bus idling occurs at pick-up points and at the various attractions such as tourist or charter operations. A profile of idling behavior for these activity scenarios will be developed (e.g., frequency, duration, number of vehicles

involved, range of location, etc.). Routes and activity levels at various charter destinations are not generally well known, though they may occur predominantly at an identifiable set of locations. Operator data may be available for this purpose, though additional information may be required. Activity-related estimation parameters will be identified and predictive indices developed and validated.

- **Transit Bus Idling.** Transit bus idling occurs at transfer points, intermodal passenger terminals, driver rest areas, and end of the line stop-overs. A profile of idling behavior at these two primary scenarios will be developed (e.g., frequency, duration, number of vehicles involved, range of location, etc.). In public transit operations, routes, transfer points, layover locations and other idling areas are consistent over time and well known. Information on these aspects of idling is readily available. In addition, explicit information will be needed on idling policy and procedures at individual transit agencies and a wide range of transit operator data are available which may be of value for this purpose. Activity-related estimation parameters will be identified and predictive indices developed and validated.

- **School Bus Idling.** School bus operations are similar to public transit operations in that destination and terminals are consistent over time and well known. In addition, daily activities are very regular and well known. The specifics of idling behavior and policy are, of course, different, as is the fleet.

Bus Idling Model Development

The bus idling inventory will yield an extensive array of bus idling data. The database will be linked to the various generators and other independent variables. Relationships will be defined and equations developed for bus idling activities for each of the generator categories. These equations will be based on the most appropriate independent variables for that generator, in the context of the anticipated application. As in past analyses of this type, we anticipate a strong preference for robust models and parameter estimates, as well as a reliance on readily available official parameters to the extent possible (e.g., school enrollment, service area population or population density, local or regional economic indicators, etc.). While a formal determination of statistical significance may be neither appropriate or possible in many cases, an indication of relative reliability and confidence associated with each measure and relationship will be provided.

The final model will, therefore, consist of a set of equations (one for each generator type or operational category) that can be used to predict countywide bus idling emissions. Locational information is provided by the known location of identifiable generators or other sites and is not part of the predictive model. This model can be used to predict future bus idling emissions, once the future values for the independent variables are determined.

Proposed Schedule of Activities — 2003-2004

Task	Description	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug
1a	Truck idling inventory											
1b	Truck idling model development											
2a	Bus idling inventory											
2b	Bus idling model development											
	Reports and Other Deliverables											

Cost Estimate:

Task 1: $125,000
Task 2: $75,000

Total: $200,000

CONCLUDING REMARKS

- The relative contribution of truck idling to mobile source emissions has increased substantially over the past few years, making it an important contributor to the overall emissions inventory.

- The emissions associated with discretionary truck idling occurring at the beginning and end of trips are not included in the current MOBILE6 drive cycles and are, therefore, not included in emissions inventories. This type of idling is referred to as extended truck idling.

- A methodology was developed through a pilot study in the BPA area to quantify truck idling activities. The methodology is based on interviews, observations, and the extrapolation and aggregation of sample data.

- The BPA methodology was applied to all the metropolitan areas in Texas to perform an order-of-magnitude calculation of the truck idling activities and emissions in Texas.

- It was found that extended truck idling occurs primarily at the following locations — truck stops, public rest areas, industries, ports, and intermodal facilities.

- It was found that approximately 23 tpd of NOx emissions are emitted in the major metropolitan areas in Texas due to extended truck idling. The contribution of the nonattainment and near nonattainment areas is approximately 13 tpd of NOx emissions.
- The initial estimates indicate that truck stops are the major contributor to truck idling emissions at 45 percent. Industries are the second biggest contributor at 43 percent. Public rest areas contribute 9 percent, whereas ports and intermodal facilities only contribute 3 percent.

- A study design was developed that provides a framework for quantifying and reducing extended truck idling emissions in Texas. By implementing the framework in a subsequent phase, TCEQ will have a clear understanding of the extent of extended truck idling emissions in Texas (current and future), strategies for reducing extended truck idling emissions, and the cost effectiveness of applying such strategies.

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APPENDIX A
RELEVANT PREVIOUS STUDIES

The following are recent studies pertaining to the extended idling of HDDVs:

Argonne National Laboratory
Compilation of previous research determined that overnight truck idling consumes more than 838 million gallons of diesel annually in the U.S. (Stodolsky, et al., 2000). On average, a truck will idle about six hours per day (1,838 hours/year) and consume roughly 1 gallon of diesel per hour. Idle length is longer during the winter months and less during the remainder of the year. The study focuses on technology options to reduce idling and benefits from these options. The three technological alternatives studied were direct-fired heaters (for heating only), thermal storage systems, and APUs. These alternatives were found to be economically feasible for trucks that idle for more than 1,000 hours per year.

Oak Ridge National Laboratory
This project is a joint effort between the Oak Ridge National Laboratory and the University of Tennessee at Knoxville (Lenox, n.d.). The project was established to develop a field laboratory in the Watt Road/I-40 corridor west of Knoxville, Tennessee to study truck emissions and their effects on the local region. The area includes three large truck stops. Meteorology towers will be installed throughout the region to measure truck emissions. No data concerning idling was available at this time.

Extended Idle Emissions Study
Study performed by Clean Air Technologies International, Inc. (CATI) for IdleAire Technologies Corporation (Lambert, et al., 2001). During the week of December 17, 2001, 53 tests were conducted measuring fuel consumption, NOx, and PM emissions of Class 8 diesel trucks under simulated truck stop conditions. Emissions were measured using a PEMS manufactured and operated by CATI. Some tests were performed outdoors and others indoors to simulate both winter and summer temperature conditions.

Study results indicated that emissions are much higher at elevated idling speeds. Engine rpm had the most significant effect on emissions, followed by air conditioner/heater loading. The NOx emissions rate for these tests ranged from 80-250 g/hr depending on the idle speed and engine loading. No clear relationship was found between the model year of the truck and NOx emissions. Vehicles tested under truck stop situations had double the emissions as normal idle conditions.

Roadside Emissions Study
Emissions were measured on 40 Class 8 diesel trucks with roadside smoke capacity testing managed by the California Air Research Board (CARB) at a rest area on State Route 99 south of Tulare, California (Lambert, et al., 2002). PEMS was used to test second-by-second mass emissions of NOx, CO, CO_2, and PM. Mass emissions were measured under various idling speeds, engine loadings and environmental conditions. A total of 22 trucks were then tested on-road.

It was observed that relative to the amount of fuel consumed, idling NOx emissions were 1.5 times higher than on-road emissions. A total of six out of the 40 trucks emitted more than 200 g/hr of NOx during high idle speeds, while running the air conditioning.

Environmental Protection Agency
A two-year study of emissions from idling HDDV was performed at the U.S. Army's Aberdeen Test Center (ATC) (EPA, 2002). In total, 42 tests were performed on nine Class 8 diesel trucks with model years ranging from the 1980s to 2001. All tests were conducted in a climate-controlled chamber, and each test was run for approximately three hours. The average NOx emissions rate for all trucks tested was estimated to be 144 g/hr.

New York State Energy Research and Development Authority
New York is in the process of implementing a demonstration project of truck stop electrification (TSE) using IdleAire technology (Drake, 2002). Located at truck stops, the project will provide access to HVAC units, cable, telephone, and modem services. Phase I of this project delivered a feasibility study for the upstate New York region. The feasibility study included a market study, preliminary TSE design and cost estimates, as well as quantification of the energy, environmental and economic implications of TSE implementation. Phase II of the project began in January 2002 and will provide 44 electrified parking spaces at New York State Thruway Travel Plazas.

Truck Turn-Time Cost Penalties to the Wood Supply System
Wood Supply Research Institute conducted a study of 10,244 loads of roundwood delivered to various mills in nine states including Texas (Deckard et al., 2001). Empirical results indicate "excess" truck idle-time at mill woodyards imposes an additional system cost of $0.20 to $0.53 for every ton of roundwood hauled in the study area or $39.2 million to $102.9 million per year.

Heavy-Duty Truck Population, Activity and Usage Patterns
In 1998 Jack Faucett Associates conducted a study for CARB (Fischer 1998). One activity of this study was to instrument 42 HDTs with data loggers. The "average" heavy-duty truck in the sample made 16.8 trips per day, had 17.9 starts per day, had an average speed of 30.6 mph, and spent 28.4 percent of their driving time at idle.

Emissions and Fuel Consumption of HDDVs During Extended Idle
David K. Irick and Bob Wilson conducted a study in 2002 and preliminary data suggests that extended idle is an important HDDV cycle that has been overlooked (Irick and Wilson, 2002). Emissions and fuel consumption during this cycle are 2.5 times greater than a truck might experience while idling at a traffic light. During an episode of extended idling, emissions are highly dynamic. Vehicles tested under a variety of simulated truck stop conditions had up to double the average NOx emissions of trucks tested under low idle conditions with no HVAC.

Truck Stop Electrification
The New York State Energy Research and Development Authority project began July 2001 (Antares Group, 2003). Commercial trucks idle for 8-10 hours a day when stopped for the driver to take a break. The engine is idled to keep it warm and to operate cab heaters, air conditioners, and appliances. There are 15 states that have laws limiting idling, however, the truckers currently

have few viable alternatives. The annual price tag for fuel and maintenance due to tractor idling is estimated to be $4,000 per tractor per year. The project will provide electrical power outlets and HVAC units at truck stops for sleeper-cab long-haul truck operators to access. This access allows the truck operators to shut down, rather than idle the truck tractor diesel engine to supply their own power. Phase I of this project delivered a TSE feasibility study for the upstate New York area. This feasibility study included a market study, preliminary TSE design and cost estimates, as well as quantifying the energy, environmental and economic implications of TSE implementation in New York State. Phase II began January 2002 and will provide 44 electrified parking spaces at New York State Thruway Travel Plazas.

Analysis of Technology Options to Reduce the Fuel Consumption of Idling Trucks
Argonne National Laboratory of the U.S. Department of Energy performed this study in 2000. It was found that long-haul trucks idling overnight consume more than 838 million gallons of fuel annually. Idling also emits pollutants. Truck drivers idle their engines primarily to (1) heat or cool the cab and/or sleeper, (2) keep the fuel warm in winter, and (3) keep the engine warm in winter so that the engine is easier to start. Alternatives to overnight idling could save much of this fuel, reduce emissions, and cut operating costs. Several fuel-efficient alternatives to idling are available to provide heating and cooling. Options that supply electricity are economically viable for trucks that are idling for 1,000 to 3,000 or more hours a year.

Electric Power Research Institute (EPRI) Study on Truck Stop Electrification
A recent study sponsored by EPRI suggests that truck stop electrification can significantly reduce the emissions of parked, heavy-duty trucks left idling (EPRI, 2003). During any hour of the day in the U.S., more than 100,000 heavy-duty truck engines may be idling to provide heating or air conditioning for their resting drivers. This number may climb during the nighttime hours to 200,000 idling engines. Exhaust emissions attributable to truck idling may amount to over 1 million tons of regulated pollutants annually. The study suggests that if simple electrical connections were available, fuel savings could repay a $2,000 investment by truck owners in one winter and yield more than $2,000 annually.

Report to Congress on the Adequacy of Parking Facilities
This report is divided into several parts. The first part contains an overview of factors affecting commercial vehicle parking demand. The next section describes the commercial vehicle parking supply and compares parking supply and demand. The next section outlines the recommended actions proposed by partners to reduce any shortages that were identified. The final section contains a summary and recommendations for states and the federal government to address the issues. It was found in the study that truck drivers sleep 54 percent of the time at truck stops, followed by loading docks at 10 percent, followed by home at 9 percent, and finally public rest areas at 8 percent. The order in which truck drivers rated amenities at truck stops and rest areas are restrooms, convenience to the highway, showers, well-lighted parking lot, public phones, restaurant, fuel, security, repair facilities, and acceptance of pre-paid fuel cards.

APPENDIX B
STATE RULES AND REGULATIONS FOR TRUCK IDLING

State	Statewide (S) or Local (L)	Rule	Exclusions	Enforcement
California	L	Limits idling to 30 minutes at terminal gates of sea ports.		
Colorado	L	Denver – Limits idling to10 minutes in any one hour period unless the temperature is less than 10˚F or less than 20˚F for a 24-hour period. Aspen – Limits idling to five minutes.	Emergency vehicles, congestion, maintenance, service situation, and use of auxiliary equipment.	
Connecticut	S	Limits idling to three consecutive minutes unless temperature is less than 20˚F.	Traffic congestion, mechanical breakdown, maintenance, engine warming, auxiliary equipment.	Air Management Personnel
Hawaii	S	Prohibits idling.	Specified applications.	Dept. of Health
Maryland	S	Limits idling to five minutes.	Traffic congestion, auxiliary equipment, engine warming, other.	State Highway Patrol
Massachusetts	S	Limits idling to five minutes.	Serviced vehicles, delivery vehicles, power takeoff (PTO) applications.	Police, Fire, Board of Health Boston – Air Pollution Dept.
Minnesota	L	City of Owatonna has anti-idling legislation.		
Missouri	L	St. Louis – Limits idling to no more than 10 consecutive minutes.	Emergency vehicles	Law Enforcement
Nevada	S	Limits idling to 15 minutes	Emergency vehicles, traffic congestion, serviced vehicles, specified equipment.	

State	Statewide (S) or Local (L)	Rule	Exclusions	Enforcement
New Jersey	S	Limits idling to three minutes unless at operator's place of business (30 minutes). If a vehicle has been stopped for more than three hours, the limit is 15 minutes.	Refrigerator and PTO units, sleeper in non-residential zones.	State and local law enforcement.
New York	S	Limits idling to five minutes unless the vehicle has been stopped for more than two hours or the temperature is less than 25˚F.	Auxiliary equipment	State Highway Patrol
Pennsylvania	L	Philadelphia – Limits idling to two minutes. HDDV cannot accelerate idle speeds.		Air Management Services, Police
Texas	L	Certain counties in the Houston area limit idling to five minutes from April 1 to October 31.	Traffic congestion, PTO units, maintenance, emergency vehicles, buses.	
Utah	L	Salt Lake, Davis, and Utah counties limit idling to 15 consecutive minutes.	Idling to provide heat/air conditioning for sleeper cabs.	Environmental Health, Police, Highway Patrol
Virginia	S	Limits idling to three minutes in commercial and residential areas. Tour buses and trucks can idle up to 10 minutes for air conditioning and warm-up purposes.		Department of Environmental Quality
Washington D.C.	L	Limits idling to three minutes unless temperature is less than 32˚F.	PTO units	Air Quality Division, Police, Parking Enforcement

State-by-State Idling Regulations, www.truck.doe.gov/plain-talk/idling-regs.html, United States Department of Energy, accessed June 4, 2003.

APPENDIX C
QUESTIONS USED FOR THE BEAUMONT/PORT ARTHUR CASE STUDY

DRIVERS AND CARRIERS

1. Fleet size (asked only of carrier company/fleet managers, not individual drivers)
2. Use of GPS – types and availability of data (asked of carrier company/fleet managers)
3. Sleepover and rest locations (asked of carrier company/fleet managers)
4. Times and duration of rests
5. Loading and offloading times and locations (asked of carrier company/fleet managers)
6. Use of teaming (1 or 2 drivers)
7. Age average/range of fleet (drivers were asked the age of their vehicle)
8. Manufacturers (fleet/engines)
9. What are the most common reasons for idling trucks?
    - To run auxiliary systems (air conditioning/heating, electricity)
    - To avoid engine shut-downs
    - To warm up engines when starting
    - Other
1. At what RPM are trucks usually idled (for extended periods)?
2. What are feasible alternatives to idling?
    - Independent generators/batteries
    - Electric hook-ups at rest areas
    - Motel facilities as an alternative to sleeping in trucks
    - Other
1. Does your fleet have/use external generators for auxiliary systems such as air conditioning and other electrical systems when the truck is not moving?
2. Do any of your trucks have an automatic idling shut-off? Can it be altered or disabled?
3. What do you think would be most likely to reduce idling times?
    - Technology changes (other ways to operate A/C, electrical systems)
    - Driver education
    - Driver incentives
    - Changes in procedure/fleet rules
    - Other

INDUSTRIES

a. Number and times of trucks present
b. Policy with regard to idling
c. Average duration of idling
4. Percentage long haul versus short haul
5. Activities during which trucks are idled (include average duration for each)
    - loading/unloading - duration
    - inspections/paperwork – duration
    - waiting in line – duration
    - other

REST AREAS

1. Number of parking spots
2. How many (or approximate fraction/percentage) are full at night? During the day?
3. Activities during which trucks are idled (and duration of each)
    - when refueling
    - when stopped briefly (using rest rooms or purchasing something)
    - when drivers are eating
    - when drivers are sleeping/spending time in truck living areas (hotelling)
4. Types of services provided
    - convenience store
    - fast food
    - restaurant (non-fast-food)
    - showers
    - motel/sleeping rooms
    - laundry
    - mail/courier
    - TV/entertainment
    - computer/online services/ports
    - other

APPENDIX D
IDLING DURATIONS OF DRIVERS INTERVIEWED

Interview #	Reported Hours of Layover	Reported Idling During Layover	Idle During Meal Breaks	Total Reported Idling
1	Several hours*	Depends on weather	No	4.5 hours
2	8 hours	60 percent or 4.8 hours average	No	4.8 hours
3	4-5 hours	Depends on weather	Sometimes	2.5 hours
4	Several hours	4 gallons per night	No	4 hours
5	Several hours	8-10 gallons per night in hot weather	No	4.5 hours
6	Several hours	Depends on weather	Sometimes	4.5 hours
7	10 hours	Depends on weather	Sometimes	5 hours
8	10-12 hours	10-12 hours	Yes	11.75 hours
9	Several hours	Depends on weather	No	4.5 hours
10	Several hours	Depends on weather	No	4.5 hours
11	Several hours	0	Yes	.75 hours
12	Several hours	Depends on weather	No	4.5 hours
13	Several hours	0	No	0
14	3-5 hours	Depends on weather	No	2 hours
15	Several hours	Depends on weather	No	4.5 hours
16	Several hours	Depends on weather	No	4.5 hours
17	12-14 hours	12-14 hours	Yes	13.75 hours
18	12 hours	2-3 hours	Sometimes	2.5 hours

* Sever hours = average idling duration of 4.5 hours.

APPENDIX E
INFORMATION ON TRUCK STOPS

Truck Stops

Metropolitan Area	Truck Stop Name	# Parking Spaces	% Occupied at Night
Austin	San Marcos Truck Stop	30	95
Austin	Sunmart #168	12	95
Beaumont/Port Arthur	Petro Stopping	250	90
Beaumont/Port Arthur	Pilot	120	90
Beaumont/Port Arthur	Flying J	150	90
Dallas/Fort Worth	Love's	20	
Dallas/Fort Worth	Flying J Travel Plaza	150	
Dallas/Fort Worth	Knox Fuel Stop	30	
Dallas/Fort Worth	Texas Oil Enterprise	2	
Dallas/Fort Worth	Total Fuel Stop	13	85
Dallas/Fort Worth	Phast Phil's	10	
Dallas/Fort Worth	Denton Travel Center	220	
Dallas/Fort Worth	Drivers Travelmart	75	
Dallas/Fort Worth	Pilot Travel Cneter #433	225	
Dallas/Fort Worth	Pilot Travel Center #320	90	
Dallas/Fort Worth	Love's	28	
Dallas/Fort Worth	Drivers Travelmart	100	
Dallas/Fort Worth	Pilot Travel Center #434	250	
Dallas/Fort Worth	Love's	20	
Dallas/Fort Worth	Hitchin Post T/s	200	65
Dallas/Fort Worth	Love's	20	75
Dallas/Fort Worth	Love's	40	100
Dallas/Fort Worth	Lucky Lady Truck Stop	45	50
Dallas/Fort Worth	Love's	50	100
Dallas/Fort Worth	Pilot Travel Center #157	80	100
Dallas/Fort Worth	Rip Griffins Center	200	90
Dallas/Fort Worth	Love's	30	80
Dallas/Fort Worth	Pilot Travel Center #206	110	
Dallas/Fort Worth	Howdy Doody #14	6	
Dallas/Fort Worth	Total #4544	8	
Dallas/Fort Worth	Conoco Fuel Stop	8	

Metropolitan Area	Truck Stop Name	# Parking Spaces	% Occupied at Night
Dallas/Fort Worth	Whip In Stop	10	
Dallas/Fort Worth	Total #4529	12	
Dallas/Fort Worth	Pride Fuel Stop	20	
Dallas/Fort Worth	Marlow's Fuel Center	20	
Dallas/Fort Worth	County Line Truck Stop	20	
Dallas/Fort Worth	Texaco Travel Plaza	20	
Dallas/Fort Worth	Midway Truck Stop	40	
Dallas/Fort Worth	Big D Travel Center	100	
Dallas/Fort Worth	Sunpower Travel Plaza	120	
Dallas/Fort Worth	Williams Travel Center	150	
Dallas/Fort Worth	Williams Travel Center	183	
Dallas/Fort Worth	Dallas South Travel Center	190	
Dallas/Fort Worth	Dallas Travel Center	250	
Houston/Galveston	Pilot Travel Center # 086	250	
Houston/Galveston	Pilot Travel Center # 383	75	50
Houston/Galveston	Trucker Paradise	100	100
Houston/Galveston	Pilot Travel Center # 234	65	100
Houston/Galveston	Baytown Citgo	34	
Houston/Galveston	Speedy Stop #15	5	95
Houston/Galveston	Sun Mart 400	45	
Houston/Galveston	Cal-Mod Hempstead Truck Stop	15	
Houston/Galveston	Normandy Truck Stop	4	
Houston/Galveston	Texas Truck Stop	25	
Houston/Galveston	Keys Truck Stop	50	
Houston/Galveston	Sunmart Truck Stop	50	
Houston/Galveston	Flying J	221	
Houston/Galveston	TravelCenters of America	207	
Houston/Galveston	Petro Stopping Center #4	189	
Houston/Galveston	Flying J	169	
Houston/Galveston	Pilot (old Speedway)	169	
Houston/Galveston	Conoco Travel Center	127	
Houston/Galveston	Williams Express #3169	104	

Metropolitan Area	Truck Stop Name	# Parking Spaces	% Occupied at Night
Houston/Galveston	Houston West Travel Center	92	
Houston/Galveston	Citgo Travel Center	80	
Houston/Galveston	Port Auto Truck Stop	67	
Houston/Galveston	Sunmart #116	66	
Houston/Galveston	Gateway Truck Plaza	61	
Houston/Galveston	Sunmart #308	40	
Houston/Galveston	Kountry Mart	40	
Houston/Galveston	Welcome Center	31	
Houston/Galveston	Hilltop Country Store	30	
Houston/Galveston	Drivers Travelmart	30	
Houston/Galveston	Quick & Easy #3	30	
Houston/Galveston	290 Express Way	26	
Houston/Galveston	Bingo Truck Stop	25	
Houston/Galveston	Cobra Truck Stop	25	
Houston/Galveston	Sunmart #128	25	
Houston/Galveston	786 Truck Stop	20	
Houston/Galveston	Sunmart #363	75	
Houston/Galveston	Fuel Mart	5	
Houston/Galveston	Short Stop Convenience	15	
Houston/Galveston	Sunmart #136	10	
Houston/Galveston	Conner's Gas & Diesel	10	
Houston/Galveston	Sunmart #131	30	
Houston/Galveston	Conoco Fuel Center	20	
Houston/Galveston	Yellow Jacket Grocery	7	
Houston/Galveston	Mike's Drive In Grocery	6	
Houston/Galveston	Handi Plus #69	19	
Houston/Galveston	Texas Star Stop	10	
Houston/Galveston	Island Food Mart	10	
Houston/Galveston	Shopper's Mart #5	14	
Houston/Galveston	Conoco Fuel Center	15	
Houston/Galveston	Flagship Truckstop	10	
Houston/Galveston	Gas Time Plaza	53	
Houston/Galveston	A-1 Truck Stop	10	
Houston/Galveston	Sunmart #361	20	
Houston/Galveston	Midway Drive In	10	

Metropolitan Area	Truck Stop Name	# Parking Spaces	% Occupied at Night
San Antonio	Flying J Travel Plaza	150	
San Antonio	Petro Stopping Center No 5	60	
San Antonio	Segovia Truck Stop	100	75
San Antonio	Rock Bottom Fina	35	95
San Antonio	Love's	120	100
San Antonio	Petro	60	90
San Antonio	Love's	45	100
San Antonio	Pilot Travel Center #306	45	75
Tyler/Longview	Love's	50	100
Tyler/Longview	Mt. Vernon Fuel Center	40	90
Tyler/Longview	Total Fuel Stop # 2863	35	95
Tyler/Longview	American Star Travel Plaza	40	50
Abilene	Red Star Truck Terminal	25	
Abilene	Sweetwater 76 Auto/Truck Stop	200	95
Amarillo	Rip Griffin's Travel Center	50	50
Amarillo	Rip Griffin's Swift Shop	40	30
Amarillo	Love's	35	
Amarillo	Love's	20	
Amarillo	Love's	20	
Amarillo	Petro	300	
Amarillo	Pilot Travel Center	92	
Amarillo	Pro Am Truck Stop	100	
Amarillo	Love's	12	95
Brownsville			
Bryan-College Station			
Corpus Christi	Corpus Christi Truck Stop	50	80
El Paso	El Paso Truck Terminal Inc.	90	
El Paso	Flying J Travel Plaza	190	
El Paso	Love's Travel Stop No 214	50	
El Paso	Petro Stopping Center - Fuel Island	250	
El Paso	Pilot Travel Center #435	91	
El Paso	El Paso Travel Plaza	170	
El Paso	Chevron Truck Stop	100	20

Metropolitan Area	Truck Stop Name	# Parking Spaces	% Occupied at Night
El Paso	Love's	32	75
El Paso	Pilot Travel Center #209	75	100
El Paso	Plateau Truck Stop	150	40
El Paso	Petro 2 #50	50	50
El Paso	Petro	160	50
El Paso	Williams Travel Center #338	100	
El Paso	R&R Food and Full	30	
Killeen/Temple	Texas Star Station #166	24	90
Laredo	Pilot Travel Center # 377	280	100
Lubbock	Rip Griffins	75	95
Lubbock	Rip Griffins Center	80	50
McAllen	Silver Spur Truck Stop	300	100
Odessa/Midland	Drivers Travel Mart	30	60
Odessa/Midland	McLain Truck Service	75	40
Odessa/Midland	Town & Country #122	4	90
San Angelo	Circle Bar 76 Auto/Truck Plaza	75	60
San Angelo	Comanche Springs Fuel Center	100	60
Sherman/Denison			
Texarkanna	Total Fuel Stop # 2800	15	90
Texarkanna	Total Fuel Stop # 2724	12	50
Texarkanna	Total Fuel Stop # 2850	50	95
Texarkanna	Total Fuel Stop # 2851	4	90
Victoria			
Waco	Ross Truck Stop	80	50
Waco	Pilot Travel Center #432	250	50
Wichita Falls	Friend's Travel Center #217	15	

APPENDIX F
INFORMATION ON PUBLIC REST AREAS

Metropolitan Area	District	County	Highway	Mile Post Exit	Location
Abilene	ABILENE	Nolan	IH 20	256	27 Miles West of Abilene
Abilene	ABILENE	Mitchell	IH 20	204 W.	28 Miles East of Big Spring
Abilene	ABILENE	Howard	IH 20	191 E.	3 Miles East of Coahoma
Abilene	CHILDRESS	Knox	US 82		2 Miles East of Benjamin
Abilene	ABILENE	Haskell	US 277		6 Miles South of Haskell
Abilene	ABILENE	Callahan	IH 20	296	10 Miles East of Abilene
Amarillio	AMARILLO	Donley/Gray	IH 40	105	west of Alanreed
Amarillio	CHILDRESS	Collingworth	US 83		9 Miles North of Wellington
Austin	AUSTIN	Hays	IH 35	212S / 211N	7 Miles North of San Marcos
Austin	AUSTIN	Gillespie	RR 1		Near LBJ Ranch
Austin	AUSTIN	Gillespie	US 290		Near Stonewall
Austin	AUSTIN	Williamson	IH 35	257S / 255N	3 Miles North of Round Rock
Beaumont/Port Arthur	BEAUMONT	Orange TIC	IH 10	879	Louisiana State Line
Bryan/College Station	BRYAN	Walker	IH 45	125S / 124N	9 Miles North of Huntsville
Corpus Christi	PHARR	Kenedy	US 77		20 Miles South of Kingsville
Corpus Christi	CORPUS CHRISTI	Refugio	US 77		3 Miles Southwest of Woodsboro
Corpus Christi	CORPUS CHRISTI	Live Oak	IH 37	82S / 78N	1 Mile South of FM 99 / 2 Miles North of FM 2049
Dallas/Fort Worth	DALLAS	Navarro	IH 45	216	16 Miles South of Corsicana
Dallas/Fort Worth	DALLAS	Ellis	IH 35E	392	10 Miles South of Waxahachie
Dallas/Fort Worth	FORT WORTH	Johnson	IH 35W	33	5 South of Burleson
Dallas/Fort Worth	FORT WORTH	Wise	US 287		2 Miles North of Decatur
Dallas/Fort Worth	FORT WORTH	Palo Pinto	IH 20	390	18 Miles West of Weatherford
Dallas/Fort Worth	DALLAS	Kaufman	IH 20	510	43 Miles East of Dallas
El Paso	EL PASO	El Paso	IH 10	50	Southeast of FM 793
El Paso	EL PASO	Culberson	IH 10	144	4 Miles East of Van Horn
El Paso	EL PASO	Culberson	US 62/180		7 Miles Southwest of New Mexico State Line
El Paso	EL PASO	Anthony TIC	IH 10	0	1 Mile East of New Mexico State Line (TIC)
Houston/Galveston	LUFKIN	Polk	US 59		9 Miles North of Livingston
Houston/Galveston	BEAUMONT	Orange	IH 10	868	12 Miles West of Orange
Killeen/Temple	WACO	Bell	IH 35	282S / 281N	3 Miles South of Salado
Lubbock	LUBBOCK	Crosby	US 82		5 Miles East of Crosbyton

Metropolitan Area	District	County	Highway	Mile Post Exit	Location
McAllen	PHARR	Brooks	US 281		5 Miles South of Falfurrias
Odessa/Midland	ODESSA	Pecos (E)	IH 10	308	23 Miles West of Sheffield
Odessa/Midland	ODESSA	Pecos (W)	IH 10	233	26 Miles West of Ft. Stockton
Odessa/Midland	ODESSA	Ward	IH 20	69	13 Miles West of Monahans
Odessa/Midland	ODESSA	Andrews	US 385		12 Miles North of Andrews
San Angelo	SAN ANGELO	Sutton	IH 10	394	6.5 Miles West of Sonora
San Angelo	SAN ANGELO	Concho	US 87		8 Miles West of Eden
San Angelo	SAN ANGELO	Coke	US 87		8 Miles Northeast of Water Valley
San Angelo	LAREDO	Val Verde	US 90		Langtry at Roy Bean Saloon (TIC)
San Antonio	SAN ANTONIO	Guadalupe	IH 10	621E / 622W	11 Miles East of Seguin
San Antonio	SAN ANTONIO	Medina	IH 35	130S.	23 Miles South of San Antonio
San Antonio	SAN ANTONIO	Kerr	IH 10	514	6 Miles East of Kerrville
San Antonio	LAREDO	Kinney	US 90		7 Miles East of Brackettville
San Antonio	SAN ANTONIO	Comal	IH 35	180	7 Miles South of New Braunfels
San Antonio	SAN ANTONIO	Bexar	IH 10	590	10 Miles East of San Antonio
Texarkana	ATLANTA	Cass	US 59		4 Miles Southwest of Atlanta
Texarkana	ATLANTA	Texarkana TIC	IH 30	223	1 Mile West of Arkansas State Line (TIC)
Texarkana	ATLANTA	Bowie	IH 30	191	4 Miles West of New Boston
Tyler/Longview	PARIS	Franklin	IH 30	143	4 Miles West of Mount Vernon
Tyler/Longview	TYLER	Van Zandt	IH 20	538	12 Miles East of Canton
Tyler/Longview	ATLANTA	Harrison	IH 20	608	10 Miles West of Marshall
Tyler/Longview	ATLANTA	Waskom TIC	IH 20	636	Louisiana State Line (TIC)
Victoria	YOAKUM	Colorado	IH 10	692	4.5 Miles West of Columbus
Victoria	YOAKUM	Victoria	US 59		10 Miles Northeast of Victoria
Wichita Falls	WICHITA FALLS	Cooke TIC	IH 35	502	Oklahoma State Line (TIC)
Wichita Falls	WICHITA FALLS	Wichita	US 287		7 Miles West of Iowa Park

APPENDIX G
SUMMARY OF INTERVIEWS WITH VARIOUS GROUPS

Questions	Emissions Related to Truck Idling - Survey Questions for Truckers / Carriers				
Carrier/trucker name, location, telephone (if applicable)	Yellow Freight Inc. Beaumont, Texas branch, (409) 842 5454	Roadway Express Inc., Beaumont, Texas branch, (409) 842 1909	Saia Motor Freight Line, Beaumont, Texas branch, (409) 840 6968	Enerson Motors, Laredo, Texas Distribution Center (956) 717 0700	Pinnacle Express, Michigan
Interviewee/position	Fred Stapleton, Operations Manager.	Manager, declined to give name.	Terry Hanks, Operations Manager.	Tom Wade, Manager.	Jim Fox, Fleet manager and driver.
Interstate/long-haul or intrastate/local carrier? Carrier operational profile.	Inter and intrastate carrier offering dry less-than-truckload (LTL) and truckload service. They provide local shuttle-drayage service and long-haul service between more than 300 Yellow consolidation terminals in U.S.	Local hauling - focus on LTL (limited truckload service). Company has operations and terminals throughout the U.S.	Local hauling - focus on LTL (limited truckload service). Company has approximately 100 terminals throughout the U.S. (headquarters is in Atlanta).	Interstate hauling. 85 percent of shipments are teamed, 15 percent are hauled by a single driver. Almost all tractors have sleeper cabs.	Both (? Think this is the case; can call to confirm. Hauls aviation fuel.)
Number of tractors in fleet?	Six (drayage tractors at local terminal).	Seven (local terminal).	Nine (local terminal).	350-400 long-haul tractors.	Six tractors and 10 trailers.
Average age of tractors in fleet (or tractor age)?	Varies from 2-10 years old.	Age of tractors varies.	Varies from 1995 - 2004.	Varies.	Average two years old; fleet was updated for maintenance purposes.
Does/do tractor(s) have sleeper(s)?	None in local drayage fleet.	None.	1 (in Beaumont fleet).	Most.	Yes.
Average trips/week requiring drivers to overnight?	Local tractors make two overnight trips per day (drivers always stay in motels).	None.	Could not say.		Drivers layover approximately 15% of the time.
Are driver teams used? How often?	No.	No.	Team is used for tractor with sleeper.	85 percent of shipments are teamed.	Increasingly commonplace especially on LTL and coast-to-coast (less-than-truckload; mixed load, multiple consignees).
Engine manufacturer(s)/size?	Cummins.	Declined to answer.	Did not know.		Freightliner (biggest truck producer now); Detroit Diesel 12.7 liter – standard is 80,000 lbs maximum weight most places (except for Michigan, where it's higher).
Are trucks equipped with GPS satellite tracking/software? What percentage of fleet?	No.	Declined to answer	No.	Yes, all.	Their trucks do not use GPS but some larger fleets do; Motorola system used for position information and communication, especially where cell phone networks are spotty.

Questions	Emissions Related to Truck Idling - Survey Questions for Truckers / Carriers				
Carrier/trucker name, location, telephone (if applicable)	Yellow Freight Inc. Beaumont, Texas branch, (409) 842 5454	Roadway Express Inc., Beaumont, Texas branch, (409) 842 1909	Saia Motor Freight Line, Beaumont, Texas branch, (409) 840 6968	Enerson Motors, Laredo, Texas Distribution Center (956) 717 0700	Pinnacle Express, Michigan
Common routes? Resting locations?	Unknown.	Drivers use whatever truck stop is closest.	Unsure of routings/rest locations.	Varies.	Anywhere you can park and not get a ticket; closed truck stops with spaces; more and more places are establishing ordinances against stopping along highways, which is creating a hardship; safety is getting pushed aside in favor of revenue enhancement (tickets issued more often to through traffic, including out-of-state trucks).
Do drivers consistently use same rest stops for eating, resting, sleeping? Why?	Common, based on driver preference (food service, ease of ingress/egress mentioned).	Drivers use whatever truck stop is closest.	Did not know.		See above.
What are typical rest times (night, morning, afternoon) and durations?	Varies.	During day, two 15-minute breaks and a 30-minute lunch break.	Vary.		Standard layover is eight hours; sometimes drivers only rest for 2-3 hours.
What are most common local loading/unloading locations (shippers, ports, rail yards, other)?	Exxon-Mobil is largest local generator of truck freight.	Declined to answer.	Primarily LTL terminal-to-terminal operations. Freight is broken down at SAIA terminals and distributed to clients from there.		
What time of day is loading/ unloading normally performed? How long does it typically take?	Varies. Trailers are spotted at large shippers like Exxon-Mobil - pick up and drop off occur within minutes.	Declined to answer.	Did not know.		Varies depending what kind of business; produce – dock location may take 8 hours to unload; at least duration of the morning; this company hauls aviation fuel, unload as soon as they arrive, bill customers after first hour of waiting.
Is tractor engine idled or shut off during loading or unloading? Why?	All their engines have auto shut off with 3-5 minutes delays.	Engine is manually shut off to prevent any extended idling.	Shut off - company policy (theft prevention, safety, cost savings).	Yes, normally.	Yes; necessary to operate the system that offloads the cargo (jet fuel).
Is tractor engine idled or shut off during driver meal breaks? Why?	No.	Yes.	Shut off - company policy (theft prevention, safety, cost savings).	Yes, normally.	See below.

Questions	Emissions Related to Truck Idling - Survey Questions for Truckers / Carriers				
Carrier/trucker name, location, telephone (if applicable)	Yellow Freight Inc. Beaumont, Texas branch, (409) 842 5454	Roadway Express Inc., Beaumont, Texas branch, (409) 842 1909	Saia Motor Freight Line, Beaumont, Texas branch, (409) 840 6968	Enerson Motors, Laredo, Texas Distribution Center (956) 717 0700	Pinnacle Express, Michigan
For what reasons are trucks commonly idled for extended periods (run auxiliary systems, avoid shutdowns, warm up engine, other)?	Tractors never idled. Local fleet does not have reefer capabilities, air conditioning, or other accessories that require power.	Engine may be idled occasionally to power air conditioning.	They do not idle their trucks.	Auxiliary systems - heat or air conditioning. Some drivers have become accustomed to hum and vibration of engine at night, and like to idle even when not using air, heat, etc.	To run auxiliary systems (air conditioning/heating, electricity) for driver comfort. To avoid engine shut-downs especially in cold weather; engine may not start if it gets too cold; for about 15-20 minutes. To warm up engines when starting –makes engine last longer, reduces repairs; engine lubrication issues – tough on motor to take off cold; 15-weight oil needs a lot of pressure to go through cold engines.
Does management have idling policy drivers must follow? What is it?	Yes, trucks must always be shut off as theft-prevention measure. Fuel cost and pollution are secondary issues.	Yes, drivers are instructed to shut engine down whenever possible.	Yes, shut off engine.	They do not have formal policy. Ask drivers to shut engines down unless they are making quick switchout (drop load and pick up another at same locale within minutes).	Driver discretion; driver safety and comfort is paramount. Don't want to sacrifice driver comfort and health because of local concerns or to save a buck.
Do union regulations or federal hours of service laws affect time or length of idling? How?	No, Yellow has contract with drivers. Driver is put up in hotel in the event of extended service.	Breaks and lunch are taken, but trucks not typically idled at these times.	Rest and breaks are mandatory, but do not affect idling - engine is shut off.	No, drivers may idle on breaks or lunch, but are encouraged not to do this.	Unions are becoming less of an issue; fewer drivers are unionized than in the past.
At what RPM are trucks usually idled for extended periods? Can this be adjusted?	Did not know.	Did not know - trucks not typically idled.	Did not know.	Did not know.	900 rpm (regular idle is 550-600 rpm) to keep oil pressure up; oil does not flow well at idle; top of engine does not get lubricated well at lower speeds; diesels run on heat of combustion (no spark plugs) – combustion ratio is 25:1 instead of 10:1 like cars. Extended idle at 550 rpm results in release of unburned fuel; idling speed is set by cruise control, from curb idle up to top speed of 2,000 rpm.

Questions	Emissions Related to Truck Idling - Survey Questions for Truckers / Carriers				
Carrier/trucker name, location, telephone (if applicable)	Yellow Freight Inc. Beaumont, Texas branch, (409) 842 5454	Roadway Express Inc., Beaumont, Texas branch, (409) 842 1909	Saia Motor Freight Line, Beaumont, Texas branch, (409) 840 6968	Enerson Motors, Laredo, Texas Distribution Center (956) 717 0700	Pinnacle Express, Michigan
Do any of your trucks have external generators for auxiliary systems? How many?	No.	No.	Did not know.	No.	No, too heavy to put on truck – takes away from freight capacity (four backup batteries weigh approximately 300 pounds); ex for jet fuel – would lose approximately $9,000/year
Do any of your trucks have an automatic shut-off to prevent extended idling? How many? Can it be altered/disabled?	Yes, all local tractors have auto shut off mechanism with 3-5 minute delay. This can only be adjusted by mechanic.	No, must be manually shut down.	Yes, tractors are equipped with automatic shut off (2-3 minute delay).	No.	One did; it was disabled through the dealer, since it's necessary to idle to offload the jet fuel.
What would be feasible alternatives to extended idling (external generator/ batteries, electric hookup, motel, other)?	Some out of state truck stops now provide metered air conditioning ducts/hoses and power sources.	More metered electricity hookups are needed at truck stops.	Did not know.	Metered hookups at truck stops may work, but there aren't many in Texas.	Metered hookups cost money -- need to weigh the cost of idling against the cost of alternatives. (See above about batteries/generators.)
What do you think would be most likely to reduce idling times (changes in fleet rules/procedures, technology changes, driver education, driver incentives to reduce idling, idling laws, other)?	Anti-idling laws would be difficult to enforce. Some clients prohibit idling at docks (tractor must either be shut down or unhooked from trailer and moved away from dock. This could help lower idling emissions.	Corporate policy discouraging idling. Roadway has reportedly determined that idling engine wastes approximately 8 gallons of diesel per hour. California has anti-idling laws, but interviewee did not endorse them. Legalizing triple trailer trains that are used in other jurisdictions would also reduce idling emissions.	Did not know.	Carrier anti-idling policies might help.	Driver education might reduce a little unnecessary idling when temperatures are moderate enough to not need air conditioning or heat; otherwise, need to consider the safety and comfort of the driver over local concerns about idling.

Questions	Beaumont - Orange Truck Stop Interviews				
Carrier/trucker name, location, telephone (if applicable)	Trucker, ~1 p.m. Thursday, July 10, Petro Stopping Truck Stop	Trucker, ~2:30 p.m. Thursday, Jul y10, Pilot Truck Stop	Trucker, ~2:45 p.m. Thursday, Jul 10, Pilot Truck Stop	Trucker, ~3:00 p.m. Thursday, July 10, Flying J Truck Stop	Trucker, ~8:00 p.m. Thursday, July 10, Pilot Truck Stop
Interviewee/position	Company Driver.	Owner/Operator .	Company Driver.	Company Driver (admits idling more than owner/operators).	Owner/Operator.
Interstate/long-haul or intrastate/local carrier? Carrier operational profile.	Interstate.	Interstate.	Interstate.	Interstate.	Interstate.
Number of tractors in fleet?	NA.	NA.	NA.	NA.	NA.
Average age of tractors in fleet (or tractor age)?	2004.	2001.	2000.	2002.	1996.
Does/do tractor(s) have sleeper(s)?	Yes.	Yes.	Yes.	Yes.	Yes.
Average trips/week requiring drivers to overnight?	Five.	5-6 nights/week.	Every night.	Five.	Overnights on road 1-2 times per week.
Are driver teams used? How often?	No.	No.	No.	No.	No.
Engine manufacturer(s)/size?	Caterpillar - could not recall size.	Cummins 500.	Detroit Diesel 445.	Detroit Diesel (did not recall size).	Mac 375.
Are trucks equipped with GPS satellite tracking/software? What percentage of fleet?	Yes.	Yes, and "Relay 4" system that shows exact percentage of operating time spent idling (shows how long, etc.).	Yes.	Yes, Qualicomm system.	No.
Common routes? Resting locations?	Truck stops - fill up quickly at night, can be difficult to find parking spot.	California - Texas and throughout the U.S., rests at truck stops.	Rests at truck stops.	Rests at truck stops.	Rests at truck stops.
Do drivers consistently use same rest stops for eating, resting, sleeping? Why?	Depends on driver.	Depends.	Stops wherever convenient.	Frequents favored truck stops when possible.	Stops where convenient.
What are typical rest times (night, morning, afternoon) and durations?	Normally rests at night, but sometimes rests during day.	Tries to rest at night for eight hours.	Rest times vary, but he usually takes 4-5 hours at a time. This may change with implementation of FMCSA's new hours of service regulations.	Varies.	Rests at night for several hours.

Questions	Beaumont - Orange Truck Stop Interviews				
Carrier/trucker name, location, telephone (if applicable)	Trucker, ~1 p.m. Thursday, July 10, Petro Stopping Truck Stop	Trucker, ~2:30 p.m. Thursday, Jul y10, Pilot Truck Stop	Trucker, ~2:45 p.m. Thursday, Jul 10, Pilot Truck Stop	Trucker, ~3:00 p.m. Thursday, July 10, Flying J Truck Stop	Trucker, ~8:00 p.m. Thursday, July 10, Pilot Truck Stop
What are most common local loading/unloading locations (shippers, ports, rail yards, other)?	Not local driver.	Not local driver.	Not local driver.	Not local driver.	Manufacturing plants and Port of Houston.
What time of day is loading/ unloading normally performed? How long does it typically take?	Varies.	Varies.	Depends on shipper.	Varies	Varies, during day Port of Houston delays can surpass 1 hr (in which case they reportedly pay driver for lost time/fuel).
Is tractor engine idled or shut off during loading or unloading? Why?	He normally shuts engine down. Some shippers ask him to do this.	Some shippers ask him to shut down at docks for safety reasons (to prevent rollaways and other accidents), others don't care (sympathize with driver in extreme heat or cold).	Most shippers allow him to idle.	Usually shuts down. Approx. 10 percent of shippers ask him to shut down at dock (primarily for safety reasons).	Depends, usually shut down.
Is tractor engine idled or shut off during driver meal breaks? Why?	Shut off.	Normally shut off.	Depends on weather.	Shut off.	Shut down to save fuel.
For what reasons are trucks commonly idled for extended periods (run auxiliary systems, avoid shutdowns, warm up engine, other)?	AC/heat.	To run heating or cooling. Company drivers idle more because they do not have to pay for fuel. He idles 60 percent of nights for AC (uses electric blanket plugged into cig lighter in colder weather).	Warm up or cool down cab.	To run air conditioner (he uses approx four gallons per night for idling). Depending on weather, some drivers idle to keep fuel lines from freezing up.	For air conditioning (cold weather isn't as big a comfort problem for him because he runs primarily in Louisiana and Texas). In hot weather, he may use 8-10 gallons per night for idling ($10-15). In exceptional cases of cold weather, he may idle to keep engine warm.
Does management have idling policy drivers must follow? What is it?	Company discourages idling, but allows driver to use discretion.	Owner/operator.	No.	No.	Owner/operator.
Do union regulations or federal hours of service laws affect time or length of idling? How?	No.	No.	No.	No.	No.
At what RPM are trucks usually idled for extended periods? Can this be adjusted?	800.	700.	1,000.	500.	500.

Questions	Beaumont - Orange Truck Stop Interviews				
Carrier/trucker name, location, telephone (if applicable)	Trucker, ~1 p.m. Thursday, July 10, Petro Stopping Truck Stop	Trucker, ~2:30 p.m. Thursday, Jul y10, Pilot Truck Stop	Trucker, ~2:45 p.m. Thursday, Jul 10, Pilot Truck Stop	Trucker, ~3:00 p.m. Thursday, July 10, Flying J Truck Stop	Trucker, ~8:00 p.m. Thursday, July 10, Pilot Truck Stop
Do any of your trucks have external generators for auxiliary systems? How many?	No.	No, but he has rig pack power inversion system that runs on battery and provides air conditioning electricity for TV and other cab appliances (not air conditioning/heat).	No.	No, these are not common - cost approximately $8,500.	No.
Do any of your trucks have an automatic shut-off to prevent extended idling? How many? Can it be altered/disabled?	No.	Has been deactivated (can be done via computer on his model)	Yes, five-min delay (can be disabled).	Yes (has four-min delay), but can be deactivated with push of button.	No.
What would be feasible alternatives to extended idling (external generator/ batteries, electric hookup, motel, other)?	Some owner operators have external generators. He felt hookups were too expensive.	Hookups might have potential if price comes down. He currently does not use them because they are too expensive and not very widespread ($1.90 for air conditioning or heat, local cable channels, internet, etc.).	None.	Perhaps hookups, but he has not seen any.	Not familiar with any of these.
What do you think would be most likely to reduce idling times (changes in fleet rules/procedures, technology changes, driver education, driver incentives to reduce idling, idling laws, other)?	Nothing. Idling highly dependent on weather.	Cheaper and more widespread hookups (right now only offered at some Petro and TA truck stops). External generators are expensive ($6,800 - $7,200) installed and weigh about 170 lbs. (reduces potential cargo weight). He has seen anti-idling policies at some truck stops (but they are less busy).	Not many viable options, idling highly dependent on weather .	See above.	None.

Questions	Beaumont-Orange Truck Stop Interviews				
Carrier/trucker name, location, telephone (if applicable)	Trucker, ~8:30 pm Thurs Jul 10, Pilot Truck Stop	Trucker, ~9:00 pm Thurs Jul 10, Pilot Truck Stop	Trucker, ~9:30 pm Thurs Jul 10, Pilot Truck Stop	Trucker, ~9:45 pm Thurs Jul 10, Pilot Truck Stop	Trucker, ~10:30 am Fri Jul 11, Flying J Truck Stop
Interviewee/position	Company Driver.	Company Driver.	Company Driver.	Company Driver.	Owner Operator.
Interstate/long-haul or intrastate/local carrier? Carrier operational profile.	Interstate.	Interstate.	Interstate.	Interstate.	Interstate.
Number of tractors in fleet?	NA.	NA.	NA.	NA.	NA.
Average age of tractors in fleet (or tractor age)?	2000.	1994.	2001.	1996.	1998.
Does/do tractor(s) have sleeper(s)?	Yes.	Yes.	Yes.	Yes.	Yes.
Average trips/week requiring drivers to overnight?	M-F.	Did not answer.	Every night.	Varies.	Almost every night.
Are driver teams used? How often?	No.	No.	No.	No.	No.
Engine manufacturer(s)/size?	Detroit Diesel 400.	Detroit Diesel (said 425, but wasn't sure).	Detroit Diesel 500.	Detroit Diesel 400.	Caterpillar 445.
Are trucks equipped with GPS satellite tracking/software? What percentage of fleet?	No.	No.	Yes, he uses Qualicomm system. This tells him and owner exactly when/how long truck idles. His truck had idled 40 percent of running time that week.	No.	No.
Common routes? Resting locations?	Rests at truck stops.	Rests at truck stops.	Rests at interstate truck stops (these apparently fill up very quickly during weeknights - have to be in by 8 p.m. to find decent spot).	Truck stops.	Truck stops.

Questions	Beaumont-Orange Truck Stop Interviews				
Carrier/trucker name, location, telephone (if applicable)	Trucker, ~8:30 pm Thurs Jul 10, Pilot Truck Stop	Trucker, ~9:00 pm Thurs Jul 10, Pilot Truck Stop	Trucker, ~9:30 pm Thurs Jul 10, Pilot Truck Stop	Trucker, ~9:45 pm Thurs Jul 10, Pilot Truck Stop	Trucker, ~10:30 am Fri Jul 11, Flying J Truck Stop
Do drivers consistently use same rest stops for eating, resting, sleeping? Why?	Driver uses those that are close to pick up/drop off locations.	Yes, good food keeps him stopping at certain locations.	Depends.	He stops where convenient.	Depends on routing, scheduling. He stops where fuel is cheap and services are provided. Most truck stops fill up between 8:30-9:00 p.m. By midnight spots are difficult to find. Lots empty out around 7:30-8:00 a.m. (Sunday evening to Thurs afternoon are busiest at truck stops - weekends slower).
What are typical rest times (night, morning, afternoon) and durations?	Depends on schedule, mostly rests at night for several hours, but sometimes rests during day.	Varies, he tries to stop for 10 hours when possible.	He tries to drive during day and rest at night (estimates that 20 percent of long-haul drivers prefer to run at night - cooler and less traffic). He idles truck for 10-12 hours per day, especially in hot/humid weather along Gulf coast.	Tries to rest at night for several hours.	He likes to run until late at night to avoid heat.
What are most common local loading/unloading locations (shippers, ports, rail yards, other)?	Varies.	Varies.	All.	Not local driver.	Shippers.
What time of day is loading/ unloading normally performed? How long does it typically take?	Loading/unloading times vary, switch out usually Takes 30 minutes - one hour.	Varies.	Depends, he will idle if it pick up or drop off takes between 1-2 hours. This occurs 50 percent of time.	Varies.	1-2 hours.
Is tractor engine idled or shut off during loading or unloading? Why?	He normally idles tractor during these times because it is reportedly cheaper to idle for 30-60 minutes than it is to shut down and start up again (start up requires a lot of fuel).	He idles at dock unless shippers ask him to shut down (exception).	See above (several shippers require him to shut down for safety reasons and to ensure that he doesn't drive off with forklift, other equipment).	Idled, normally doesn't take long.	Shut down to save fuel. Shippers don't tell him to shut down, normally.
Is tractor engine idled or shut off during driver meal breaks? Why?	In hot weather, engine is idled during meal breaks to keep cab cool	Shut down.	Idled to keep cab cool on hot days.	Shut off.	Shut down to save fuel.

Questions	Beaumont-Orange Truck Stop Interviews				
Carrier/trucker name, location, telephone (if applicable)	Trucker, ~8:30 pm Thurs Jul 10, Pilot Truck Stop	Trucker, ~9:00 pm Thurs Jul 10, Pilot Truck Stop	Trucker, ~9:30 pm Thurs Jul 10, Pilot Truck Stop	Trucker, ~9:45 pm Thurs Jul 10, Pilot Truck Stop	Trucker, ~10:30 am Fri Jul 11, Flying J Truck Stop
For what reasons are trucks commonly idled for extended periods (run auxiliary systems, avoid shutdowns, warm up engine, other)?	Air conditioner and heat. Interviewee thought most truckers would idle that night because of heat (low of 76 F according to local paper).	Air conditioning/heating and to avoid cold weather starting problems.	Company drivers do not watch fuel consumption like owner/operators do. Weather is key factor, fuel prices are also important.	To run air conditioning/heat when weather is hot/cold. This is very common.	Temperature is critical factor, drivers want to be comfortable.
Does management have idling policy drivers must follow? What is it?	No anti-idling policy company only asks that he conserve fuel by not speeding - fuel expenditures due to speeding are reportedly much greater than for idling at night, etc).	No.	No. Company asks that he not speed. 60 mph yields fuel efficiency of 6 miles per gallon, 70 mph yields 5.5 miles per gallon. Speed is more critical issue for carrier.	No, companies want drivers to be comfortable and well rested. If this means idling at night, fine. They do not want drivers to be tired or have fatigue-related accidents.	NA, some carriers offer bonuses or incentives to drivers that avoid excess idling. Idling information can be downloaded from engine. Idling costs $8-10 per night (approximately 1 gallon/hr). Tanks hold approx. 180 gallons of fuel.
Do union regulations or federal hours of service laws affect time or length of idling? How?	No, not unionized.	No.	No.	No.	No.
At what RPM are trucks usually idled for extended periods? Can this be adjusted?	500-600.	500.	800 for overnight idling (can be adjusted).	800-900.	Can be adjusted, he sets to 1,000 to ensure overhead lubrication in engine.
Do any of your trucks have external generators for auxiliary systems? How many?	No.	No.	No, not common.	No.	No, but is considering purchasing one.
Do any of your trucks have an automatic shut-off to prevent extended idling? How many? Can it be altered/disabled?	No.	No.	Not ever used, but can be activated.	No.	His is disabled.
What would be feasible alternatives to extended idling (external generator/ batteries, electric hookup, motel, other)?	None. His company does not pay for motels.	He doesn't view these as attractive options for company drivers who don't pay fuel.	Company will provide "layover" pay for hotel etc. if he has to wait a couple of days for load.	He has not seen any hook ups.	External generators or hook ups.
What do you think would be most likely to reduce idling times (changes in fleet rules/procedures, technology changes, driver education, driver incentives to reduce idling, idling laws, other)?	None.	None.	None.	A greater number of hook ups might help.	Only place he has been asked to shut down is Chicago.

Questions	Beaumont-Orange Truck Stop Interviews				
Carrier/trucker name, location, telephone (if applicable)	Trucker, ~11:30 am Thurs Jul 10, Petro Stopping Truck Stop	Trucker, ~11:35 am Thurs Jul 10, Petro Stopping Truck Stop	Trucker, ~11:45 am Thurs Jul 10, Petro Stopping Truck Stop	Trucker, ~11:50 am Thurs Jul 10, Petro Stopping Truck Stop	Trucker, ~12:00 pm Thurs Jul 10, Petro Stopping Truck Stop
Interviewee/position	Company Driver.	Company driver.	Company driver.	Owner/operator.	Company driver.
Interstate/long-haul or intrastate/local carrier? Carrier operational profile.	Interstate.	Interstate.	Interstate.	Interstate.	Interstate.
Number of tractors in fleet?	NA.	NA.	NA.	NA.	NA.
Average age of tractors in fleet (or tractor age)?	1994.	1996.	1996.	1993.	2000.
Does/do tractor(s) have sleeper(s)?	Yes.	Yes.	Yes.	Yes.	Yes.
Average trips/week requiring drivers to overnight?					
Are driver teams used? How often?	No.	No.	No.	No.	No.
Engine manufacturer(s)/size?	Caterpillar 475.	Freightliner -- Detroit.	Freightliner Detroit.	Peterbilt.	Freightliner.
Are trucks equipped with GPS satellite tracking/software? What percentage of fleet?					
Common routes? Resting locations?	Pennsylvania to Florida.	Indiana, Michigan, Texas.			Based in Minnesota; travels coast to coast.
Do drivers consistently use same rest stops for eating, resting, sleeping? Why?					
What are typical rest times (night, morning, afternoon) and durations?				3-5 hours to sleep.	
What are most common local loading/unloading locations (shippers, ports, rail yards, other)?	Shippers.				
What time of day is loading/ unloading normally performed? How long does it typically take?					
Is tractor engine idled or shut off during loading or unloading? Why?			Usually shut off for safety and security reasons.	Usually shut off to save fuel.	Usually shut off to save fuel.

Questions	Beaumont-Orange Truck Stop Interviews				
Carrier/trucker name, location, telephone (if applicable)	Trucker, ~11:30 am Thurs Jul 10, Petro Stopping Truck Stop	Trucker, ~11:35 am Thurs Jul 10, Petro Stopping Truck Stop	Trucker, ~11:45 am Thurs Jul 10, Petro Stopping Truck Stop	Trucker, ~11:50 am Thurs Jul 10, Petro Stopping Truck Stop	Trucker, ~12:00 pm Thurs Jul 10, Petro Stopping Truck Stop
Is tractor engine idled or shut off during driver meal breaks? Why?	Yes; keeps air conditioner on.	Not usually.	Usually shut off for safety and security reasons.	Usually shut off to save fuel.	Usually shut off to save fuel.
For what reasons are trucks commonly idled for extended periods (run auxiliary systems, avoid shutdowns, warm up engine, other)?	Usually doesn't idle at night; generally temperatures cool down enough.	Run air conditioning.		Idles in cold weather for heat or in extremely hot weather for air conditioning. Doesn't like to idle unless necessary -- wastes up to eight gallons of fuel per night.	Idles only in very hot or cold weather for sleeping.
Does management have idling policy drivers must follow? What is it?	Driver's discretion.	Driver's discretion.	Driver's discretion.	NA.	Driver discretion.
Do union regulations or federal hours of service laws affect time or length of idling? How?					
At what RPM are trucks usually idled for extended periods? Can this be adjusted?	Usually 800.	1,000 rpm.	NA.		
Do any of your trucks have external generators for auxiliary systems? How many?	No.	No.	No.	No.	No.
Do any of your trucks have an automatic shut-off to prevent extended idling? How many? Can it be altered/disabled?	No.	No.	NA.	NA.	NA.
What would be feasible alternatives to extended idling (external generator/ batteries, electric hookup, motel, other)?	Haven't heard of those mentioned.	Have not seen any of those mentioned.			Have seen electric hookups in Atlanta but haven't used.
What do you think would be most likely to reduce idling times (changes in fleet rules/procedures, technology changes, driver education, driver incentives to reduce idling, idling laws, other)?					

Questions	Beaumont-Orange Truck Stop			
Carrier/trucker name, location, telephone (if applicable)	Trucker, ~12:15 pm Thurs Jul 10, Petro Stopping Truck Stop	Trucker, ~12:30 pm Thurs Jul 10, Petro Stopping Truck Stop	Trucker, ~1:00 pm Thurs Jul 10, Petro Stopping Truck Stop	Trucker, ~9:50 pm Thurs Jul 10, Petro Stopping Truck Stop
Interviewee/position	?	Company driver.	Owner/operator.	Company driver.
Interstate/long-haul or intrastate/local carrier? Carrier operational profile.	Interstate.	Interstate.	Interstate.	Interstate.
Number of tractors in fleet?	NA.	NA.	NA.	NA.
Average age of tractors in fleet (or tractor age)?	?	1995.	1997.	1996.
Does/do tractor(s) have sleeper(s)?	Yes.	Yes.	Yes.	Yes.
Average trips/week requiring drivers to overnight?				
Are driver teams used? How often?	No.	No.	Yes.	No.
Engine manufacturer(s)/size?	Peterbilt.	International.	Freightliner; (gave truck's maximum load as 80,000 lbs.).	Freightliner FLD 120 Detroit 60 series.
Are trucks equipped with GPS satellite tracking/software? What percentage of fleet?				
Common routes? Resting locations?			Texas to California.	Texas, Oklahoma.
Do drivers consistently use same rest stops for eating, resting, sleeping? Why?				
What are typical rest times (night, morning, afternoon) and durations?			Have been at this rest stop from previous night until noon, waiting for a load to take to California.	Will be at this stop overnight, about 12 hours.
What are most common local loading/unloading locations (shippers, ports, rail yards, other)?			Various.	
What time of day is loading/ unloading normally performed? How long does it typically take?				
Is tractor engine idled or shut off during loading or unloading? Why?	Usually shut off to save fuel.	Turn off to save fuel when possible.		
Is tractor engine idled or shut off during driver meal breaks? Why?	Usually shut off to save fuel.	Not currently idling; saving fuel.	Yes; to run air conditioning.	Not all the time.
For what reasons are trucks commonly idled for extended periods (run auxiliary systems, avoid shutdowns, warm up engine, other)?	Idles only in very hot or cold weather for sleeping.	To run air conditioning in hot weather (if will be inside the truck).	To run air conditioning and to avoid engine shut-downs. Do not generally idle as much in cold climates.	To run air conditioning; don't tend to idle all night, just for 2-3 hours to cool the cab.

Questions	Beaumont-Orange Truck Stop			
Carrier/trucker name, location, telephone (if applicable)	Trucker, ~12:15 pm Thurs Jul 10, Petro Stopping Truck Stop	Trucker, ~12:30 pm Thurs Jul 10, Petro Stopping Truck Stop	Trucker, ~1:00 pm Thurs Jul 10, Petro Stopping Truck Stop	Trucker, ~9:50 pm Thurs Jul 10, Petro Stopping Truck Stop
Does management have idling policy drivers must follow? What is it?	Driver discretion.	No.	Owns truck; does not generally stop the engine during rest stops.	Driver discretion.
Do union regulations or federal hours of service laws affect time or length of idling? How?				
At what RPM are trucks usually idled for extended periods? Can this be adjusted?	1,000 rpm.	1,000 rpm.	As low as possible.	1,000 rpm.
Do any of your trucks have external generators for auxiliary systems? How many?	No.	No.	No.	No.
Do any of your trucks have an automatic shut-off to prevent extended idling? How many? Can it be altered/disabled?	No.	No.	No.	No.
What would be feasible alternatives to extended idling (external generator/ batteries, electric hookup, motel, other)?	Electric hookups cost approximately $20-25 per night; cheaper to use fuel and idle.	Do not use electrical hookups - do not have the setup for electrical systems (TV, computer, etc.) in the truck.	Have seen electrical hookups but have not used; idling uses about 1.5 gallons per hour and is less expensive.	Hook-up in Knoxville provides air conditioning, electricity, cable and internet hookup for around $11/night.
What do you think would be most likely to reduce idling times (changes in fleet rules/procedures, technology changes, driver education, driver incentives to reduce idling, idling laws, other)?				

Emissions Related to Truck Idling – Survey Questions for Shippers / Terminals	
Name and location of shipper/terminal (interviewee, position, telephone)	**How many loads are received/sent per day? When are trucks commonly idled (queuing to load/unload, loading/unloading, paperwork transactions, other? How long?**
E.I. DuPont	An average of 50 trucks are loaded per day, occasionally more due to special orders. No idling is permitted onsite, due to safety reasons.
Goodyear Tire and Rubber, Royce Mathews - Receiving, (409) 794 5212	Five trucks/day received, many more sent out. Loading docks are always full. For safety reasons, drivers are not permitted to idle engines or be in cab while at dock. Idling does occur at a gated Goodyear staging area away from docks. There are often several trucks in this area. They may idle for a few minutes or up to two hrs depending on load schedule/availability and time of year. Drivers typically idle more in the summer to power air conditioning. For permission to interview truckers in staging area and possibly get ingate and outgate data to determine length of idling, contact Carrol Lee Thompson (409) 794 5280.
Wilson Warehouse Co, Charlie Maize - Supervisor, (409) 833-2608	Wilson is largest warehouse operator in region with a total of six warehouses in Beaumont, Port Arthur, and Orange. Approximately one million pounds of merchandise moves in and out of their facilities per day (20-20 truckloads). On average, trucks may wait for one hour while picking up and dropping off loads. Whether they idle or not depends on trucker and carrier. Engines are idled more frequently on hot summer and cool winter days. It may be possible to interview truckers at their facilities, but must contact Mr. Maize in advance for permission.
North Star Steel Co. 340 Old Highway 90, Vidor, TX 77662 Jeff Dyson (Traffic Manager) Phone: (409) 768-1211 (ext. 9 then 5)	North Star Steel is one of the largest generators of truck freight in region. They handle approximately 30 outbound loads and 30 inbound (scrap/raw materials) loads per day. Trucks do not normally have to idle when dropping off loads. When picking up, however, they may idle for between 20 minutes and 2 hrs (or longer). Congestion sometimes forms at peak loading times (around midday), forcing truckers to idle in queue for over 30 minutes. Idling is sometimes done at discretion of driver, but some firms have anti-idling policies. Fuel prices also affect amount of Idling. More idling occurs on hot days - air conditioning.
Bayer Corp Fm 1006 Rd, Orange, TX 77630 Phone: (409) 769-3518	Bayer loads an average of 96 trucks per day. Average idling time for each truck is 30 minutes.
AtoFina Petro Chemicals	Automatic answering system - could not reach shipping/receiving or transportation personnel.
A. Schulman Inc. in Orange, TX 3007 Burnet St, (409) 883-9371 (ext. 7)	A. Schulman loads 12 to 15 trucks per day. Most (estimated 90 percent) idle during the entire wait and load time, usually from one to three hours per truck. Once or twice per month, a truck will spend the night at the company site, usually idling all night for air conditioning, etc.
Firestone	Twenty trucks per day are loaded at Firestone, with no idling permitted during the two-hour average loading time.
Honeywell	Approximately 16 trucks per day are loaded at Honeywell, eight of which are local drayage shipping. About half of those trucks idle during loading, which lasts 45-60 minutes.

Emissions Related to Truck Idling - Survey Questions for Truck Stops / Rest Areas			
Name, location, telephone of rest area?	Petro Stopping Center Truck Stop, on I-10, SW Beaumont, Texas, (409) 842 9600.	Flying J Travel Plaza - commercial and passenger vehicles, Orange, Texas (16.7 miles from downtown Beaumont on I-10), (409) 883 9465.	Pilot (formerly Mapco and Williams) Travel Center, Orange, Texas (14.6 miles from downtown Beaumont - a couple of miles south of I-10), (409) 745 1124.
Interviewee/position	Toni Irvin, Manager.	Jane Hill, Assistant Manager.	Don Stelly, Manager.
Number of parking spots?	250.	150.	120.
Number or percentage of spaces filled at night (~8pm-6am)?	Completely full with trucks parked in driveway as well.	120-130.	~90.
Number or percentage of spaces filled during day (~6am-8pm)?	Much less - Did not know.	Approximately 50.	Much less - Did not know.
Activities during which trucks are usually idled (refueling, brief stops-not eating or sleeping, sleeping/spending night, preparing to leave rest stop)	Trucks idle all night (approximately 10 hours) and during breaks and meals (approximately three hrs/day total).	Depends on trucker - could not estimate.	Did not know.
Which of the following services are offered at this rest stop:			
Convenience store	Yes.	Yes.	Yes.
Fast food	Yes (not theirs).	Yes.	Yes.
Restaurant (non-fast-food)	Yes.	Yes.	Yes.
Showers	Yes.	Yes.	Yes.
Laundry	Yes.	Yes.	Yes.
Mail or courier	Yes.	Yes.	Yes.
TV/ entertainment	Yes.	Yes.	No.
Computer ports	Yes.	Yes.	Yes.
Motel/ sleeping rooms	Yes.	No.	No.
Barber	No.	Yes.	No.