



Implementation of Idle Reduction Technologies at Ports – Case Study Evaluation for the Port of Houston

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Introduction

The Texas Transportation Institute (TTI) was awarded \$2,960,000 by the Environmental Protection Agency's (EPA's) Office of Transportation and Air Quality as a part of the Smartway Transportation Partnership. The project covered two main sections –one relating to idle reduction at truck stops, and the other dealing with idling at national ports. Under the first section, a national deployment strategy for truck stop electrification (TSE) was developed to identify priority corridors for truck stop electrification. TSE was then deployed at three locations along a priority corridor. The study included an analysis of idling activity before and after implementation of TSE at these locations.

The project objectives under the second section included studying truck idling at national ports, identifying a port that could benefit the most from implementation of idle reduction technologies, and developing a strategy for deploying stationary idle reduction technologies at the port. The TTI team identified and investigated major national ports in terms of idling activity and the Port of Houston was selected as the one with the greatest potential for idle reduction. This report summarizes the findings from the tasks conducted for this research.

Background

Ports in the U.S. are major gateways to the movement of goods and freight. A wide variety of imports, ranging from cars, toys, and industrial supplies to food products make their way into the country via ports, where they are shipped inland along road or rail freight networks. Recent research has indicated that the growth in container trade represents the most significant increase in shipments at the nation's ports. An allied effect of this growth in container volumes is the increased truck activity, since trucks are needed to move the container cargo to-and-from port areas.

The increase in container shipments and truck activity has resulted in greater congestion at and near ports, and recent research efforts have focused on characterizing and documenting port operations with a view of reducing truck turnaround times. However, the air quality impact due to truck idling at ports has not been widely studied. In addition to idling related to congestion while approaching the port, truck idling can also occur at other stages, including overnight idling at rest areas near the port, and idling during port entry/exit, and loading and unloading operations at the port itself. Characterizing the nature and magnitude of truck idling occurring at ports would enable researchers to assess the feasibility of implementing various idle reduction technologies. The Port of Houston in Texas was used as a case study location to assess truck idling and the various idle reduction options available at ports.

Port Operations and Truck Movements at Container Terminals

In general, cargo transported by ship can be broadly classified as container shipments and bulk shipments. Container shipments represent a majority of goods that are shipped inland by trucks – unlike bulk shipments that usually make use of rail or other means for transport. Container shipment volumes are also expected to increase significantly in the future. Thus, the focus of this project was on container terminals and the associated truck movements at the site.

Figure 1 shows the typical truck movements occurring at a container terminal. The containers are unloaded from the ship or loaded onto the ship by wharf cranes located near the berthing area. Generally, the containers are moved between the berthing location and the container yard using yard trucks (usually referred to as “yard hustlers”), though some ports simply use larger cranes that can directly place containers at the stacking/yard location. It is at the container yard location that the road trucks (i.e., the trucks that move containers to and from the port) pick up or drop off their shipments. The trucks also need to travel through entry and exit check posts at the port location, where the drivers present their paperwork and complete other administrative formalities.

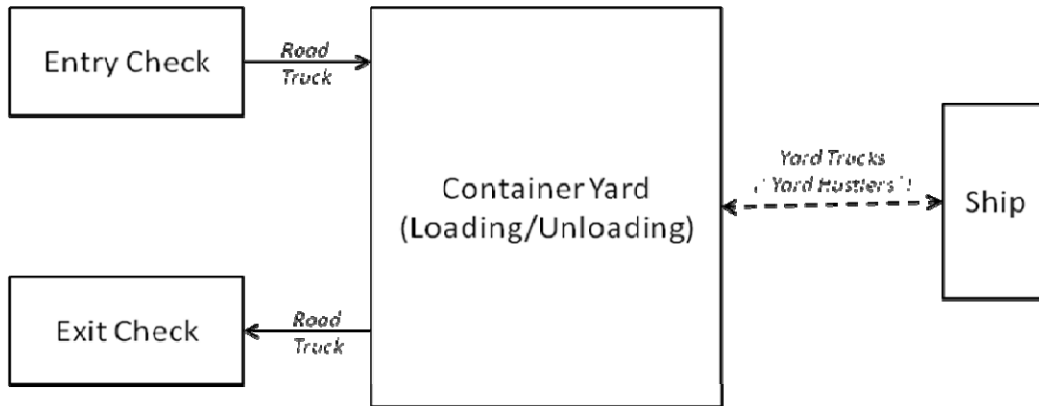


Figure 1. Truck movements at a container terminal.

This research focused only on the road trucks, i.e. those operating to and from the port areas. Among road trucks, there is usually a distinction made between drayage and long-haul trucks.¹ Drayage trucks refer to those that operate within the urban area near the port, while long-haul trucks are those that move the shipments over long distances. This research does not distinguish

¹ Harrison, R. et al. *Characteristics of Drayage Operations at the Port of Houston*. SWUTC Report 08/ 473700-00075-1, September 2008.

between these two types of road trucks, but rather focuses on their idling characteristics at and near the port locations.

Selection of the Port of Houston

The research team considered the following ports as candidate locations for detailed study: Los Angeles-Long Beach, New York-New Jersey, Seattle, and Houston. The port of Los Angeles-Long Beach has a system (PierPass) to reduce the duration of truck activity and idling at the port and was eliminated from consideration. Based on preliminary interviews with port management authorities at other locations, and information regarding container volumes and truck activity, it was concluded that the Port of Houston (POH) had the greatest potential to reduce truck idling.

The POH is a major container facility, with thousands of trucks leaving and entering this port on a daily basis. The two major container terminals at the POH are the Barbour's Cut terminal and the Bayport terminal. The Bayport terminal is a new facility, and was not yet operational when this research was conducted. Thus, the research team focused on the Barbour's Cut terminal.

Description of Barbour's Cut Terminal

The Barbour's Cut terminal is the largest container terminal on the U.S. Gulf Coast. It is located in LaPorte, Texas, and has been operational since the mid 1970s. Approximately 2,500 trucks visit this terminal on a daily basis, and the terminal has a capacity of 23,000 20-foot equivalent units (TEUs).² Figure 2 shows the location and broad layout of the Barbour's Cut terminal. The Barbour's Cut terminal has a total of six berths – two of which are leased to private operators (APM-Maersk Terminal and P&O Terminal), while the remaining are operated by the Port of Houston Authority (POHA). The entry and exit check locations marked on the figure are for the terminals operated by POHA. The privately operated terminals have separate entry and exit checks, and are located as shown in the figure. The APM-Maersk terminal (referred to as the APM Terminal) is the larger of the two privately operated terminals and was also included in site visits and interviews by the research team.

The Barbour's Cut terminal area is accessible from State Highway 146, through Barbour's Cut Boulevard, which is a four-lane divided roadway. There are two truck stops – the Lion King Truck Stop and the Plaza Truck Stop – located near the intersection of Barbour's Cut Boulevard and Highway 146. These truck stops (also indicated in Figure 2) are often patronized by truck drivers on port business, and were surveyed as part of this research.

² *Major Truck Idling Generators in Texas: Extended Idling.(Unpublished Report)*. Draft Report for the Texas Department of Transportation, TTI, August 2008.



Figure 2. Location of Barbour's Cut terminal.

The distance from the intersection of Barbour's Cut Boulevard and Highway 146 to the main entrance of the Lion King Truck Stop is less than half a mile. Truck speed along this stretch of highway was observed to be approximately 25 mph, while the posted speed limit is 35 mph. The distance from the truck stop to the entrance of the POH pre-check facility (shown in Figure 2) is approximately 0.6 miles, and from this point to the entrance of the port is 1.5 miles. At the time of the initial study, the average truck speed on Barbour's Cut Boulevard from the truck stop to the port entrance was only 10-to-15 mph due to the poor pavement condition. Significant congestion was observed due to poor roadway conditions as well as heavy truck traffic, as seen in the photograph in Figure 3. However, observations during a subsequent site visit in early 2009 indicated that the pavement conditions on Barbour's Cut Boulevard had been significantly improved.



Figure 3. Heavy truck traffic and poor pavement conditions along Barbour's Cut Boulevard.

Trucks entering the container terminal area need to undergo entry and exit checks. The terminals operated by POHA and the private terminals have separate entry/exit check points. At the time of initial study, POHA was constructing an entry pre-check facility to help speed up the entry check process, and this pre-check area is now operational. Currently, trucks entering the POHA's terminals need to pass through the pre-check location for an initial screening and paperwork check. The pre-check location has parking spaces for trucks, and is also equipped with an information system that informs drivers about the status of their shipments. Drivers may spend some time at this pre-check location while waiting for final notification regarding their shipments.

After passing through the pre-check, the drivers proceed to the entry inspection station after which they enter the container yard to load and unload shipments. After conducting business at the container yard, the trucks must to travel through an exit check and inspection before leaving the terminal. Figure 4 shows the movement patterns of the trucks entering and exiting the Barbour's Cut facility for the POHA terminals, and Figure 5 is a picture of the truck entry lanes to the new pre-check area.

A feature of the entry check areas at both the POHA and private terminals is the trouble booth (or trouble parking area), which is located after the initial screening booths. Drivers may make use of the trouble booth facilities if the initial screening indicates that the driver has a problem with the drop-off or pick-up. At the terminals operated by POHA, the trouble booth area was initially located at the entry inspection station and was shifted to the new pre-check location after it became operational. At the APM terminal, the area has six truck parking spaces, along with

telephone lines, a fax machine, and printers. From conversations with port authorities and those at the APM terminal, researchers found that drivers would not know that they have a problem until they reach the checkpoint. It was estimated that approximately 5 percent of all trucks visiting the terminal daily encountered problems that required the driver going to the trouble booth.

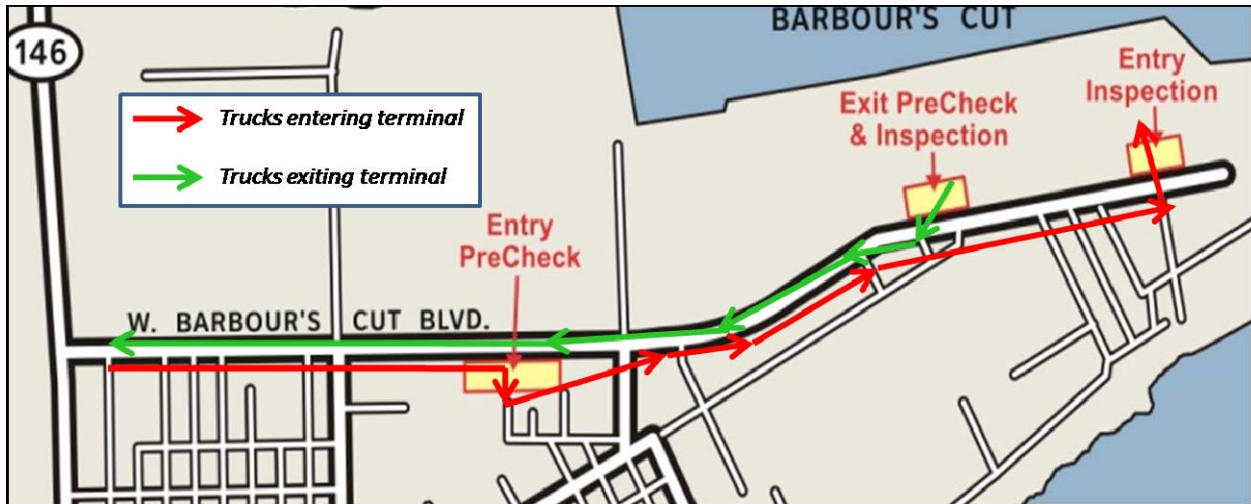


Figure 4. Truck movements to and from terminal area.



Figure 5. View of truck lanes at the new entry pre-check facility.

The following sections of the report discuss the research objectives, the data collection procedures at the Barbour's Cut terminal, research findings, proposed approaches to reduce truck idling, and final conclusions and recommendations.

Research Objectives

The main objectives of this research was to document and attempt to quantify truck idling activity in an around the Barbour's Cut terminal at the POH, with a view of proposing suitable idle reduction technologies that could be implemented to maximize the idle reduction benefits.

Data Collection

The investigation included site visits, discussions with the director of operations and other key port staff, surveys of truck movements in and out of the terminal, interviews of truck drivers and a survey and truck count at the two truck stops near the Barbour's Cut terminal. Each of these is discussed in detail below. Based on the findings from the data collection, the research team was able to identify the types of idling occurring at and near the port.

Site Visit and Interview with Port Authorities

As discussed in the introductory section, researchers visited the APM terminal as well as the terminals operated by POHA. During the site visit, researchers also observed the processing and loading/unloading operations at the main terminal locations. Personal and e-mail interviews were also conducted with the port authorities with the view of identifying the proportion of truck trips that wait in the vicinity of Barbour's Cut for longer than half an hour, the reasons why trucks may wait longer, and where trucks layover at such times.

The normal gate hours at the Barbour' Cut terminal are from 7 a.m. to 6 p.m. on weekdays, and the private terminals follow a similar schedule. Authorities informed the research team that overall, the truck activity was uniform throughout the course of the workweek. The gate hours can be extended (after hours or on weekends) based on requests from individual shippers for particular consignments, but authorities indicated that this was not a normal occurrence.

While some drivers do queue up before the gates open in order to enter and exit the terminal quickly, port authorities and shipping companies were not able to specify the number of truck drivers who choose this method. The port authorities indicated that 70-80 percent of trucks coming to Barbour's Cut are local drivers – they receive notification via their cell phone and usually arrive just in time for their shipment. It was speculated that these drivers would not find it necessary to arrive beforehand and wait near the port areas. The remaining drivers (non-local) probably comprised a bigger proportion of those who spent longer times near the port. The interviews conducted at truck stops (discussed in the following section) attempted to characterize these truck drivers' habits.

In terms of possible sources of idling during the entire container pick-up and drop-off process, the following observations were made: creep idling occurred along Barbour's Cut Boulevard due to congested traffic and waiting in queues. It was observed during the site visit that each truck takes approximately 5 minutes to be processed at the APM Terminal entry. At the time of the visit (about 2 p.m.) there were approximately three in-bound trucks per lane, with a total processing time of 15 minutes. Creep idling occurred while entering, as well as when exiting trucks were being inspected. Another source of idling during the entry and exit process was at the trouble booth locations. As mentioned previously, approximately 5 percent of the trucks entering the terminal require going to the trouble booth area. Drivers often leave their trucks idling at the trouble booth while they attempt to solve the problem. Based on surveys of the truck drivers, researchers found that typical problems that required moving to the trouble booth include having the wrong booking number or missing shipment details. Drivers indicated that the time spent at the trouble booth varies, but was usually is no longer than 15 minutes, except in the case of major problems.

Survey of Truck Stops

At the time of the analysis, there were two truck stops located near the entrance to the terminal – the Lion King Truck Stop and the Plaza Truck Stop. Figure 2 in the introductory section showed the location of these two truck stops, and photographs from the truck stops are shown in Figure 6. In addition to parking spaces for trucks, both truck stop locations have a fuel station, convenience store, and a restaurant attached. In addition, the Plaza location also includes a hotel on site. From interviews with truck drivers, researcher found that nearly 70 percent of trucks using these truck stops were there on port business.³ Some extended idling occurs at these two truck stops, and neither have TSE facilities. The Plaza location had a total of 59 marked truck spaces, while the Lion King location had 50 such spaces, and these were considered to be the capacities of the respective truck stops.

³ EPA Study: *Strategy to Reduce Truck Idling at the Port of Houston*. Presentation to the Port of Houston Authority by TTI and EPA. April 11, 2006.



Figure 6. Photographs from the Lion King and Plaza Truck Stop locations.

Surveys were conducted at each truck stop for a 48-hour period (December 7-9, 2005 – Wednesday to Friday) during which hourly observations of the trucks parked were made. The details collected included: the number of trucks parked, the number of trucks idling, number of trucks with the curtain drawn over the sleeper section [indicating the driver is asleep], and the ambient temperature. Figures 7 and 8 show the graphical results from the idling survey.

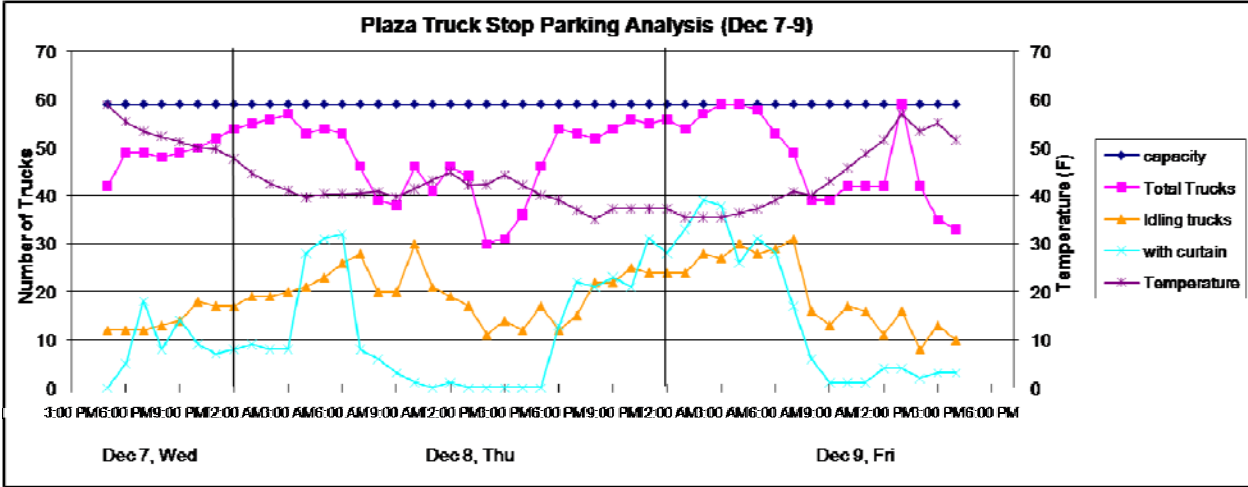


Figure 7. Plaza Truck Stop Parking Analysis.

The survey findings indicate that there was less variation in the number of trucks at the Plaza location when compared to the Lion King location. While there were some instances where the Lion King location was filled beyond capacity (with trucks being parked in unmarked open areas), there were also much larger drops in truck numbers compared to the Plaza location. While the number of trucks at the Plaza location never dropped below 50 percent of total capacity, the truck numbers at the Lion King location dropped to as low as 10 percent of capacity. The Lion King location seemed to have distinctive “peaking” at the early hours of the

day (2 a.m.-6 a.m.) when compared to the Plaza location, which could indicate that the drivers arrive early in the day to rest at this location, while those at the Plaza location may instead arrive the night before.

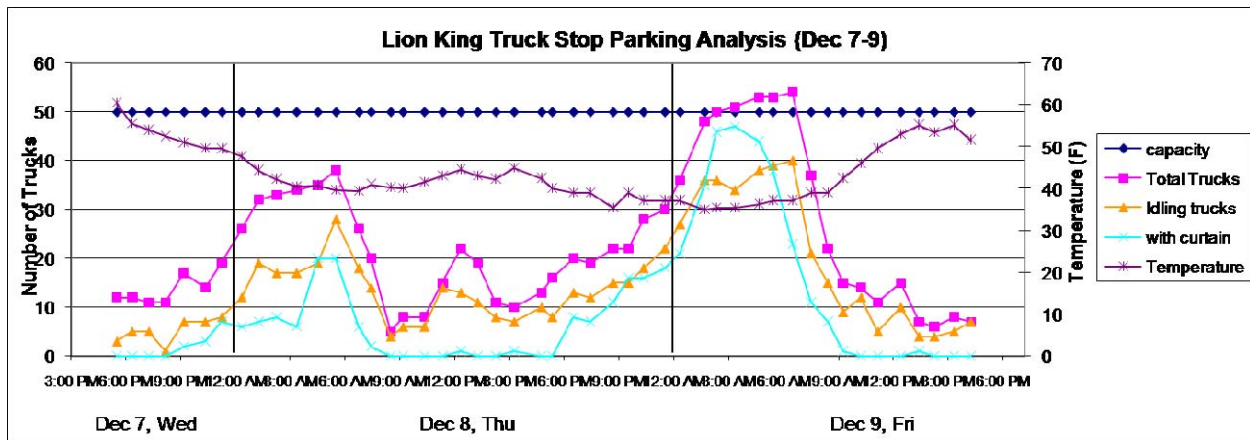


Figure 8. Lion King Truck Stop Parking Analysis.

The graphs for both truck stops indicate a strong correlation between the total number of trucks and the number of trucks idling, and not so much with the temperature – indicating that a fixed proportion of trucks probably idle regardless of the weather conditions. It was noted, however, that the overall proportion of trucks idling was higher at the Lion King location than at the Plaza location – on an average, about 63 percent of the trucks at the Lion King location were found to be idling when compared to an average of about 40 percent at the Plaza location. This could be explained by the Plaza location also having hotel rooms and more amenities available to the drivers. This is also corroborated by the observation that at a maximum, only 68 percent of trucks were observed with the sleeper curtain drawn at the Plaza location, compared to a maximum of up to 92 percent at the Lion King location. This indicates that more drivers might use the Plaza location rooms for overnight stays and thereby idle less and be less inclined to sleep in the truck.

Interviews with Drivers at Truck Stops

In addition to the interviews with the port management and authorities, researchers also conducted interviews with truck drivers at the two truck stop locations. As mentioned previously, approximately 70 percent of drivers at the truck stops indicated that they were on port business. Of these, a majority of the truck drivers (21 out of 38 total responses) visited the truck stop either for overnight stays or for food and refreshments. Other reasons that truck drivers visited the truck stops included waiting for orders, resolving booking issues, or fueling. About 50 percent of the drivers surveyed indicated that they operate within the greater Houston area – and a majority of the other drivers indicated that the picked-up or dropped-off loads within Texas. Approximately 30 percent of the drivers surveyed spent the night at the truck stop. Among the others, the

average time spent at the truck stop was approximately 25 minutes. Approximately half the drivers indicated that they visited the truck stop everyday – it can be inferred that these respondents are probably those who operate within the greater Houston area, who also comprise approximately 50 percent of the total truck drivers surveyed.

Combining the results from the truck driver interviews with the survey at truck stops shows that idling at truck stops does represent a significant source of idling when compared to other sources of truck idling during the port pick-up and drop-off process. At the truck stops, overnight idling is possibly the most significant, as drivers who did not stay overnight stayed only 25 minutes on average. During the interviews with the truck drivers, it was noted that a majority of them had heard about the use of stationary idle reduction technologies in the form of electric hookups at truck stops. However, only a few drivers reported making use of these hookup facilities at other locations.

Findings – Types of Idling in the Vicinity of Barbour’s Cut

Based on the findings from the data collection and interviews, the type of idling at and near port locations was classified by the research team as follows.

Overnight Idling – This form of idling occurs at the truck stops, mostly by drivers who arrive from outside of the greater Houston area. Surveys conducted at truck stops indicated that the percentage of trucks idling seemed unaffected by weather and other conditions, but rather represented a fixed proportion of the total trucks parked at the truck stops. This form of idling could benefit from the implementation of idle reduction technologies.

Ad-Hoc Idling – Ad-hoc idling is idling that occurs place in the container yards, during container loading or unloading, and while awaiting gantry cranes/yard hustlers to move the cargo. Site visits and observations indicated that this form of idling was typically from 25-to-45 minutes depending on time-of-day. Given the unpredictability of ad-hoc idling, implementation of idle reduction technologies may not be of practical applicability.

Creep Idling – Creep idling occurs due to queues formed at the processing booths, resulting trucks to move forward very slowly in line. From site visits, researchers found the queue and gate processing time at the Barbour’s Cut facility varied from 15-to-60 minutes depending on the time of day. This form of idling can be handled more effectively by reducing time in queues rather than implementing idle reduction technologies. At the time of the original study, creep idling was also found to occur due to congestion at Barbour’s Cut Boulevard, leading to slow movement of trucks. However, the follow-up site visit in early 2009 showed that conditions along this roadway had significantly improved.

Idling at Trouble Booth – Approximately 5 percent of trucks entering the port daily are issued a trouble ticket, and are sent to the trouble booth parking area while the driver attempts to resolve

the problem. Typically, drivers were found to spend between 10 minutes and 1 hour in this area, with many leaving the truck idling for that duration. However, note that the parking areas in the trouble lots are small, and may not be suitable for implementing idle reduction technologies. Additionally, drivers using the trouble booth would be primarily concerned with sorting out their shipment problems, and may not take the time to use idle reduction technologies/hook-ups available at the site.

Proposed Approaches for Idle Reduction

In general, there are three approaches that can be used for implementing idle reduction technologies: 1) stationary idle reduction 2) mobile idle reduction 3) combined stationary and mobile idle reduction. TSE is a form of stationary idle reduction, and involves a truck hooking up to full-service units that provide Heating, Ventilation and Air-Conditioning (HVAC), electricity, and other services to the cab area. Auxiliary power units (APUs) are a form of mobile idle reduction technology, in the form of an on-board diesel or battery powered engine used to run a separate HVAC system. The third approach (Shore Power) involves the truck hooking up to an external power source to run an on-board electric powered HVAC system. Idle reduction can also be accomplished through technological and logistical innovations that help reduce truck queuing and optimize truck turnaround time to reduce the need for idling.

Based on the findings from the data collection, the research team developed a set of approaches to enable idle reduction, specific to the Barbour's Cut Terminal. These are discussed in the following sections.

Implementing TSE at Lion King Truck Stop

Both truck stops located close to the entrance to Barbour's Cut were observed to have some levels of extended and overnight idling, and could benefit from the provision of TSE. Though the smaller of the two truck stops the Lion King Truck Stop was found to be a better candidate for implementing TSE. This is due to the greater occurrence of overnight idling at the Lion King location when compared to the Plaza Truck Stop, and greater availability of additional space for expansion at this location.

Implementing TSE at the New Pre Check Area

The new pre-check area at Barbour's Cut was also identified as a possible location for the provision of electrified truck parking spaces. Figure 9 shows the layout of the pre-check area, with the proposed location for additional electrified spaces. Truck drivers often wait in the pre-check area for notification on their shipments since there is an information system available at the pre-check area location. Electrified truck spots can be used by the drivers to prevent idling – however, a further study of the duration and extent to which trucks wait at this location would be desirable before estimating the possible benefits of this.

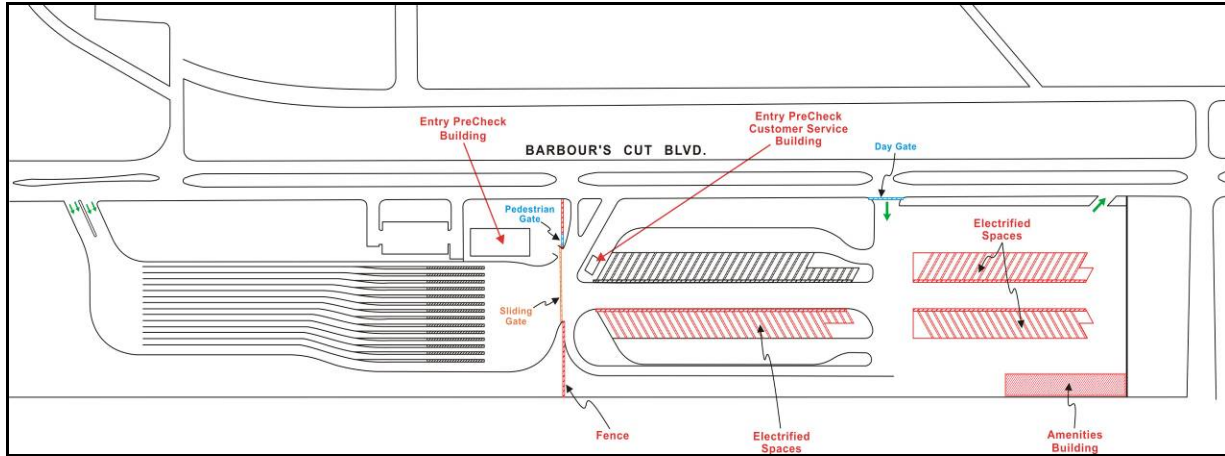


Figure 9. Implementing TSE at Pre Check Area.

Use of APUs

Auxiliary power units (APUs) are a form of mobile idle reduction technology that could be used by trucks as an alternative power source while the driver rests/sleeps or stops for longer durations. While unlike TSE, it is up to the truck owners/operators to install such idle reduction devices. APUs might prove to be a useful strategy for non-local trucks and those that idle overnight at truck stop locations.

Enhanced Information Systems

Currently, the POHA's gate operations use a camera and voice system to record container and chassis numbers to speed up operations. The APM terminals also use similar information systems. POHA is also currently examining options to update the system to an Optical Character Recognition (OCR)-based system that can automatically read and transmit shipment information. Using advanced information systems can help further optimize port operations and reduce the need for truck idling. Additionally, the information systems used at present are between the container terminal areas and the entry check/pre-check locations. Another possible improvement is to extend these information systems to the truck stop locations with a display board that provides shipment notification details. This would enable drivers (especially those who spend longer times at the truck stops) to better plan their arrival at the pre-check and terminal entry locations to minimize time spent idling.

Conclusions and Recommendations

Container shipments generate a significant amount of truck traffic at and near ports. This report provides a detailed overview of truck operations at the Barbour's Cut container terminal facility at the Port of Houston and identifies the possible sources of idling and mitigation strategies. The

study included site visits, interviews, and surveys that enabled the research team to classify the types of idling.

It was found that creep idling, occurring due to queuing and congestion is very difficult to control because the vehicles are almost constantly moving (though at a very low speed). Similarly, ad-hoc idling could not be eliminated as it is random in nature, and not an extended occurrence. While stationary idling also occurred at the trouble booth locations, the provision of idle reduction facilities at this location was thought to be unviable given the small size of the parking areas and the short duration of idling. POHA's pre-check area was also considered as a possible location for the implementation of stationary idle reduction technologies. However, it was concluded that further research was needed to assess the viability of such a provision.

Longer-term stationary idling and overnight idling occurred at the two surveyed truck stops. However, the TTI team found through their research and meetings with the port and EPA officials that implementation of stationary technology (TSE or Shore Power) at these truck stops will result in a duplicate electrified truck stop application (there are two other truck stops with such facilities close to the port) that could be underutilized and unsuccessful. TTI has also already implemented and studied three TSE facilities at other locations under this grant.

The research team also identified other means of reducing idling, including improved operations through advanced information systems and the use of on-board idle reduction devices such as APUs. Based on these findings from the study, the TTI research team concluded that further research is needed to assess the viability of implementing idle reduction technologies at the Barbour's Cut container terminal facility and at other port locations.