CALIFORNIA SUSTAINABLE FREIGHT ACTION PLAN: PILOT PROJECT IDEA

REDUCED EMISSIONS THROUGH EFFICIENT PARKING FOR TRUCKS

Submitted to the California Air Resources Board by Truck Smart Parking Services, Inc.

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1. Name and Contact Information

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2. Title: Reduced Emissions through Efficient Parking for Trucks (REEPT)

3. Project Location

REEPT will locate, initially, on I-5 in California. It will run from south of Los Angeles for 700 miles to the north. Ten locations, where truckers park to satisfy Hours of Service (HOS) regulations, will be instrumented to monitor and report real-time parking availability.

4. Project Summary

Parking-search travel, fatigue-related truck crashes, and intermodal terminal queuing and idling are significant sources of greenhouse gas (GHG) emissions and wasted time and money for the trucking industry and passenger vehicles as well as a major source of frustration for commercial vehicle drivers. A recent survey found that most truck drivers must end their shift early to search for parking in order to meet their HOS requirements. It is common for truckers to spend 30 minutes or more searching for available parking. Research suggests that truck driver fatigue causes about 12% of all injury and fatal truck crashes, and the proximity of truck parking is significantly associated with the frequency of truck crashes (McArthur et al., 2013). Truck idling at intermodal terminals to pick up and drop off containers is a notorious source of high levels of GHG emissions and lost productivity for truckers and the trucking industry. Using publicly available California-specific data, we estimate that, in one year alone, these factors produce over 37 metric tons of GHG emissions, 13 million hours of delay, and $1 billion in yearly costs to California (see the detailed description of calculations below).

REEPT will target these problems and costs through a strategy that builds on existing and proven intelligent transportation technologies and services (ITS), and installs a network that connects locations where trucks park to meet HOS regulations. This network will serve as the backbone for a statewide
service that will optimize commercial vehicle productivity, meet HOS requirements, and reduce GHG emissions. The network will (1) enable delivery of real-time parking availability and reservations, (2) incorporate real-time information with HOS requirements to predict parking location availability for truck drivers and routes, (3) connect to ports and terminals to alert drivers of parking opportunities, and (4) ultimately, provide an optional trip planning service for shippers and truckers using big data analytics.

5. Detailed Project Description

Project Overview

REEPT will provide truckers guaranteed parking, ensure adequate rest, and predict the shortest possible travel times, including routes, departure times, and avoided queuing at terminals. We propose a five-phased deployment plan for the REEPT system, as described in Figure 1 below.

**Figure 1: Real-Time Truck Parking Availability and Information**

Project partners include Truck Smart Parking Services, Inc., HERE (detailed description in text below), Kimley-Horn and Associates, Inc. and eX² Technology (eX²). Kimley-Horn and Associates, Inc. consistently
ranks as one of the nation’s leading design firms by Engineering News-Record, the company has more than 2,500 employees in 70+ offices throughout the United States, including 14 offices in California, providing master planning, transportation engineering, environmental services, and site civil design and engineering. eX2 Technology (eX2) specializes in designing, installing and maintaining robust broadband (fiber and wireless), intelligent transportation and critical infrastructure networks for city, state and federal government entities, consortiums, private companies and public/private partnerships (P3).

What are the truck parking and trip planning challenges?

Commercial vehicle truck travel has grown dramatically over the last decade (5% annually and 60% total truck ton-miles from 2002 to 2013) and is projected to grow at an even faster rate in the future (9% annually and 241% total truck ton-miles from 2013 to 2040) (FHWA, 2015). While passenger vehicle miles traveled (VMT) per capita has leveled off and may decrease in the future, total passenger VMT will grow by about 20% from 2015 to 2040 (ARB, 2015). Moreover, in the foreseeable future, public funding of roadway infrastructure will focus largely on repairing and maintaining existing assets and not expansion. As a result, congestion and travel time delays on highways in major urban areas in California will most often be the rule rather than the exception.

At the same time, modern freight logistics practices (i.e., just-in-time delivery), which are designed to reduce inventory costs and streamline supply chains, have caused significant queuing at parking facilities near large metropolitan areas and terminal gates to time deliveries. Moreover, by law in California, trucks cannot idle or queue for more than 30 minutes outside port terminal gates (Health and Safety Code, Section 40720) and many ports require truckers to schedule arrival appointments or pay a fee for arriving during congested hours. However, the system barely complies with the regulation and waiting times to enter the gates at port terminals can be in excess of two hours.

Truck drivers’ travel is also restricted by HOS regulations, which are designed to reduce driver fatigue and related truck accidents. HOS regulations limit driving hours to a maximum of 11 hours after 10 consecutive hours of duty. Drivers must also take a 30-minute rest break after 8 hours of travel. Truck drivers keep logs of driving, working, resting, and change in duty status. Increased congestion, modern freight logistics, and HOS regulations have not only increased the demand for truck parking, but they have also made advanced planning for truck parking extremely difficult, if not impossible. Figure 2 below summarizes these dynamics.
Figure 2: Trends Driving GHG Emissions and Costs.

What and how significant are the consequences?

Parking-search travel, fatigue-related truck crashes, and terminal queuing and idling are a significant source of GHG emissions as well as wasted time and money for truck drivers and motorists (see Table 1). In total, we estimate that they result in over 37 metric tons of GHG emission, 13 million hours of delay, and $1 billion in costs a year in California. See detailed discussion of cost estimates below.

Table 1: Yearly Estimated GHG, Hours of Delay, and Monetary Costs of Parking-Search Travel, Fatigue-related Truck Crashes, and Terminal Queuing and Idling in California.

<table>
<thead>
<tr>
<th></th>
<th>GHG (metric ton)</th>
<th>Hours Delay</th>
<th>Cost ($ US)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parking-Search Travel</td>
<td>20,382</td>
<td>9,913,289</td>
<td>$664,190,373</td>
</tr>
<tr>
<td>Fatigue related Truck Crashes</td>
<td>2,325</td>
<td>422,529</td>
<td>$303,161,117</td>
</tr>
<tr>
<td>Terminal Queuing and Idling</td>
<td>14,608</td>
<td>3,193,750</td>
<td>$213,981,250</td>
</tr>
<tr>
<td>Total</td>
<td>37,315</td>
<td>13,529,568</td>
<td>$1,181,332,740</td>
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</table>
Parking Search Travel

California has the third worst parking shortage in the US (just behind Hawaii and Rhode Island) with only 55 truck parking spaces per daily 100,000 truck VMT and shortages are most pronounced on the I-5 corridor (FHWA, 2015). Truck drivers must end their shift early, traveling from lot to lot, to find available parking. A survey of nearly 4,000 US truckers found the average truck parking search times as described in Figure 3 below (Wood et al., 2013).

![Figure 3. Average Parking-Search Time for Truckers](image)

**Figure 3. Average Parking-Search Time for Truckers**  
(reproduced from 2013 Safe Truck Parking Survey PowerPoint, October 2013)

Often, parking is available, but truck drivers do not know where it is because they are unfamiliar with parking in the area or past experience leads them to believe that parking will not be available (FHWA, 2012 and FHWA, 2002). One study found that 63% of truck drivers had no knowledge of nearby parking areas (Adams et al., 2009).

Truck parking-search travel unnecessarily contributes to GHG emissions as well as truck operator delay and associated marginal costs\(^1\). Nationally, there are about 400,000 daily truck-parking events and about 11% of these events occur in California\(^2\). Applying the parking-search travel times, from the 2013 Safe Truck Parking Survey to the California events\(^3\), shows that in one day parking-search travel causes as much as 27,000 hours of unproductive truck travel time, at a cost of about two million dollars ($67

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\(^1\) Marginal truck parking costs obtained from the American Transportation Research Institutes' (ATRI) An Analysis of the Operational Cost of Trucking: 2014 Update. Marginal costs per hour in 2013 are $67 (USD) and includes vehicle-based costs (fuel, truck/trailer lease or purchase payments, repair & maintenance, truck insurance premiums, permits and licenses, tires, and tolls) and driver-based costs (wages and benefits).

\(^2\) We assume that California’s share of truck parking events is equivalent to California’s share of total US truck ton-miles, which is 11% according to FAF3 data.

\(^3\) Applied distribution: 5% at 0 minutes, 12% at 15 minutes, 44% at 30 minutes, and 39% at 60 minutes
per hour), and 56 metric tons of GHG emissions\textsuperscript{4} to be released into the atmosphere. Table 1 above shows yearly values.

**Truck Accidents**

As described above, the Federal government enacted HOS regulations to reduce fatigue-related truck accidents. The body of available literature clearly establishes the causal relationship between truck driver fatigue and accidents (Banerjee et al., 2009; FMCSA, 2007; IIHS, 2015; Transport Accident Commission, 1998; New Zealand Ministry of Transport, 2014). It also shows a relationship between truck driver accidents and lack of truck parking facilities (McArthur et al., 2013; Taylor et al., 1999; SRF, 2007). The existing research suggests that about 12% of all injury and fatal truck crashes are caused by truck driver fatigue. When this figure (12%) is applied to California fatal and injury truck crashes in 2013 (CHP, 2013), we estimate about 31 fatal and 625 injury crashes a year due to driver fatigue. A recent study (FMCSA, 2013) estimated the total costs (GHGs, time delay, time cost, and property damage) per truck accident in the US that produced a fatality and/or injury. The study found the following per crash:

- 1,627 hours delay (fatal)
- 596 hours delay (injury)
- 9 metric tons CO\textsubscript{2} (fatal)
- 3 metric tons CO\textsubscript{2} (injury)
- $15,000 property damage (mean for both fatal and injury)
- $39,000 time delay costs (fatal) and
- $15,000 time delay cost (injuries).

These cost values are applied to estimates of California fatigue-related truck crashes in 2013 and the results are included in Table 1.

**Truck Queuing and Idling at Terminal Gates**

Truck idling at terminals to pick up and drop off containers is a notorious source of GHG emissions and lost productivity for truckers and the trucking industry. To quantify and understand the magnitude of these costs, we assume that on a daily basis in California there are over 35,000 trucks (which is the average daily volume of trucks at the Port of Los Angeles) and that each of these trucks idle for 15 minutes, which equates to over 3 million hours of idling and delay a year. We apply the GHG emissions rate (0.0046 metric tons per hour) for heavy-duty truck model year 2012+ at low idle\textsuperscript{5} and find that this produces 14,000 metric tons of GHGs released into the atmosphere a year. Applying the marginal truck operating cost per hour ($67), the yearly cost of time delay is about $214 million.

\textsuperscript{4} Emissions' Rates from EMFAC2014: Vehicle MY 2015+ 2,056 g CO2 per hour (ARB, 2015)

How does this project improve California's competitive edge in freight transportation?

More than $1 billion in yearly costs, from parking-search travel, fatigue-related truck crashes, and terminal queuing and idling, significantly reduce the competitiveness of California ports. Currently, California accommodates some of the highest truck volumes in the US. It also has one of the worst parking shortages and highest roadway congestion levels in the US. Other states in the US (i.e., Kansas, Iowa, Indiana, Kentucky, Michigan, Minnesota, Ohio, and Wisconsin) are already implementing advanced truck parking information dissemination systems. In order to keep freight transportation competitive in California, we need to invest in new technology and services to optimize routing and parking options for trucks to maximize the use of existing resources and minimize truck transportation costs to both the industry and society.

What is the solution?

REEPT will collect and transfer real-time parking availability, real-time traffic, trucker HOS requirement, terminal queuing, and trucker/shipper origin and destination data to the cloud. Real-time parking availability and traffic information will be wirelessly communicated to variable message signs (VMS), websites, and/or smart phone apps. Big data analytics will produce a number of services including parking reservations, predictive parking, predictive traffic, and terminal arrival times. All the data and services integrated by REEPT will provide truckers guaranteed parking to ensure adequate rest AND the shortest possible travel times, including routes, departure times, and avoided queuing at terminals. See Figure 4 below.

![System Integration: Big Data Analytics and Services](image)

**Figure 4: System Integration: Big Data Analytics and Services**
As described above, the proposed pilot project consists of five phases.

**Phase 1: Truck Parking Awareness Service**

Video and magnetic sensory technology installed in 10 parking facilities (rest areas and private facilities) will monitor and detect parking availability. Information will be communicated wirelessly in real-time to variable message signs (VMS), websites, and smart phone apps. The system will be modeled after Michigan’s, which has been successfully implemented and operated by Truck Smart Parking Services for over a year. More than 1,000 parking spaces in Michigan have been accurately monitored using video and magnetic sensors and communicated in real-time to VMS on highways located at least 50 miles before the next three parking facilities. This information allows truck drivers to make informed decisions about when and where to stop for rest. Real-time parking availability information is also available via websites, smart phone apps, dispatchers, and 511 systems.

**Phase 2: Real-Time Traffic Integration**

HERE Traffic will be integrated into the truck parking management system to provide accurate time-saving traffic information to get truckers to their destination faster, safer, and more efficiently. HERE’s traffic data is updated every 60 seconds using information from over 100 sources and billions of GPS probe points gathered every day. Redundant servers ensure continuity of service for complete coverage. Robust testing has proven that HERE traffic meets the strict requirements of automotive-grade quality.

HERE Traffic identifies where, when, and why traffic congestion occurs and delivers up-to-the-minute information about current traffic conditions and incidents that could cause delays. HERE Traffic is available in DAB+, RDS, HD Radio, satellite, connected APIs and TPEG. Key features include:

- Arrival time accuracy and alternative routes,
- Prompts to slow down drivers in anticipation of a quickly building traffic jam ahead,
- Updates of direction of traffic flow on metropolitan reversible express lanes,
- 24/7 testing and monitoring, and
- Congestion start and end-points with 10-meter precision.

Five US state departments of transportation, including California, Michigan, Florida, Montana, and Oklahoma, currently use HERE traffic information.

**Phase 3: Expand to Include Predictive Parking, Reservations, HOS, and Off-the-Grid Availability**

In phase 3, the system will be expanded to predict parking availability up to five hours in advance and make reservations. An advanced parking reservation system is currently under development by Truck Smart Parking Services for deployment near the end of 2015 and will be integrated into Michigan’s truck parking awareness service. Parking availability will be predicted using real-time parking information, average seasonal conditions, and historical parking data flow data. In addition, the system will incorporate an HOS management tool (also under development by Truck Smart Parking Services) that will use predictive parking availability, HERE traffic information, and HOS requirements to continually compute and recommend optimal parking locations. As traffic conditions affect the rate of travel and
ultimately HOS, drivers will be alerted of any change in parking availability and, if necessary, reservation options. In addition, the number of truck parking locations will expand to include "off-the-grid" locations, such as big-box parking lots.

**Phase 4: Connect with Ports and Shippers to Optimize Truck Parking and Minimize Queuing**

Partnerships with ports and shippers in California will be developed to integrate optimal departure and arrival times for truck drivers, allow for HOS parking and rest needs, and minimize queuing at terminals. For example, trucks could be diverted to or delayed at a truck stop and informed of the best time to leave and which route to take to minimize queuing at terminals. This phase will be prototyped using traffic in, out, and around the Port of Richmond, in Contra Costa County, with a specific group of volunteer truckers and trucking companies. Queuing times, parking locations (instrumented with parking availability monitoring equipment in Contra Costa County), and origin and destination locations will be established to demonstrate and evaluate the service. Once proven, it will be offered to other ports.

**Phase 5: Next Generation Trip Planning Integrating Origin and Destination Location Data from Shippers and Truckers with Predictive Traffic, Real-Time Parking Information, and Big Data Analytics.**

In the final phase, the system will expand to include origin and destination locations from shippers and truckers and HERE predictive traffic to recommend optimal departure times and routes to maximize travel distance, meet HOS requirements, and minimize travel time delays. HERE’s predictive traffic uses big data analytics to accurately predict traffic and plan journeys up to 12 hours in advance. It accurately estimates travel time by including real-time traffic, average seasonal conditions, and historical traffic flow data. It offers 100% coverage of every Interstate and freeway in the US and anticipates future traffic conditions by analyzing over one trillion GPS data points. Predictive Traffic will provide the information needed to give truckers the most accurate travel time estimates. Timely information about changing conditions or better route options fosters trust and appreciation with truckers and shippers. Estimated time of arrival accuracy is proven to increase by up to 20%.

**Business Model**

The trucking industry is interested in paying for these advanced services (reservation and optimized route planning). Parking reservations included in this project will subsidize the operation and maintenance costs of the service and associated infrastructure. Truckers currently pay for reservations (from $15 to $50 per night), but there are few facilities that provide reservation options. In a survey of California truck drivers, more than 50% of respondents indicated that they would be willing to pay between $3 and $5 per month for parking availability information (Martin and Shaheen, 2012). Carbon credits could be used to offset some user costs.
6. Estimated Cost

The total cost will be $4.8 million over 3 years to install REEPT at 10 locations; establish the network; provide system enhancements; operate and maintain the system and network for two years after launch; develop and perform third party evaluations; and recruit users through an aggressive public relations and outreach campaign. In addition, REEPT will provide in-kind support of between $1 and 2 million in licensing and labor. Additional data services defined and developed during years two and three will support operational expenses. The trucking industry has a reputation for being first to deploy advanced technologies and services that improve its bottom line. The suite of services outlined in this proposal is expected to improve the bottom line of trucking companies and improve trip quality for drivers. As these groups evaluate the services, they will be early adopters of some of the fee-based services included in REEPT. Other sources of funding could include the federal agencies that currently fund related truck facility operational activities.

7. Timeline

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<tr>
<th>TIMELINE</th>
<th>FY 2016</th>
<th>FY 2017</th>
<th>FY 2018</th>
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<tr>
<td></td>
<td>1Q</td>
<td>2Q</td>
<td>3Q</td>
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<tr>
<td>Task 1 Project Schedule</td>
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<tr>
<td>Task 2 Stakeholder Coordination</td>
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<tr>
<td>Task 3 Method of Evaluation</td>
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<td>Task 4 Instrumentation &amp; Hardware/Software Testing</td>
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<td>Task 5 Before Data Collection</td>
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<td>Task 6 System Launch</td>
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<td>Task 7 Expand Deployment Geographically and Functionally</td>
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<td>Task 8 After Data Collection</td>
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<td>Task 9 Final Evaluation</td>
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The project will have a three-year timeline. Task 1 includes planning for the deployment of all project phases and software modification. Task 2 includes stakeholder outreach to secure public and private truck parking facilities and non-traditional additional locations (such as big-box parking lots) along the selected project route. Intermodal terminals and commercial vehicle operators will be recruited to participate in the project. Systems for obtaining needed information from intermodal terminals and commercial vehicles will be established and integrated into the software and tested over time. In task 3, Institute of Transportation Studies researchers at University of California (UC Davis) will develop an evaluation framework to measure progress toward pilot goals. Task 4 is instrumentation and testing of the parking availability equipment in the parking facilities. In task 6, the project will be launched in the
initial location (700 miles on I-5 from south of Los Angeles running north) and, in task 7, deployment will be expanded geographically and functionally. Data will be collected before (task 5) and after (task 8) deployment. Task 9 includes the detailed evaluation of the project.

8. Measuring Progress

ITS-UC Davis researchers will evaluate progress toward meeting REEPT goals over time. This will include an analysis of a sample of instrumented freight vehicles before and after the implementation of the project. The data will (1) identify travel patterns of the operators; (2) quantify the activity associated with the parking-search and idling at intermodal terminals; and (3) estimate the direct benefits from the implementation of the system. Moreover, the before implementation surveys will be designed to include stated preference questions that can be validated after implementation. Using both stated and revealed preference information, researchers will evaluate expected project outcome based on pre-established performance metrics, and monitor the systems effectiveness throughout implementation.

The evaluation plan will also include impacts related to the freight carriers (e.g., productivity, safety, operational costs, parking costs), communities (e.g., air pollutants, safety), freight receivers or shippers (e.g., reliability, productivity), and public sector (e.g., direct, indirect and launching costs). The assessment of the impacts will include both quantitative and qualitative measures based on the data previously discussed and the information gathered through a continuous stakeholder engagement process.

9. Potential Roles of Interagency Partners

The proposed project needs government funding for initial installation and operations. The level of funding could be reduced by support from interagency partners to assist with outreach and the marketing of system availability. REEPT will become the foundation for other services that generate revenues. Signs on any government facilities will be the responsibility of the agency to acquire and install. REEPT will provide connectivity and data feeds.

Randy Iwasaki has agreed to serve as an unpaid executive advisor to this project. He currently serves as the Executive Director, Contra Costa Transportation Authority. Mr. Iwasaki is a nationally recognized transportation and ITS expert. He is the Chair of USDOT’s National Freight Advisory Committee, former Director of CALTRANS, and a member of the board or directors of ITS America and the ITS World Congress. His expertise will bring depth of knowledge and direction to the proposed project. He will advise on outreach to the local government communities and assist with public relations in the phase 5 prototype. As the state looks to the integration of V2I expansion to include commercial vehicles, this pilot could be the first commercial V2I deployment in the nation and could connect to the Go Momentum project in Contra Costa County. Incidentally, the FWHA is expected to announce funding for a connected vehicle pilot to focus on commercial vehicle applications.
References


To Whom It May Concern:

Truck Smart Parking Services, Inc. (TSPS) has been supplying Intelligent Transportation Systems (ITS) services to the Michigan Department of Transportation (MDOT) for over three years, delivering real time truck parking availability information to the trucking industry. During that time frame, TSPS has been integral in the successful development and deployment of a real-time truck parking information and management system (TPIMS) along I-94 in southwest Michigan.

Since September 2014, TSPS has been responsible for operating data collection, processing, and distribution services for 15 public and private truck parking facilities. During that period, approximately 35 million trucks have had the opportunity to access the real-time information provided by the system via roadside signs, websites, and smart phone applications to make well-informed parking decisions. In general, the system has been well received by the trucking industry and MDOT is pleased with the service TSPS provides.

If additional information on the project is of interest, please contact either me or Collin Castle, Connected Vehicle Specialist, at 517-636-0715.

Sincerely,

[Signature]

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November 29, 2015

To Whom It May Concern,

I am pleased to write a letter of support for the Reduced Emissions through Efficient Parking for Trucks (REEPT). The proposed pilot would address a significant source of greenhouse gas (GHG) emissions (from parking-search travel, fatigue related truck crashes, and port and terminal queuing and idling). The odds of successful implementation are high; the project integrates proven ITS technologies, data sources, and services. REEPT should produce clear benefits to both the trucking industry and the public. The same services that reduce GHG emissions and fatigue related crashes will also significantly reduce truck-operating costs. In sum, the proposed project has a high likelihood of near term success and benefits at a relatively low cost.

Please do not hesitate to contact me with any questions that you might have about this project.

Sincerely,

[Signature]

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