THE UNIVERSITY OF TEXAS AT AUSTIN
CENTER FOR TRANSPORTATION RESEARCH

**PRODUCT 0-6817-P3**
TxDOT PROJECT NUMBER 0-6817

# Case Study Guidelines

Kevin Savage
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Michael Murphy
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August 2016; Published March 2017

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*TxDOT Project 0-6817: Review and Evaluation of Current Cross Vehicle Weights and Axle Load Limits*

**AUGUST 2016; PUBLISHED MARCH 2017**



| **Performing Organization:** | **Sponsoring Organization:** |
|---|---|
| Center for Transportation Research<br>The University of Texas at Austin<br>1616 Guadalupe, Suite 4.202<br>Austin, Texas 78701 | Texas Department of Transportation<br>Research and Technology Implementation Office<br>P.O. Box 5080<br>Austin, Texas 78763-5080 |
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# 1 Introduction

In TxDOT project 0-6817, *Review and Evaluation of Current Gross Vehicle Weights and Axle Load Limits*, the project team reviewed the estimated costs imposed by use of overweight (OW) vehicles and ways to allocate costs to different vehicle classes. Additionally, cost recovery structures were explored for the possibility of generating additional revenue to fund pavement repairs needed due to accelerated consumption by OW vehicles. The different cost recovery methods studied included the following:

- State fuel taxes;
- Truck registration fees;
- Truck sales taxes;
- Truck tire sales taxes;
- OW truck permit fees;
- Weight-miles and vehicle-miles traveled (VMT) fees; and
- Corridor truck fees.

The research team studied the cost recovery methods identified and then selected a recommended set of methods for use on a specific Texas freight corridor; this document reports the findings as follows. Chapter 2 identifies the Texas corridor selected for implementation of the corridor truck fee. Chapter 3 explores the existing cost recovery methods in use in Texas and other innovative and technological methods in use around the world. This chapter also identifies the positives and negatives of potential implementation or extensions of each method. Chapter 4 selects a preferred cost recovery method and identifies agency costs to be included in the fee structure. Chapter 5 summarizes the researchers' exploration of the potential implementation of OW vehicle cost recovery methods on a specific freight corridor in Texas.

## 2 Selection of Preferred Corridor

The research team collaborated with state officials and industry experts in its selection of a preferred freight corridor for developing guidelines for the OW cost recovery implementation. The corridor selected includes the following segments:

- State Highway (SH) 146 from W. Barbours Cut Boulevard in La Porte, Harris County to Fitzgerald Road in Mont Belvieu, Chambers County (17.5 miles);
- SH Spur 330 from interchange with SH 146 to W. Baker Road in Baytown, Harris County (2.3 miles).

The corridor under study is highlighted in yellow in Figure 1.

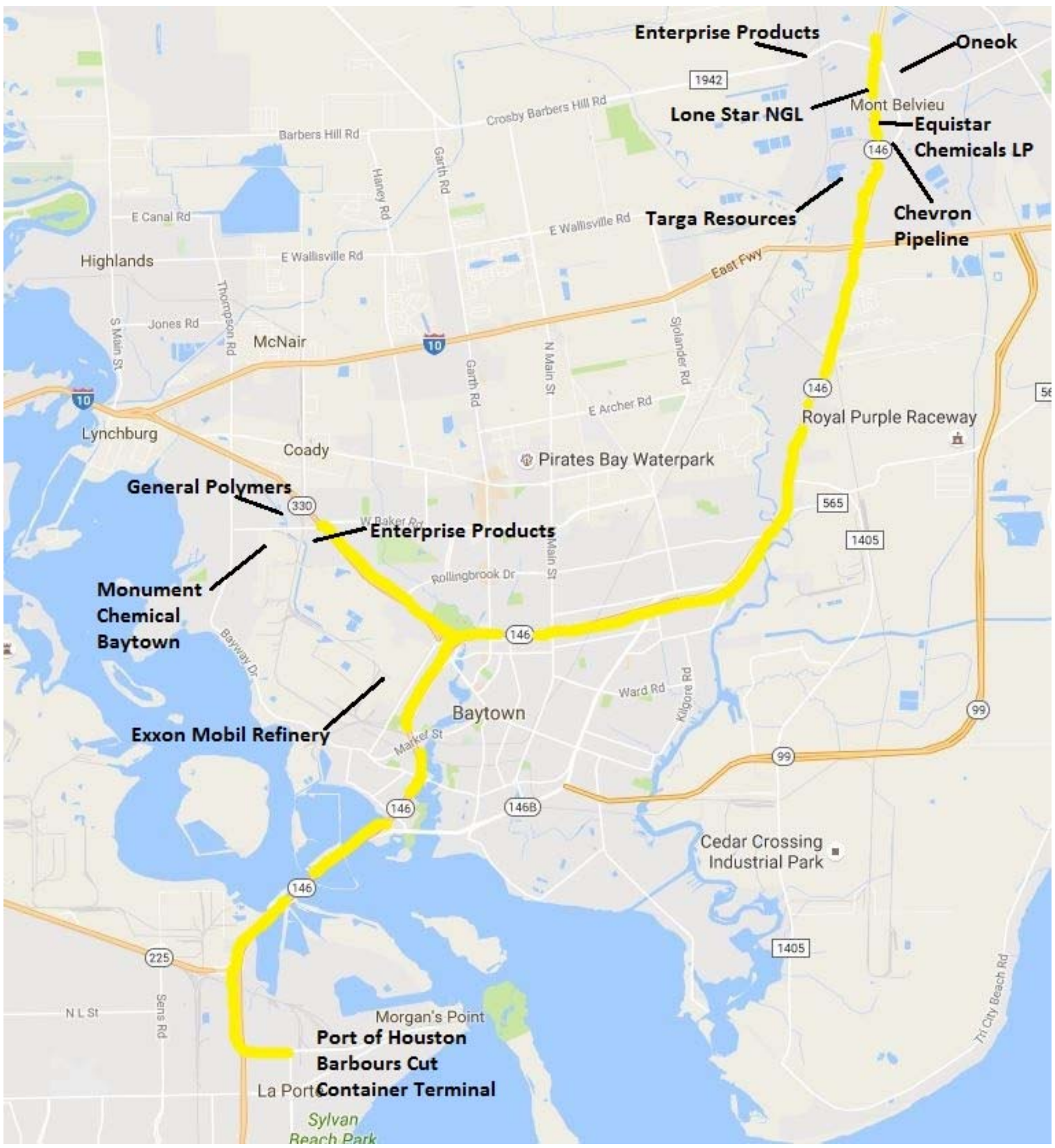


**Figure 1. SH 146/Spur 330 Proposed OW Corridor (Google, Inc., 2016).**

There are many industrial facilities along the length of the corridor (indicated in Figure 1), including petrochemical plants, pelletized resin manufacturing facilities, and heavy oil field operations, which rely on imports and exports from the Port of Houston Barbours Cut Container Terminal, the beginning/end of the proposed corridor. The SH-146 segment of this specific corridor has been deemed by the Texas Trucking Association's Intermodal Committee as a preferred corridor for implementation of proposed House Bill 3061. This bill (text included in Appendix A) proposes an OW corridor for ocean cargo container truck shipments weighing up to 97,000 lbs gross vehicle weight (GVW).

A majority of the corridor is paved with Portland cement concrete. Two short segments of the corridor on SH 146 north of the interchange with Spur 330 have been repaved with asphalt. There is currently an active Federal Highway Administration (FHWA) Long-Term Pavement Performance (LTPP) test section located on southbound SH 146 at the intersection with Shell Road in Baytown, 2.2 miles south of the interchange between SH 146 and Interstate Highway (IH) 10. The test section (48-3010) consists of the following pavement layers (LTPP InfoPave, 2016):

- 12.5 in. thick Portland cement concrete layer;
- 7.3 in. thick bound (treated) base layer of cement aggregate mixture;
- 7.1 in. thick bound (treated) subbase layer of lime-treated soil; and
- Subgrade (untreated) of fine-grain soils: lean inorganic clay.

The LTPP InfoPave database also included monitored and estimated annual average daily truck traffic (AADTT) for this test section location (Figure 2). In both 2014 and 2015, the monitored AADTT was 773 and 763, respectively. These counts consider only southbound truck traffic since the section is located on the southbound lanes of SH 146.

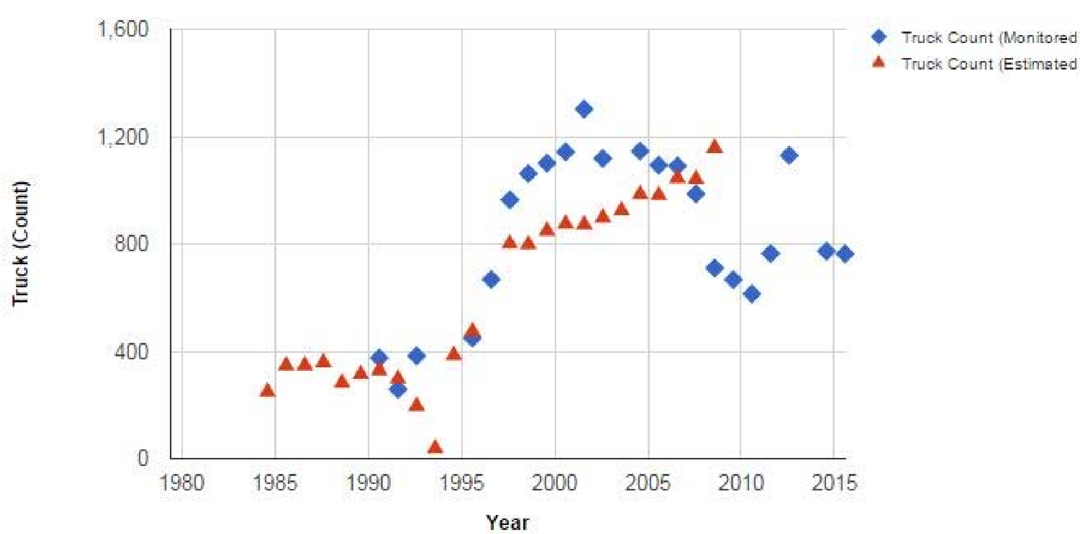


**Figure 2. AADTT for SH 146 SB LTPP Test Section 48-3010 (LTPP InfoPave, 2016).**

The TxDOT Transportation Data Management System (TDMS) also has a number of count locations along the proposed corridor. These counts may identify the number and percentage (of AADTT) of business/commercial vehicles traveling the route. These vehicles are identified as

FHWA Class 4 and above, including buses and single unit trucks as well as larger tractor-trailers. The following two-way truck counts (locations noted in Figure 3) were extracted for the year 2014 for the proposed corridor (TxDOT, 2016):

- SH 146 north of interchange with SH 225 (Location ID: MS107) – 10,335;
- SH 146 north of interchange with Spur 330 (Location ID: 102H166) – 2,498;
- Spur 330 north of interchange with SH 146 (Location ID: 102H167) – 4,849; and
- SH 146 in vicinity of LTPP Test Section (Location ID: S508) – 2,873.

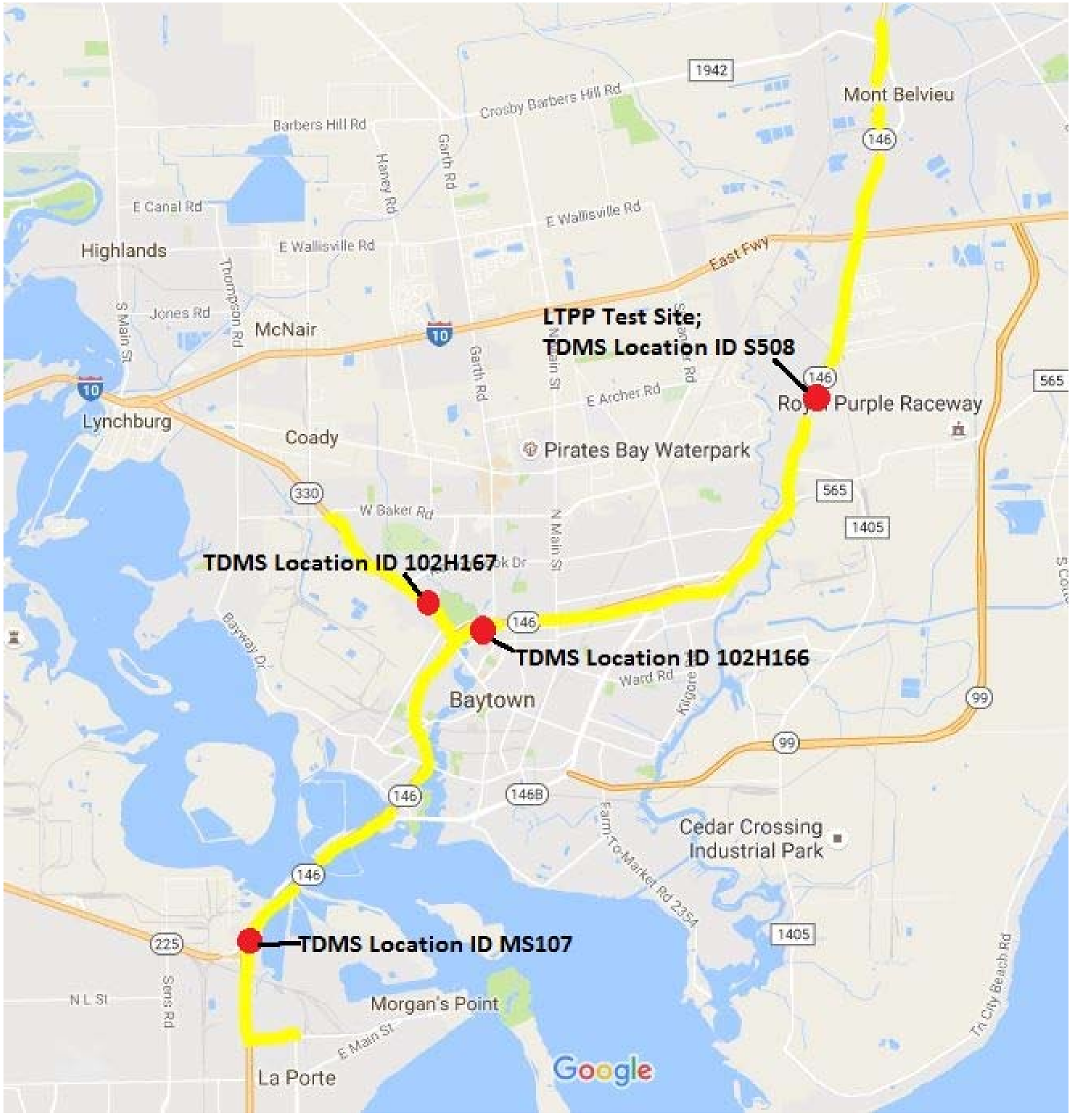


**Figure 3. LTPP Test Site and TDMS Traffic Count Locations.**

According to the Transportation Planning and Programming Division's Online Planning Map (Figure 4), SH 146 and Spur 330 are considered part of the TxDOT Secondary Freight Network. SH 225 intersects SH 146 just north of Barbours Cut Terminal and is designated as part of the TxDOT Primary Freight Network.

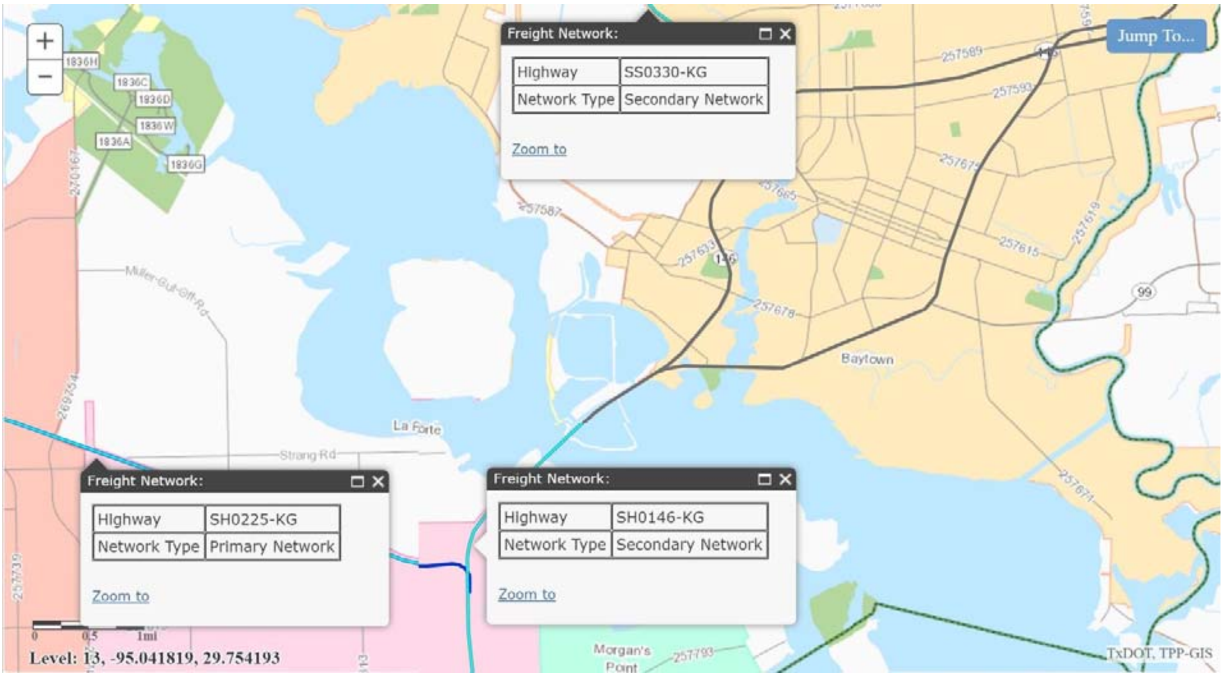


**Figure 4. Transportation Planning and Programming Division – TxDOT Freight Route Designations – SH 146 and SH 225.**

The corridor proposed for this study has been selected to end at specific industrial facilities or nearby locations so that these industries are able to move OW containers to/from the Port of Houston Barbours Cut Container Terminal. In practice, the corridor could be extended further along SH 146 to include trucks traveling southbound from the Barbours Cut Terminal or those traveling further northbound towards US 90. Additionally, SH 225 extending from IH 610 to SH 146, portions of IH 610, and portions of IH 10 within Harris County could be included in the planned corridor network to increase the amount of OW truck shipments that are permitted by the implementation of this OW corridor.

While the corridor evaluated in this study is of high value because it serves the important Port of Houston Barbours Cut Container Terminal and local industry in Harris County, our evaluation considers only local truck freight movements. It is suggested that future studies could evaluate regional and statewide container freight movements.

# 3 Review of Cost Recovery Methods

This section reviews the following OW vehicle cost recovery methods identified during the course of this project for recovering the costs associated with the consumption of pavement and bridges, damage to infrastructure, and other impacts:

- State fuel taxes;
- Truck registration fees;
- Truck sales taxes;
- Truck tire sales taxes;
- OW truck permit fees;
- Weight-miles and VMT fees; and
- Corridor truck fees.

The cost recovery methods are further studied to determine if implementation or further increase of the technique on a freight corridor could be used to target OW vehicles.

## 3.1 State Fuel Taxes

The state of Texas fuel tax is currently set at 20¢ per gallon of gasoline or diesel fuel. The federal tax, paid in addition to the state fuel tax, is 18.4¢ per gallon of gasoline fuel and 24.4¢ per gallon of diesel fuel. The difference in federal gasoline and diesel fuel tax rates is partially due to the increased pavement and bridge consumption of trucks that primarily use diesel fuel (Conway & Walton, 2009). Additionally, it is anticipated that diesel-operated trucks will consume higher volumes of fuel due to lower gas mileage and will pay slightly more in fuel taxes than trucks operating at the maximum legal load of 80,000 lbs GVW. However, these fuel tax rates are not equitably tied to pavement and bridge consumption (Prozzi, et al., 2012). In Texas, diesel fuel taxes are paid by the commercial distributor (gas station operator) at the bulk terminal at the time of purchase, but ultimately the truck operator pays the cost of the diesel fuel tax at the pump.

Intra-county bridge density is another important consideration to determine the most equitable relationship between truck infrastructure consumption rates and tax revenue. Based on studies conducted through TxDOT Project 0-6820, *A Process for Designating and Managing Overweight Truck Routes in Coastal Port Regions*, and the Truck Configuration Library developed for the TxDOT State Legislative Affairs Section, bridge consumption rates vary significantly from county to county due to numbers of bridges expressed in terms of bridge density or bridges per mile of roadway. Harris County has among the highest bridge consumption cost rates in the state due to its high bridge density (Prozzi, et al., 2012).

Only seven states have a cheaper diesel fuel tax than Texas (Figure 5), with Pennsylvania taxing at the highest rate of 65.1¢ per gallon. The Texas fuel tax has remained unchanged since October 1991, while the federal tax rate has not been altered since October 1997 (FHWA, 2013).

OW trucks would generate additional fuel tax revenue due to the increased fuel consumption required to carry the load; however, the increased consumption rate would be related to a number of factors not directly associated with the truck weight and resulting pavement or bridge consumption. Driver operating behaviors, truck age, and maintenance condition—including proper tire inflation pressure, the average driving speed, terrain conditions, pavement smoothness, and other factors—all contribute to the amount of fuel burned and the amount of fuel tax paid. Thus, although fuel taxes are historically the primary method by which TxDOT receives revenue for roadway maintenance, fuel taxes are not an equitable means for recovering costs due to OW truck operations. Additionally, it would be very difficult to identify and toll or tax OW truck traffic on a specific corridor using an increase in fuel tax.

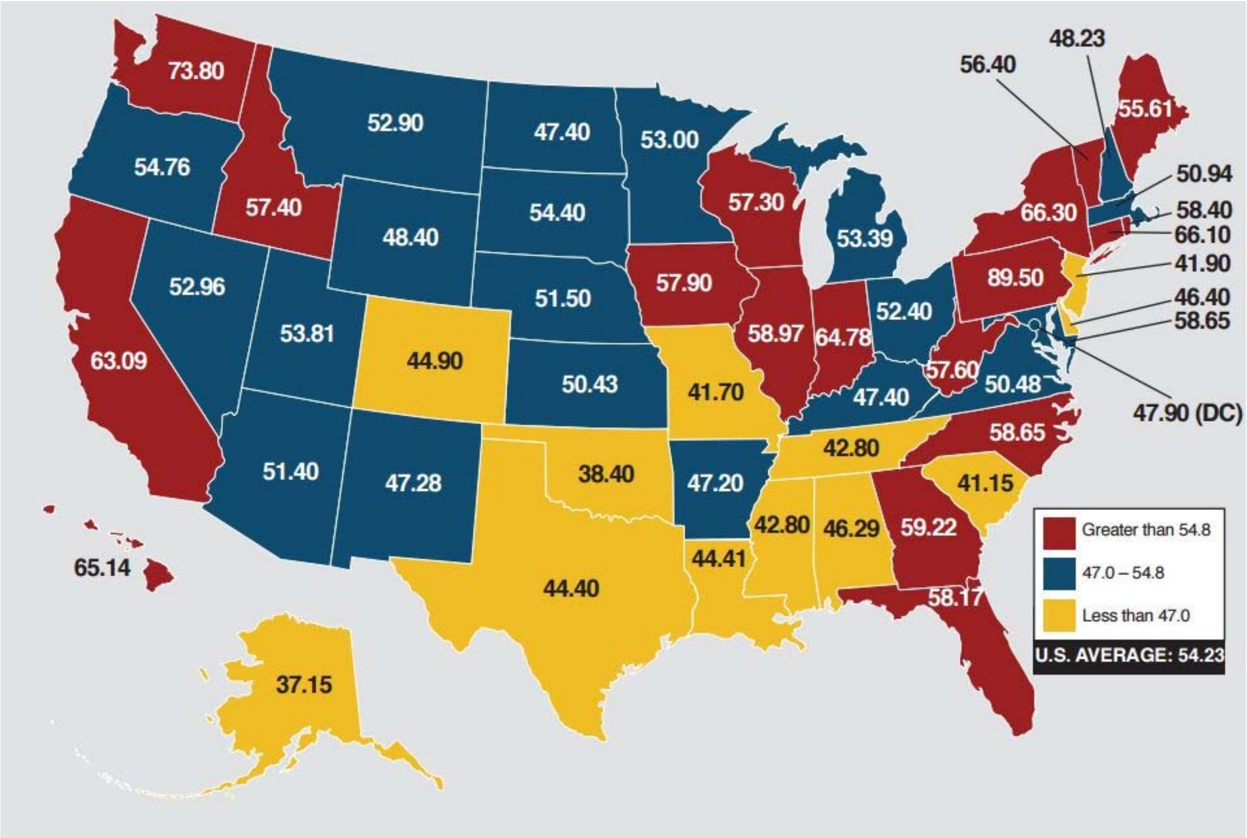


**Figure 5. State Diesel Fuel Tax Rates (including Federal and Local Taxes) as of July 1, 2016 (American Petroleum Institute (API), 2016).**

In Texas, 75% of state motor fuel tax revenue is paid to Highway Fund 6 and 25% is paid to the school fund. Some of the motor fuel tax receipts have even been diverted from these two funds to pay for other state expenditures (Texas Legislative Budget Board Staff, 2011). Therefore, an increase in the state fuel tax may not result in all of the additional revenue being paid directly to Highway Fund 6 for infrastructure maintenance, repair and rehabilitation.

The authors realize that newer truck engines are more efficient and that new trucks can achieve 6 miles per gallon (mpg) or higher in some cases. However, there is a mixed fleet of trucks operating in Texas that range in age from new (2016 models) to older trucks that are one, two, or even three decades old. Thus, the actual fuel efficiency achieved for a given truck in the 'Texas truck fleet' would vary due to technology, truck and engine age, and other factors; 5 mpg is considered a reasonable average value.

Assuming that an 80,000 lb GVW tractor trailer achieves 5 mpg and travels 100,000 miles per year, a total of 20,000 gallons of diesel fuel would need to be purchased, based on this calculation:

20,000 gallons x $0.20 per gallon = $4,000 x 75% of state fuel tax that accrues to TxDOT = $3,000 in annual state sales tax paid.

We can further calculate that dividing $3,000 by 100,000 VMT yields a figure of $0.03/VMT in revenue paid to TxDOT.

### 3.2 Truck Registration Fees

Truck registration fees are an annual payment required for trucks to legally operate. The annual registration fee for a combination tractor-trailer in the state of Texas operating at a GVW of 70,001 to 80,000 lbs is $840, well below the national average of $1,338 (Texas Department of Motor Vehicles, 2016). This fee is another revenue source that could potentially provide funding to TxDOT for pavement damage by OW vehicles. However, it will be very difficult to specifically target OW vehicles at the time of registration fee payment, as truckers and operating companies may not know how heavy their loads may be throughout the year. It is even more difficult to identify OW vehicles operating on a specific corridor within the state. A truck operating 100,000 VMT per year would pay approximately $0.008/VMT ($840/100,000), which accrues to TxDOT through Highway Fund 6. Considering the estimated state fuel tax paid as calculated in Section 3.1, state fuel sales tax and registration fees combine to provide a revenue of about $0.04/VMT to TxDOT.

### 3.3 Truck Sales Tax

Trucks pay both state and federal sales taxes at the time of purchase. The federal truck and trailer sales tax of 12% is required for trucks over 33,000 lbs GVW and trailers over 26,000 lbs GVW (loaded capacity). The state of Texas motor vehicle sales tax is 6.25% of the standard present value of the vehicle. As with previous cost recovery methods, it would be very difficult to target OW trucks, especially those operating on a specific freight corridor, at the time of purchase. Since this is a one-time fee applied at the point of purchase, but some trucks may have a much longer service life than others, this fee can be viewed as inequitable. An increase in this fee may also result in larger fleet carriers deciding to purchase their commercial vehicles in a nearby state with a lower sales tax.

Trucks purchased in a different jurisdiction (state or country) could potentially be operating with OW loads on Texas roadways. These trucks will not have been subjected to Texas sales taxes.

### 3.4 Truck Tire Sales Tax

Truck tire sales tax is another cost recovery method available. Truck tires are subjected to a federal tire sales tax of 9.45¢ for every 10 lbs of maximum rated load capacity over 3,500 lbs. Several states charge a small recycling or environmental fee on the purchase of new tires. These state fees are not intended to generate revenue but more often fund a recycling, remediation, or cleanup program.

Since OW trucks may need additional tires or may replace tires more often than trucks operating at the legal limit, this cost recovery method could potentially more accurately identify OW vehicles. However, there is not a straightforward relationship between truck operating weights and the number of tires purchased. It may be difficult to identify which trucks or tires will carry OW loads at the time of purchase. Furthermore, since relatively few states charge a fee on truck tire sales, truckers or fleet operators could purchase tires in a nearby state if the tire tax is too high in any one particular state.

The tire load rating may be higher for an OW truck than for a legally loaded truck. As the truck tire load rating increases, the amount of federal tire sales tax would increase. An additional consideration is that a truck operator may choose to buy dual tires or single wide-base tires for the tractor or trailer(s) being operated. It is important to note that if a truck operator owns different types of trailers to transport OW loads, the number and load rating of the tires might increase for each trailer used, though only one truck tractor is used. For example, a truck operator might own the following tractor and trailers as shown in Tables 1 and 2.

**Table 1. Estimated Federal Tax for Tractor Truck Tires (Duals or Single Wide-Base)**

| Tire position | Tire Size | Load Range | Load Rating | Federal Tax Per Tire | Number of tires | Federal tax |
|---|---|---|---|---|---|---|
| **Steer axle** | 315/80R22.5 | L | 10,000 | $61.43 | 2 | $122.85 |
| **Tractor Tandem Drive Axle (dual tires)** | 11R22.5 | G | 5,840 (dual) | $22.11 | 8 | $176.90 |
| | | | | Total Federal Sales Tax 10 tires on tractor | | **$299.75** |
| **Tandem Drive Axle (single wide base tires)** | 315/80R22.5 | L | 9090 (single) | $52.83 | 4 | $105.65 |
| | | | | Total Federal Sales Tax 6 tires on tractor | | **$228.50** |

**Table 2. Estimated Federal Tax for Trailer Tires (Duals or Single Wide-Base)**

| Trailers | Tire Size | Load Range | Load Rating | Federal Tax Per Tire | Number of tires | Federal tax |
|---|---|---|---|---|---|---|
| Container Chassis tandem axle - duals | 11R22.5 | G | 5,840 (dual) | $22.11 | 8 | $176.90 |
| Container Chassis tridem axle - duals | 11R22.5 | G | 5,840 (dual) | $22.11 | 12 | $265.36 |
| Container Chassis tridem axle singles | 385/65R22.5 | J | 9920 (single) | $60.67 | 6 | $364.01 |
| Container Chassis quad axle singles | 385/65R22.5 | J | 9920 (single) | $60.67 | 8 | $485.35 |
| Heavy Oil Field Roll Off - tandem axles | 11R22.5 (16) | H | 6,395 (dual) | $27.36 | 8 | $218.86 |
| Heavy Oil Field Roll Off - split tandem axles | 385/65R22.5 | J | 9920 (single) | $60.67 | 6 | $364.01 |
| Box van - tandem axles | 11R22.5 (16) | H | 6,395 (dual) | $27.36 | 8 | $218.86 |
| Flat Bed - Split tandem | 385/65R22.5 | J | 9920 (single) | $60.67 | 6 | $364.01 |

Thus, as an example, the total federal tire tax a truck owner would pay for a truck tractor with dual tires, tandem axles, and four trailers (container chassis tandem axle duals, container chassis tridem axle singles, heavy oil field roll off unit with split tandem axles, and a flat bed with split tandem axles) would be $1,568.78.

Assuming that a trucker could achieve 150,000 miles for steer tires and 350,000 miles for drive axle tires, four sets of truck steer tires and two sets of truck drive tires would need to be purchased in the first 500,000 miles of operation.

Truck trailer tires last longer because they are free rolling and different trailers may be operated depending on the load types that the truck transports. Tread depths for trailer tires are shallower and the expected annual mileage is lower if more than one trailer is owned. For purposes of this estimate, one set of trailer tires will be adequate for 500,000 miles of tractor operation considering that the four trailers would be operated for 125,000 miles each.

Thus, for 500,000 miles of operation or 500,000 VMT, the federal truck tractor tire sales tax paid would be

(4 x \$299.75) + (2 x \$176.90) + (2 x \$364.04) + (2 x \$364.04) + (2 x \$364.04) = \$3,737.04.

The \$/VMT rate for federal tire sales tax (excluding the fact that some life tire would remain when 500,000 miles was achieved) = \$3,737.04/500,000 VMT = \$0.007/VMT.

### 3.5 OW Truck Permit Fees

OW trucks have traditionally been targeted through OW truck permit fees. The current fee structure for general single-trip permits in the state of Texas is as follows (Texas Department of Motor Vehicles, 2016):

- 80,000–120,000 lbs GVW: \$210
- 120,001–160,000 lbs GVW: \$285
- 160,001–200,000 lbs GVW: \$360
- 200,001 lbs or greater GVW: \$435

Vehicles over 200,000 lbs GVW are additionally subjected to a vehicle supervision fee. A super heavy single-trip permit is required for vehicles exceeding 254,300 lbs GVW. However, despite these fees specifically targeting OW truck operations, the current permit fee rates are only 20–25% of the total costs necessary to fully recover the accelerated pavement structure consumption costs, as determined by the Rider 36 study (Prozzi, et al., 2012).

The state of Texas is unique among its peer states regarding the structure of OW single-trip permit fees. OW trucks are grouped into weight classes, with all trucks falling into one weight class paying the same fee. Under this fee structure, a truck weighing just over 80,000 lbs will pay the same permit fee as a truck weighing 120,000 lbs, despite the latter truck potentially consuming many more pavement and bridge resources. A map showing the geographic distribution of OW single-trip permit fee structures in the United States is presented in Figure 6.

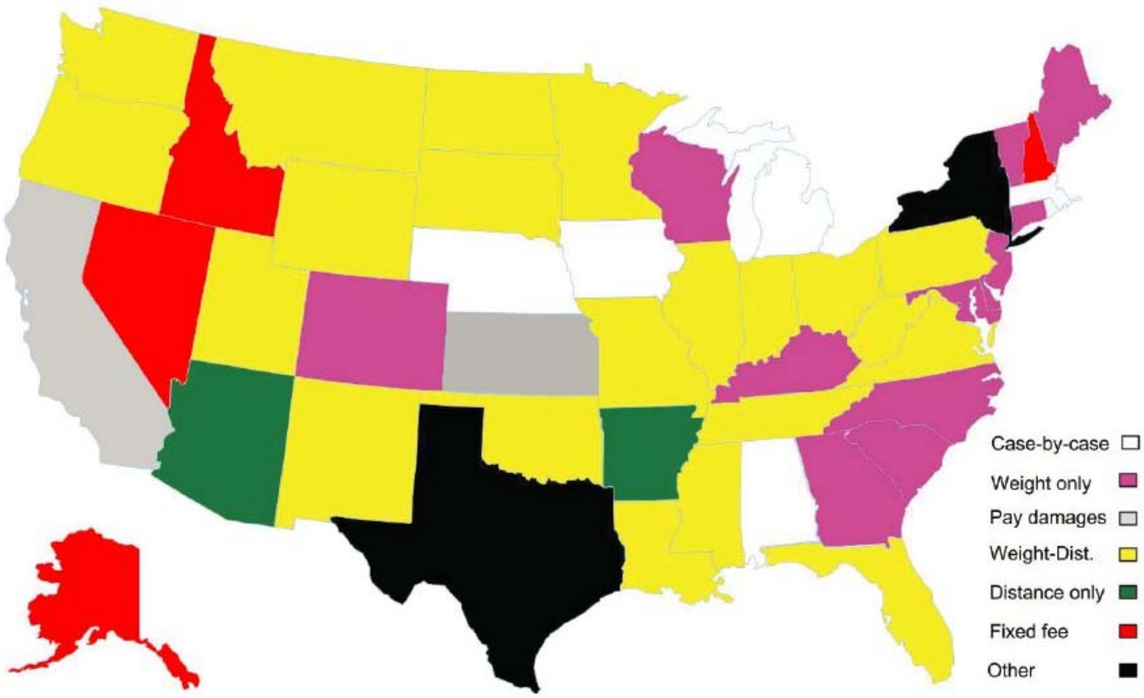


**Figure 6. Geographic Distribution of OW Single-Trip Permit Fee Structures in the United States (NCHRP, 2015).**

The majority of states (those pictured in yellow) employ a weight-distance formula for calculating a single-trip OW permit fee. The Rider 36 research team recommended that pavement consumption rates be based on units of cost per equivalent single-axle load (ESAL) per VMT and bridge consumption rates be based on units of cost per VMT (Prozzi, et al., 2012). Therefore, these weight-distance based permit fee structures more accurately represent the infrastructure costs incurred by an OW truck load.

OW permit fees may be increased to more closely recoup the costs associated with OW truck operations or may be applied only on specific corridors to target OW operations on these corridors only. However, not all of the revenue collected from oversize and OW permit fees is directed to Highway Fund 6 for maintenance, rehabilitation, and repair. Some permit revenue is paid to counties and some is directed to the state General Fund (Prozzi, et al., 2012). Should the OW permit fees be restructured or increased, more revenue should be directed to repair the infrastructure damages associated with these truck movements.

### *3.5.1 Weight-Miles and Vehicle-Miles Traveled (VMT) Fees*

A number of states and countries have pursued a weight-miles or VMT-based fee structure for motor vehicles, including OW trucks. Many of these systems track vehicle mileage using more traditional methods such as self-reporting and hubometers (or hubodometers). Innovative technologies are being introduced across the world to replace these traditional methods, including electronic tracking and geofencing. Entry and exit barriers may also be used to track total distance traveled; however, these barriers are typically associated with specific tolling corridors and are discussed in the following subsection.

*3.5.1.1 Oregon's Weight-Mile Tax Structure*

Oregon's weight-mile tax is one of the most sophisticated charging schemes among its peer states. OW vehicles transporting non-divisible loads over 98,000 lbs are subjected to a Road Use Assessment Fee (RUAF) (Oregon Department of Transportation, 2014). This fee ranges from \$0.01 to \$26.01 per mile based on the number of axles and gross weight of the OW truck. Tables break down the RUAF charges into weight increments of 2,000 lbs (Oregon Department of Transportation, 2010). The incorporation of the number of axles in the RUAF calculation provides a much more accurate consumption calculation than a GVW-only approach allows (Conway & Walton, 2009).

Oregon's weight-mile tax structure is summarized in Figure 7. Trucks weighing between 26,000 lbs and 80,000 lbs pay a weight-mile tax ranging between \$0.0498 and \$0.1638 per mile, broken down by 2,000 lbs weight groups. OW trucks weighing between 80,001 lbs and 105,500 lbs pay an axle-based weight-mile tax ranging between \$0.1692 and \$0.2304 per mile, again broken down by 2,000 lbs weight groups (Oregon Department of Transportation, 2010). Oregon has also initiated a pilot study of a road user charge for cars and light-duty commercial vehicles. Though not extended to larger trucks or OW vehicles, the OReGO program volunteers pay a road user charge of \$0.015 per mile, receiving a refund on fuel taxes paid at gasoline stations (OReGO, 2016).

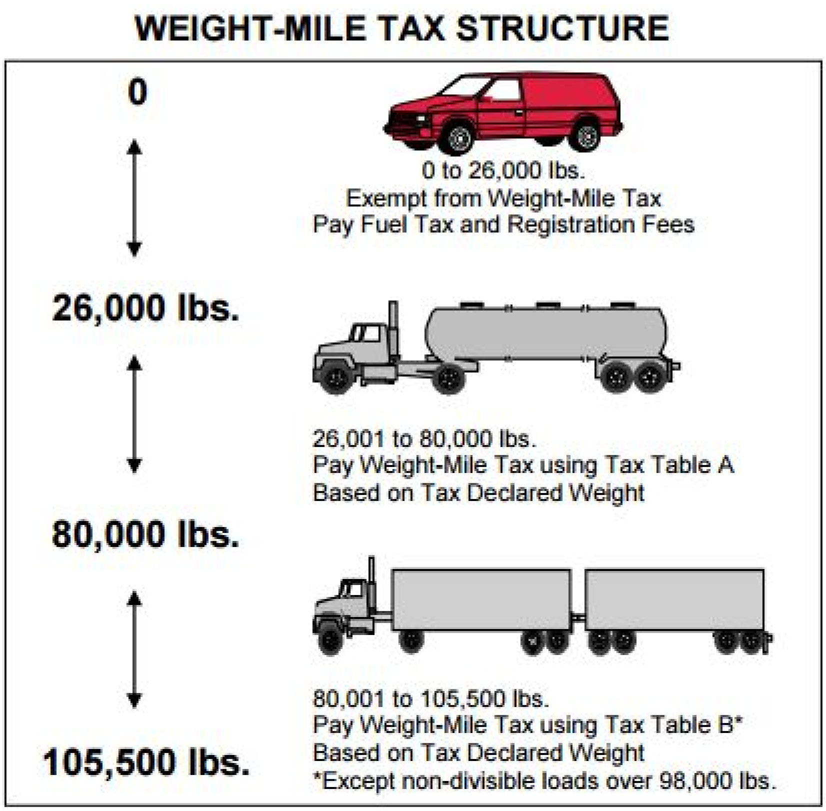


**Figure 7. State of Oregon Weight-Mile Tax Structure (Oregon Department of Transportation, 2014).**

Outside of the Unites States, many countries have implemented a distance-based truck toll, notably in Europe (Conway & Walton, 2009). Some countries have implemented or proposed programs that use innovative technologies and tracking systems to more accurately charge vehicles based on their usage (Sorenson & Taylor, 2005). These programs include the following:

- Australia – Autoroads "IAP" truck monitoring proposal;
- Austrian – "GO" weight-distance truck toll;
- Bristol (United Kingdom) - Combined truck toll/cordon toll demonstration;
- Czech Republic – "MYTO CZ" weight-distance-emissions truck toll;
- Germany – "Toll Collect" weight-distance-emissions truck toll;
- Netherlands – "Mobimiles" distance-based user fee proposal;
- New Zealand – Road User Charges (RUC) weight-distance truck toll;
- Switzerland – Heavy Vehicle Charge weight-distance-emissions truck toll; and
- United Kingdom – proposed weight-distance-emissions truck toll.

The systems in use in Germany, New Zealand, and Switzerland will be further examined in this report, due to these countries' widespread implementation of innovative methods.

#### *3.5.1.2 Germany*

The German Toll Collect system requires all motor vehicles or vehicle combinations with a GVW of 7.5 tonnes (16,535 lbs) or more and designed or used exclusively for goods transport to pay the weight-distance-emissions based toll (Toll Collect, 2016). The toll is enforced on all German motorways and selected federal trunk (B-letter designated) roads. The weight charges are based on the number of axles, with all trucks falling into categories of two, three, four, five, or more axles. Sorenson and Taylor (2005) note that this axle-based system is a "problematic surrogate" for weight, since pavement consumption costs do not necessarily correlate to the number of axles. Toll charges range from €0.081 per kilometer ($0.145 per mile) for two-axle trucks with the S6 or Euro 6 emissions class to €0.218 per kilometer ($0.389 per mile) for five or more axle trucks with S1, Euro 1, Euro 0, or no emissions class (Toll Collect, 2016).

The Toll Collect system is summarized in Figure 8. Truckers have an option of installing an onboard unit (OBU), which allows the truck's position to be tracked by GPS to determine distance traveled and calculate the total toll amount. Routes can also be pre-booked manually online or at a toll station terminal for those truckers that do not often use the German road system (Toll Collect, 2016).

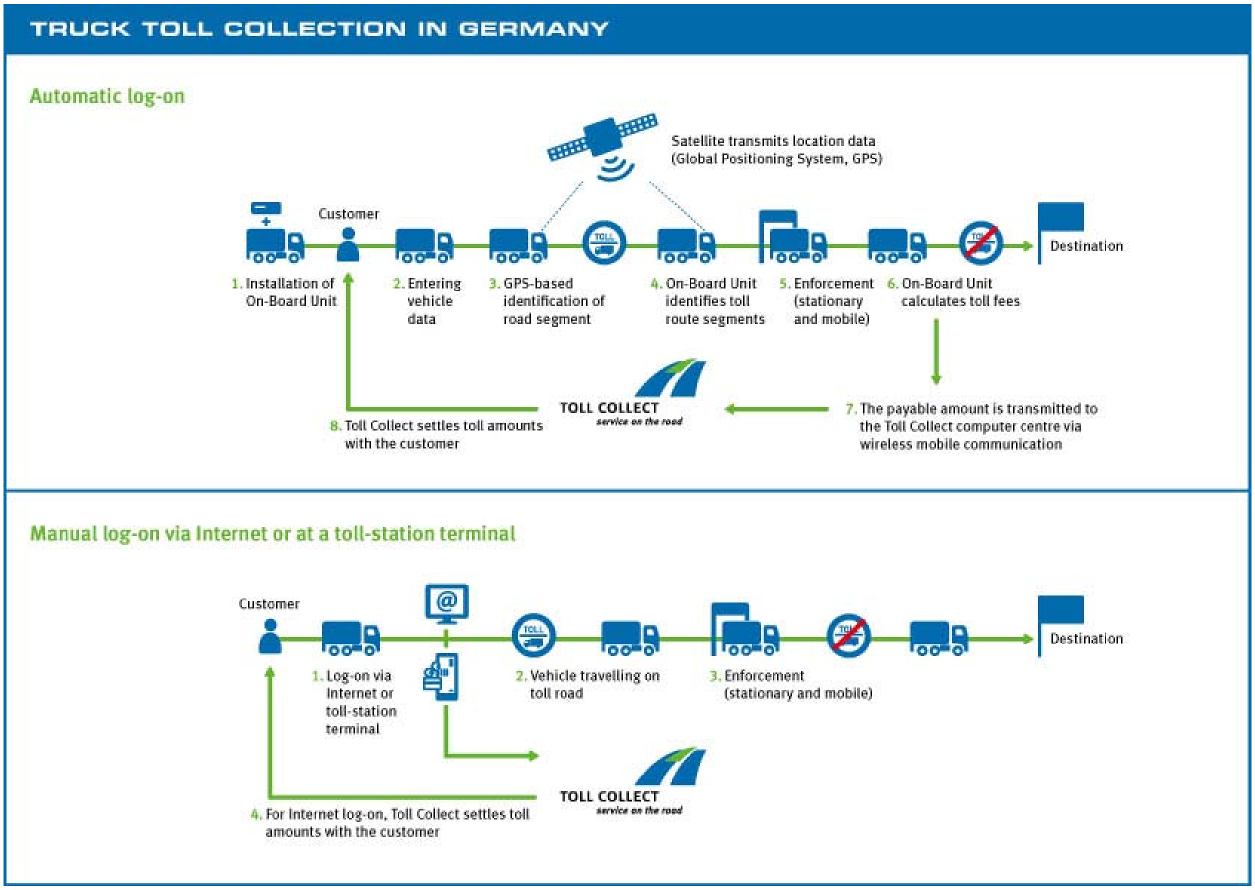


**Figure 8. German Toll Collect System (Toll Collect, 2016).**

As of July 20, 2016, one million OBUs have been installed for use with the German Toll Collect system. The unit is installed in a DIN slot (Figure 9) or on the dashboard and clearly displays the toll rate (per km) and total toll amount. The OBU is provided to each truck for free, but remains the property of Toll Collect GmbH. Truckers must pay the following costs (Toll Collect, 2016):

- OBU installation;
- OBU removal after use;
- Change of vehicle registration or change of vehicle data in a service center; and
- Travel time to service center and vehicle idle time during this work.

**Figure 9. DIN Slot OBU for German Toll Collect (Toll Collect, 2016).**

*3.5.1.3 New Zealand*

New Zealand's Road User Charges (RUC) system requires vehicles over 3.5 tonnes (7,716 lbs) that use diesel or other fuels not taxed at the source to purchase an RUC license in units of 1000 kilometers. Vehicles fueled by petrol, compressed natural gas, and liquefied petroleum gas are exempt from the RUC system. The RUC license charge is determined by the type of vehicle (powered or unpowered), the number of axles on the vehicle, the spacing between each axle, the number of tires per axle, and the weight of the vehicle. Since the license differentiates between powered and unpowered vehicles, separate licenses are required for truck tractors (powered) and trailers (unpowered). OW vehicle charges are required as an additional license, broken down into 1,000-kg weight increments (additional weight over legal limit) (New Zealand Transport Agency, 2016).

The New Zealand RUC is unique in that users can choose a distance recorder from an approved list. Many hubometers (called *hubodometers* by the New Zealand Transport Agency) and two electronic distance recorders have been approved for use with this system. The approved electronic distance recorders are the EROAD (Figure 10) and ibright eRUC (Figure 11) (New Zealand Transport Agency, 2016). Both of these electronic distance recorders allow GPS tracking of vehicles and also permit users to purchase RUC licenses through their system for display on the electronic units (license seen in Figure 11), even across a trucking fleet.

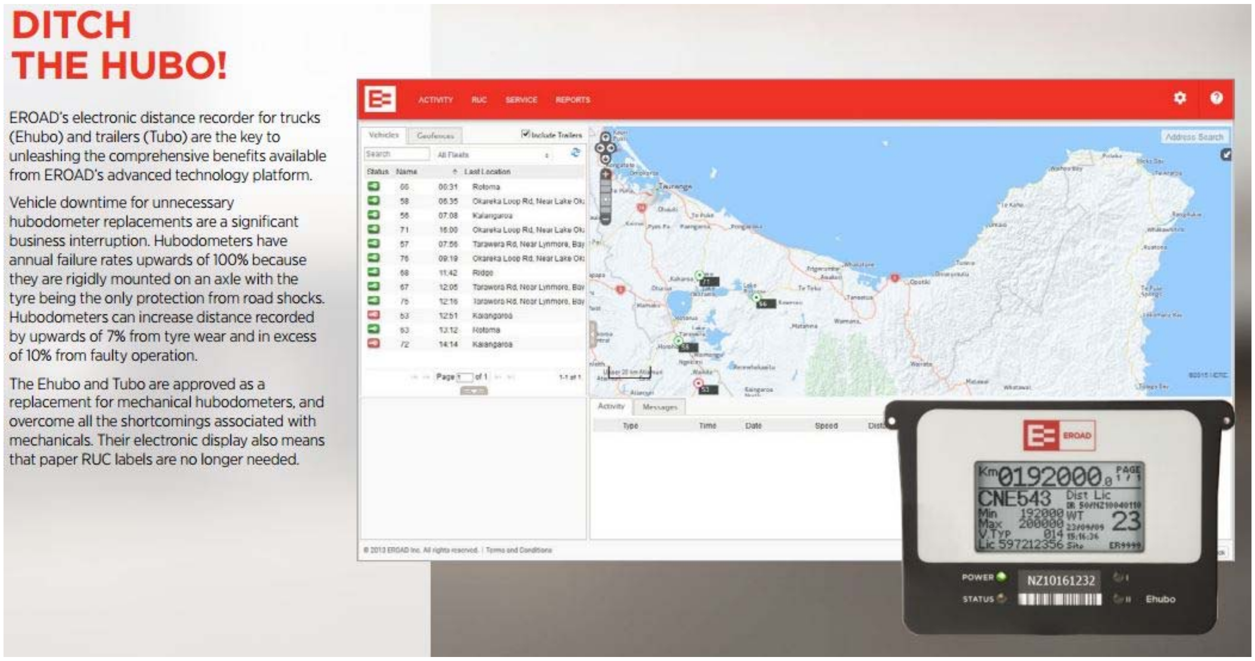


**Figure 10. EROAD Electronic Distance Recording Unit (EROAD, 2016).**


**Figure 11. ibright eRUC Electronic Distance Recording Unit (International Telematics, 2014).**

#### *3.5.1.4 Switzerland*

The Switzerland Heavy Vehicle Charge (HVC) is paid by all Swiss and foreign vehicles with a total maximum permitted weight exceeding 3.5 tonnes (7,716 lbs). The fee is based on weight and emissions class and ranges from CHF 0.0228 per tonne-km ($0.0339 per ton-mile) for vehicles with the Euro 4, 5, or 6 emissions class to CHF 0.0310 per tonne-km ($0.0460 per ton-mile) for vehicles with the Euro 0, 1, or 2 emissions class. All Swiss heavy vehicles subject to the charge must be fitted with a GPS-equipped Emotach OBU or, in special cases, a log book and tag unit. The first Emotach unit for each vehicle is provided by the Directorate General of Customs at a cost of around CHF 1,100 ($1,119.53). Truckers or transport companies must pay for the installation of this unit, costing between CHF 300 ($305.29) and CHF 700 ($712.59). Foreign vehicles must use a self-service machine to track mileage upon entrance to and exit from the country. The recording equipment is summarized in Figure 12 (Switzerland Federal Customs Administration, 2013).


**Figure 12. Switzerland Heavy Vehicle Charge Recording Equipment (Switzerland Federal Customs Administration, 2013).**

The Emotach recording unit can be switched on or off upon crossing a Swiss border. This process is completed by a short-range microwave radio link using radio beacons installed above the road (Figure 13). Additionally, truck drivers must note when their truck tractors are connected to a trailer and input information regarding the trailer into the OBU (Switzerland Federal Customs Administration, 2013).

**Figure 13. Overhead Radio Beacons in Switzerland (Switzerland Federal Customs Administration, 2013).**

### *3.5.2 Corridor Truck Fees*

OW trucks have also been subjected to corridor-specific fees across the United States. Texas currently has several OW truck corridors, including those operated by the Hidalgo County Regional Mobility Authority (RMA), the Port of Brownsville, and Port Freeport. In each of these corridors, OW trucks are charged a standard permit fee for use of the corridor. The revenue collected from these permit sales is used for administrative costs of the permitting system and for infrastructure repairs on the specific roads. The three OW corridors are shown in Figure 14 (Hidalgo County RMA), Figure 15 (Port of Brownsville), and Figure 16 (Port Freeport). These corridors end at specific roads or industry facilities, allowing OW transport of goods (up to 125,000 lbs GVW) from border crossings and ports of entry. The permit fee for the Hidalgo County RMA is $80, while the fees for the Port of Brownsville and Port Freeport OW corridors are $30. The permit fee is not dependent on the weight or number of axles of the OW vehicle. Additionally, 15% of the permit fee is paid to the port or RMA that operates the corridor and 85% of the permit fee accrues to TxDOT.

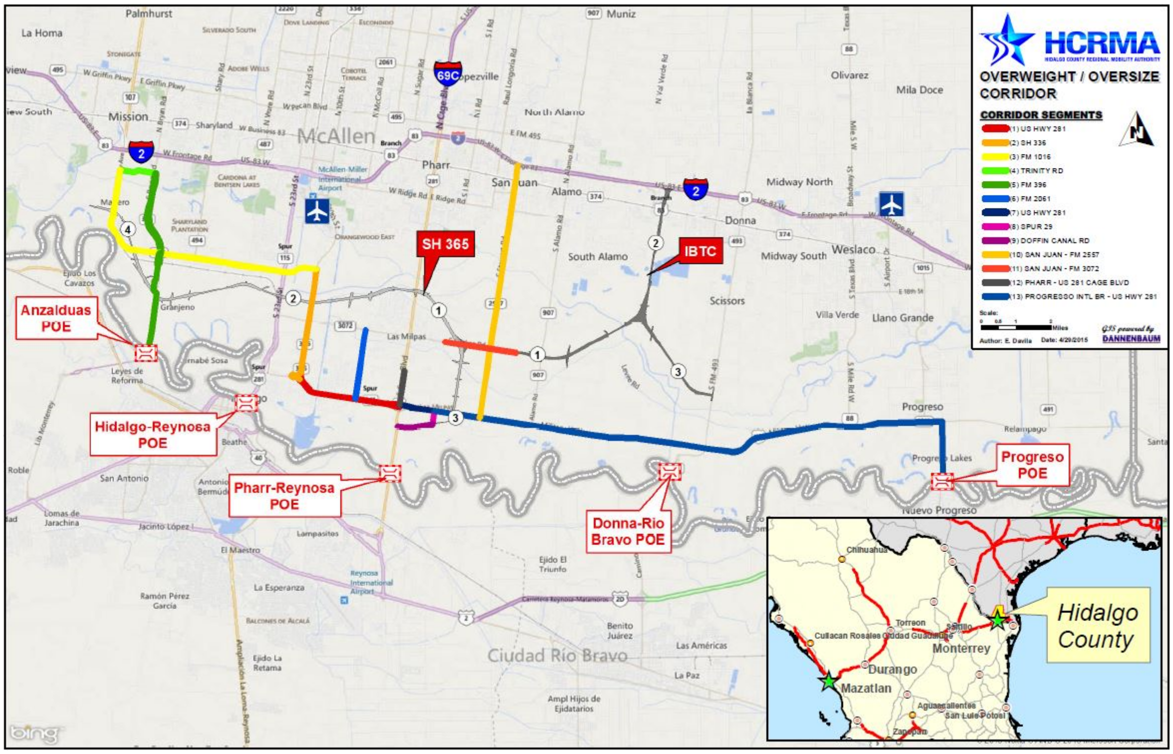


**Figure 14. Hidalgo County RMA OW Permit Route (Hidalgo County RMA, 2016).**


**Figure 15. Port of Brownsville OW Permit Route (Port of Brownsville, 2016).**


**Figure 16. Port Freeport OW Permit Route (Port Freeport, 2016).**

Many U.S. toll roads charge vehicles a variable fee based on distance traveled on the corridor and the number of axles or weight of the vehicle. Conway & Walton (2009) summarize the classes of trucks on United States toll roads in Figure 17. All but two of the toll roads identified charge vehicles based on the number of axles. GVW or the number of axles alone are not necessarily the best indicators of pavement or bridge consumption. Axle spacing is required to more accurately gauge a truck's consumption (Conway & Walton, 2009). Nonetheless, the number of axles is an easily identifiable characteristic for toll operations. A majority of the axle-based classification systems group trucks with five, six, or more axles into the same category.

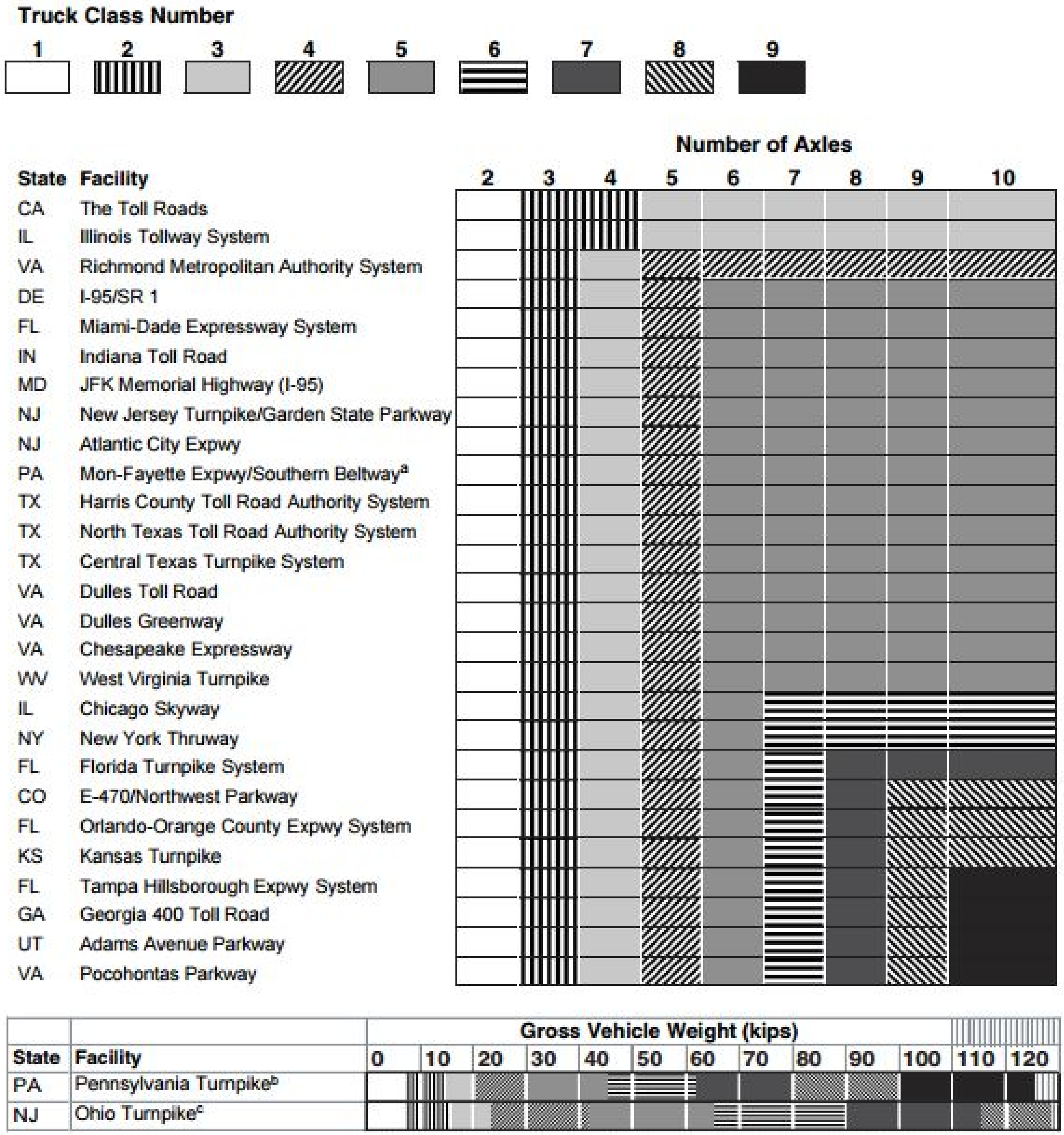


**Figure 17. Toll Rate Structures on United States Toll Roads (Conway & Walton, 2009).**

Many of these toll roads are equipped with entry and exit barriers through which all vehicles must pay upon entrance to and exit from the road. These barriers are equipped with ticket/cash and/or electronic toll collection (ETC) lanes. A typical entry/exit plaza on the New Jersey Turnpike is pictured in Figure 18. The large capital and operational costs of these entry and exit barriers are a significant obstacle to these corridor-type toll facilities. On the New Jersey and Pennsylvania Turnpikes, for example, exits from the facilities are limited to major interchanges.

**Figure 18. New Jersey Turnpike Entry/Exit Plaza (The Louis Berger Group, 2016).**

Conway & Walton (2009) note that a number of United States facilities have implemented ETC-only tolling on designated lanes or routes. It is anticipated that ETC-only tolling may reduce the costs of implementing and maintaining a corridor-type facility of this nature, even allowing traffic to proceed at highway speeds through toll booths.

# 4 Selection of Preferred Cost Recovery Method and Implementation Technique

## 4.1 Cost Recovery Method Selection

As discussed in Chapter 3, OW truck permit fees, including weight-, axle- or distance-based fees, can specifically target OW vehicles for their impacts on the infrastructure of a freight corridor. Since the corridor selected for estimating the impacts of such approaches within a Texas context is relatively short (19.8 miles on all segments), a distance-based fee is not recommended. It would involve substantial system requirements in terms of entry/exit barriers on various segments of the corridor, significantly increasing the cost of implementation for a relatively small benefit. Additionally, since all trucks permitted under the proposed corridor and permit system would need to begin or end their journey on Barbours Cut Boulevard, the permit system costs could be minimized by the construction of one entry/exit barrier at the entrance to the Port of Houston Barbours Cut Container Terminal.

The weight limit discussed for this corridor implementation is 97,000 lbs. This weight limit is currently under consideration for approval for OW transport of ocean cargo shipping containers by the Texas Legislature in House Bill 3061 (Appendix A). Since the proposed weight limit is only 17,000 lbs greater than the existing weight limit of 80,000 lbs, it is not anticipated that a weight-based permit system would make considerable difference in permit fee price, especially over the limited length of the proposed corridor. A weight-based system would necessitate additional administrative and infrastructure requirements (such as scales) that would add significant costs to the permit program.

A standard permit fee system is recommended. This cost recovery structure allows for straightforward implementation and administration of the OW truck corridor. Should the corridor be extended to include additional road segments or should heavier vehicles be permitted on the proposed corridor, a weight-, axle- or distance-based fee structure should be implemented to more equitably recoup costs from trucks using the corridor.

Several different types of OW truck permits may be used for this corridor, including one or more of the following:

1. **Texas Department of Motor Vehicles (TxDMV) Annual Permit –** one significant permit purchase allows a truck to carry as many loads as needed within a one-year timeframe. This type of permit allows for minimal transactions and simple system administration. However, companies or trucks that transport relatively few OW loads per year will be at a significant disadvantage due to the high cost of the permit. Permit will be administered by the TxDMV rather than the Port of Houston, potentially allowing the corridor to be extended a significant distance from the port.
2. **Port of Houston Single-Trip Permit –** a separate permit is required for each one-way OW truck trip. This type of permit provides more equitability with regards to infrastructure consumption as trucks are required to purchase a permit for each trip. Administrative costs are higher as more transactions are required. The permit is issued by the Port of Houston, with a large percentage of revenue (e.g., 85% at the Port of

Brownsville) deposited in Fund 6 for use by TxDOT and the remaining used for administration of the system.

3. **TxDMV Single-Trip Permit –** similar to existing OW truck permit fee in Texas. All revenue is deposited into General Fund, and administrative costs would be minimal, as the system already exists.
4. **Booklet of Permits –** truckers could purchase a booklet of permits, using each permit as needed when a load is transported to or from the Port of Houston. This system would allow more flexibility for trucks transporting numerous OW loads and require fewer permit purchase transactions.
5. **Toll Tag System –** toll tags would be installed on all trucks transporting OW loads to or from the Port of Houston. System would require significant costs for the installation of tag-reading systems and possibly paying for installation of toll tags. However, the system could be partially automated, limiting operating costs once in place.

In any of the above methods, the following costs should be included in the fee calculations:

1. Pavement Consumption – calculated as a cost per ESAL per loaded VMT. A typical five-axle tractor-trailer configuration carrying a loaded container operating at 97,000 lbs could be used to determine the pavement consumption costs along the proposed corridor.
2. Bridge Consumption – calculated as a cost per loaded VMT. For this corridor, the bridge consumption costs corresponding to an urban SH road in Harris and Chambers counties are specifically used for calculations (Weissman & Weissmann, 2015). As above, a typical five-axle tractor-trailer configuration carrying a loaded container operating at 97,000 lbs could be used to determine the bridge consumption costs along the proposed corridor.
3. Safety Costs – any preventative safety costs or estimated punitive damages associated with OW vehicle operations along the proposed corridor.
4. System Operational and Maintenance Costs (including weigh-in-motion/permit tag costs, if applicable).
5. Administration Costs.
6. Enforcement Costs.

Inclusion of these costs will ensure that the permit fee pays for the administration resources required to operate the system while accurately allocating increased pavement and bridge consumption costs to OW vehicles.

### 4.2 Implementation Method Selection

To implement the permit fee cost recovery system, one entry/exit barrier should be constructed at the entrance to the Port of Houston Barbours Cut Container Terminal. All OW trucks would be required to purchase or provide a valid corridor OW truck permit in order to pass through this entry/exit barrier.

Two technological implementations could be used on Barbours Cut Boulevard to aid in managing the permit fee system:

1. **Toll Tags –** as previously discussed, these tags could be used to identify vehicles entering or exiting the port so that the permit system could be partially automated. These tags would allow trucks to pass through the entry/exit barrier at normal or slightly reduced speeds, decreasing total trip time.
2. **Weigh-in-Motion Scales –** these scales could be used to identify vehicles that are operating OW (between 80,000 and 97,000 lbs GVW) that require a permit and, furthermore, ensure that no vehicles are traveling over the proposed weight limit of 97,000 lbs GVW. Further supporting the construction of an entry/exit barrier with a weigh-in-motion scale is new legislation introduced by the International Maritime Organization (IMO). A new amendment to the Safety of Life at Sea (SOLAS) regulation VI/2 requires that the gross mass of a packed container be verified in order for that container to be loaded onto a container ship regulated by SOLAS (International Maritime Organization, 2016). The new amendment came into effect on July 1, 2016. These scales could aid the Port of Houston in determining weights of containers upon their entrance to the container terminal. Trucks would be weighed at their entrance to the port and then again after depositing their container (or when leaving the port). These weights could then be linked to the Barbours Cut Container Terminal database that manages loading of containers onto cargo ships.

Should the corridor be extended to include longer segments or to include heavier weight classes, the introduction of the toll tag and weigh-in-motion systems could assist in administration of the system. Toll tag readers would need to be installed at additional locations along the corridor, wherever OW trucks are permitted to enter or leave the corridor, to determine the distance traveled of each truck. However, the weigh-in-motion scales would only need to be administered on Barbours Cut Boulevard since each trip would still begin or end at the Port of Houston Barbours Cut Container Terminal.

## 5 Conclusions

This project explored the OW truck cost recovery methods in use in Texas. Though a number of cost recovery methods are used to recover infrastructure costs from motor vehicles and trucks, OW permit fees most specifically target OW trucking operations. The state of Texas currently employs a weight-grouped permit fee system. A number of U.S. states and countries worldwide have introduced a VMT or weight-distance based fee for OW truck trips. Agencies in Germany, New Zealand, and Switzerland have used GPS-enabled onboard units to determine the total distance vehicles traveled. Corridor-based fee charging systems are also common across the United States. A number of state toll roads charge vehicles based on the number of axles or truck weight.

This study recommends the implementation of an OW truck permit fee system on segments of SH 146 and Spur 330 north of the Port of Houston Barbours Cut Container Terminal. The total length of the corridor is 19.8 miles, ending at areas of industrial activity in the vicinity of IH 10 east of Houston. Due to the short length of the proposed corridor and the minimal increase in permitted weight, the research team recommends a straightforward permit fee system. Numerous charging schemes could be used on this corridor, including an annual permit, single-trip permits, a booklet of permits, or a toll tag system.

Should the corridor be extended or should heavier vehicles be permitted to operate on this corridor, a weight-distance based system is recommended. A weight-distance permit system more equitably recoups consumption costs from OW vehicles. The introduction of toll tags or weigh-in-motion scales could allow for partial automation of the permit system and easily allow further expansion of the corridor and implementation of a weight-distance system.

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## Appendix A – House Bill 3061

84R20270 JTS-F

By: Anchia H.B. No. 3061

Substitute the following for H.B. No. 3061:

By: Anchia C.S.H.B. No. 3061

A BILL TO BE ENTITLED
AN ACT

relating to the movement of vehicles transporting ocean cargo shipping containers; authorizing a fee.

BE IT ENACTED BY THE LEGISLATURE OF THE STATE OF TEXAS:

SECTION 1. Subchapter B, Chapter 623, Transportation Code, is amended by adding Section 623.0172 to read as follows:

Sec. 623.0172. OCEAN CARGO SHIPPING CONTAINERS. (a) In this section, "ocean cargo shipping container" means an enclosed, standardized, reusable container that:

(1) is used to pack, ship, move, or transport cargo;

(2) is designed to be carried on a trailer or semitrailer and loaded onto a vessel for ocean-borne transportation; and

(3) when combined with vehicles transporting the container, has a gross weight that exceeds the limits allowed by law to be transported over a state highway.

(b) The department may issue an annual permit for the movement of a sealed ocean cargo shipping container moving in overseas international commerce on a trailer or semitrailer with three axles if the combination of vehicles transporting the container has:

(1) a single axle weight of not more than 20,000 pounds;

(2) a tandem axle weight of not more than 40,000 pounds;

(3) a tri-axle weight of not more than 60,000 pounds; and

(4) a gross weight of not more than 97,000 pounds.

(c) The department shall restrict vehicles operating under a permit under this section to routes that:

(1) do not include:

(A) roadways or bridges that the department determines through sound engineering principles should not be used for overweight vehicles; or

(B) federal highways, if the department determines that the operation of a vehicle under a permit under this section on those highways would result in the loss of federal highway funding; and

(2) end at a facility in this state at which the sealed container will be loaded on a ship or train in the course of overseas international shipment.

(d) The department may adopt rules necessary to implement this section, including rules:

(1) governing application for a permit under this section; and

(2) requiring additional safety and driver training.

(e) The department shall set the amount of the fee for an annual permit issued under this section in an amount not to exceed $7,000, of which:

(1) 90 percent shall be deposited to the credit of the state highway fund; and

(2) 10 percent shall be deposited to the credit of the Texas Department of Motor Vehicles fund.

SECTION 2. This Act takes effect January 1, 2016.