Houston-Galveston Area Council

Ports Area Mobility Study

Final Report

Houston-Galveston Area Council

January 27, 2020

HDR
WSP
MARTIN ASSOCIATES
HOLLAWAY ENVIRONMENTAL + COMMUNICATIONS

This page is intentionally left blank

Contents

Tables

Figures

List of Appendices

Acronyms and Abbreviations

Air draft	Vertical distance between the highest structure on a vessel and the underside of a bridge or crane structure measured in feet from mean higher high water.
Berth	The area alongside a dock or pier structure that vessels occupy when moored.
CAGR	Compound Annual Growth Rate
CEU	Car equivalent unit
Class (Vessel)	Type of vessel all built according to the same design.
Container	Generally referring to an intermodal container transported by vessel, rail or truck. A container may be 20, 40, 45, 48 or 53 feet in length, 8 feet 0 inches or 8 feet 6 inches in width, and 8 feet 6 inches or 9 feet 6 inches in height, with 1,100 to 3,000 internal cubic feet of volume. Container types include dry cargo container, reefer (refrigerator-temperature controlled), half high container, tank container, and flat rack (collapsible steel flat rack, bin with removable sides, or platform) container.
Crude oil	Unrefined petroleum as removed from the earth.
Domestic cargo	Cargo moved within the boundaries of the United States or moved by vessel between US ports.
Draft	The depth of the vessel below the waterline in any loaded or empty condition measured to the keel of the vessel.
Dray	The movement of cargo by truck between a terminal or other type of transportation or manufacturing facility.
Dwell time	The amount of time cargo remains at a terminal before being picked up.
Dwt	Dead-weight tons
EIA	Energy Information Administration
Gross Ton	The total weight of a vessel expressed in short, long or metric tons.
H-GAC	Houston-Galveston Area Council
Hinterland	The area around a port facility either incorporated into the port area or the immediate region around the port.
IAPH	International Association of Ports and Harbours.
IAMPE	International Association of Maritime and Port Executives.
Intermodal	The conveyance of cargo or persons from one mode of transportation to another.
In-transit	Cargo passing through a port or terminal not intended to be destined for the port or its immediate region.
LNG	Liquefied natural gas, generally handled at -250 degrees Fahrenheit.
MARAD	U.S. Federal Maritime Administration, Department of Transportation.
Net Ton	The cargo carrying capacity of a vessel measured in short, long or metric tons.

PCC	Pure Car Carrier
PCTC	Pure Car and Truck Carrier
PTRA	Port Terminal Railroad Association
Reefer	Refrigerated cargo such as perishable agricultural or seafood commodities or temperature-controlled vessels or containers.
Ro-Ro	Roll on/Roll off cargo such as automobiles, trucks or other wheeled vehicles carried aboard specialized vessels such as pure truck/car carriers (auto ships).
TEU	Twenty-foot equivalent unit, the base standard for intermodal sea containers.
Throughput	The amount of cargo moving through a port or terminal measured during a specific period in tons, barrels or TEU's (loaded, empty or combined volume).
Tonnage	Carrying or throughput capacity or volume measured as a Short Ton= 2000 pounds (lbs.), Long Ton= 2240 lbs. or Metric Ton = 1000 Kilograms (2204.6 lbs.)
Trans-shipment	Point of interchanged between modes of transportation.
ULCS	Ultra large container ship, generally in excess of 14,000 TEU carrying capacity.

1 Executive Summary

The Houston-Galveston Area Council (H-GAC) Regional Goods Movement Plan, completed in 2013, recommended a follow-up study to analyze supply chain connections between the region's four deep-water ports (Port of Freeport, Port of Galveston, Port of Houston and Port of Texas City) and emerging markets without having to traverse Houston's dense urban core. This need was also cited in previous Texas Department of Transportation (TxDOT) IH 69 corridor studies, the IH 69 Advisory Committee report, and the TxDOT Texas Freight Mobility Plan.

In 2017, H-GAC initiated the Ports Area Mobility Study (PAMS) after significant outreach with stakeholders and coordination with port representatives. The purpose of PAMS is to better understand the supply chains linking the four deep-water ports in the area and identify port related mobility improvements and alternatives. The study aims to establish a stronger future for the region's freight economy by recommending improvements that will better connect the region's four deep-water ports with emerging population and employment centers. The study also aims to identify and assess a range of infrastructure and multimodal improvements, as well as operational strategies and policy-level changes, that enhance and position the economy for future growth, while mitigating impacts upon surrounding communities. Mobility improvements for the region's ports can significantly benefit access to local markets and port users, who are the proven and primary drivers of demand for the region's ports; and better position the region's ports for a larger potential share of hinterland markets over the longer term.

Did You Know?

Petroleum products, crude oil and chemicals comprise over 85 percent of all trade flows, both domestic and international, in the region's ports.

The H-GAC region's ports will grow and prosper primarily because the larger region is growing and prospering, and the local ports support much of the region's international and domestic maritime trade. This "captive" cargo will continue to be the core driver of regional port activity. Ports also handle, to varying degrees, what is known as "discretionary" cargo – that is, cargo that can be well-served by more than one port and may move from one port to another depending on conditions. A key opportunity for volume growth though H-GAC ports is to improve their service to hinterland markets- making them faster and more efficient than competing ports and their respective inland transport connections. However, hinterland market opportunities are complex to define – they are influenced by many factors that include origins and destinations of cargo, commodity type, handling type, transportation cost, reliability of services, supply chain configuration, frequency of vessel sailings and services, risk management (deliberately spreading moves through multiple ports), etc.

The supply chain and commodity flow analyses performed for this project demonstrate that much of the market area for H-GAC ports is local, but there are some longer-distance hinterland opportunities. One such opportunity, which has been flagged in other studies, is Dallas-Fort Worth which is a significant consumer market and where many companies locate their distribution warehouses to serve the metropolitan areas throughout Texas. Attracting more Dallas-Fort Worth containerized volume through the region's ports, capturing some share of what would otherwise move through Los Angeles and Long Beach, is an important opportunity for ports in the H-GAC region – and, to the extent it could offer Texas freight shippers and receivers a cheaper, faster, more reliable way to move goods.

The Ports Area Mobility Study has identified that access to and from the region's ports and their respective terminals, is essential for so many industries and supply chains. Companies and organizations locally, across the region, state and nation, depend upon access to the four ports in the H-GAC region as their gateway for global trade and domestic waterborne distribution. This is especially so for the crude oil, refining and chemical industries. The importance of the region's ports and terminals for this particular industry cannot be overstated.

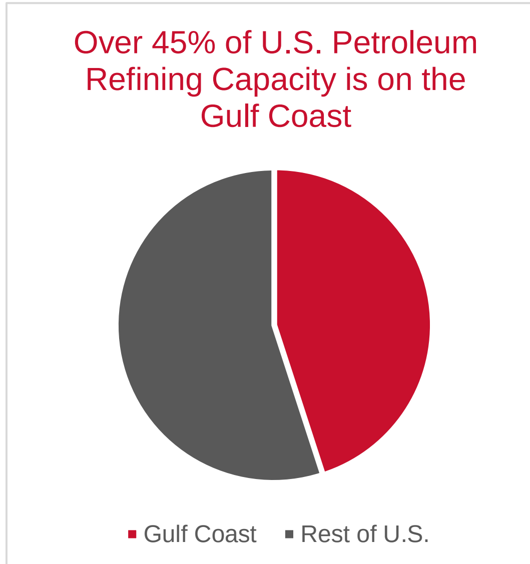


Figure 1-1. U.S. Petroleum Refining Capacity

But, despite the vast volumes of chemicals, fuels and oils flowing through the region's ports, other industries also rely on the region's ports and these include:

- Produce importers that supply the central swath of the U.S. with bananas and tropical produce, reaching as far afield as Wisconsin and Minnesota.
- Auto importers supplying dealers in the southern U.S. and auto exporters sending vehicles into foreign markets.
- The Texas oil industry who use imported steel pipe for oil well drilling and local steel processers who process imported steel into pipe for oil field applications.
- Retailers, such as Ikea, Walmart, Home Depot and Academy Sports who source products from across the globe including clothing, furniture, and household items and process their products through warehouses located in the immediate Houston region, before distributing to retail outlets across the southern U.S.
- Distributors, including Heineken, Red Bull and Diageo who import consumable products for distribution within Texas and nearby states.
- Texan and surrounding state farmers competing in the global agricultural market place, exporting products such as cotton, meat, poultry, grain and sorghum to foreign users.

- Construction and building material suppliers, who import various materials including aggregates, lumber, ceramic tiles and stone.
- Heavy and large equipment manufacturers importing power generation, such as wind turbines and power station equipment, and chemical and oil refining equipment that are installed in the region's petrochemical processing facilities.
- Plastic resin manufacturers who have established supply chain structures, including packaging facilities, to export their products through the region's ports

The oil and chemical industries have traditionally relied upon non-highway forms of transportation including, pipeline, rail, barge and short sea shipping to distribute their products within the nation, though trucks are used for local movement and distribution. In more recent years, the critical nature of the highway network in supporting the region's port access needs has risen to the fore. A growing regional population (the fastest in the U.S.), coupled with changing supply chain configurations, in addition to regional port upgrades and investments, has attracted national companies to locate their import warehouses and distribution facilities in the region and import through the region's ports, rather than use ports on the west or east coasts. The expansion of Texan on-shore oil production has resulted in a demand for drilling pipe and product pipelines, with much of that material sourced from overseas, imported through the region's ports and moved by truck from the port direct to the oil drilling site when needed.

The growth in domestic natural gas production has not only lead to the development of LNG export facilities in the region, but also spurred chemical manufacturers to invest in chemical processing facilities to produce plastic resins, of which a significant proportion is destined for export markets. The phenomenal growth of these facilities in the Houston region has led to the Port of Houston being the primary export port for this product.

Did You Know?
According to PIERS, the Port of Houston handled 42 percent of all resin exports from the U.S. in 2018

This Ports Area Mobility Study is largely driven by the need to identify both traditional and non-conventional solutions and actions to accommodate the continued growth of the ports while considering. Traditional solutions, namely the need for continued highway investment, which is widely acknowledged and understood by the various entities associated with highway planning in the region including TxDOT, H-GAC and the counties. These planned highway investments have been identified in this study. However, not all regional highway investments have a direct benefit for port users. This study's benefit analysis for the IH 69 bypass did not identify significant benefits for port users. But such projects can support port related road movement by creating capacity elsewhere in the highway network and relieving congestion hotspots that port related truck movement cannot avoid.

Rail is also recognized as a critical mode in supporting the region's port related mobility and in particular the chemical, oil and steel supply chains. Infrastructure and operational investment decisions are based on commercial, financial, market and customer needs and considerations. This is clearly demonstrated with Union Pacific's decision to halt the

Port of Houston-Dallas container service due to low customer demand. While such a service is important in reducing the number of trucks travelling between Houston and Dallas, it has to be commercially viable to the rail road operator, unless other organizations, who might value the externalities produced from road based freight movement differently than a commercial railroad, agree to take some of the commercial risk. However, it is recognized that investment within the regional rail network is required. Projects already identified in the Texas Rail Plan and reiterated in this study, support port related rail mobility.

This study has identified the expected growth in truck trips related to the region's ports. By 2045, with the exception of the Port of Texas City, the model suggests that truck trips associated with each port will double. Port of Houston trips are expected to have grown from 3.5 million one-way truck trips in 2019 up to 8.5. million in 2045. Freeport's will increase from 270,000 to nearly 550,000 and Port of Galveston's from just under 200,000 to nearly 500,000.

Did You Know?

By 2045, truck trips to the Port of Houston are expected to double to 8.5 million per year

Those extra trucks, through the coming years will have to compete with other road users for the finite capacity of the highway network. Despite planned investment in capacity enhancement of existing highways, in addition to new highways, it is highly probable that the highway network, may not be able to adequately accommodate all the demands expected to be placed on it, without detrimental impacts upon service levels and impacting the timely and expeditious movement of goods to and from the region's ports. Furthermore, in some locations, there may not be the ability to physically expand infrastructure, and the number of highway bottlenecks in the region may increase.

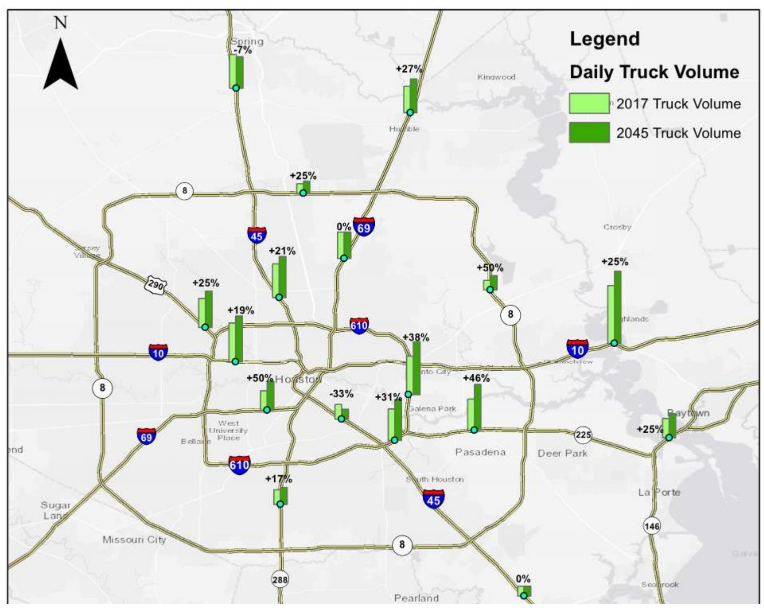


Figure 1-2. Daily Truck Counts

Recognizing that there are future constraints on highway capacity, there is an increasing volume of goods passing through the region's ports, and truck trips will continue to pass through the urban core to serve customers within the immediate region and further afield. This study has identified a "menu" of other solutions that can play a role in facilitating port related mobility and supporting other transportation modes. These include operational strategies, alternative transportation systems and enhancement of existing modes through the application of different techniques, processes and infrastructure.

Some of the innovative solutions identified in this study are relatively affordable and implementable and can be pursued now. Looking to container movement, addressing the issue of moving empty containers between the port and importers and exporters, through better matchbacks/streetturns is one of those early adoptable solutions. This solution is a win-win – it reduces transportation costs for the drayage industry, shippers and goods receivers and it reduces truck trips at the ports and on the highway network. The study has identified a number of ways that this could be taken forward and further dialogue with interested stakeholders is necessary to determine next steps. H-GAC has a key role to facilitate this process, engage partners and drive the potential project forward.

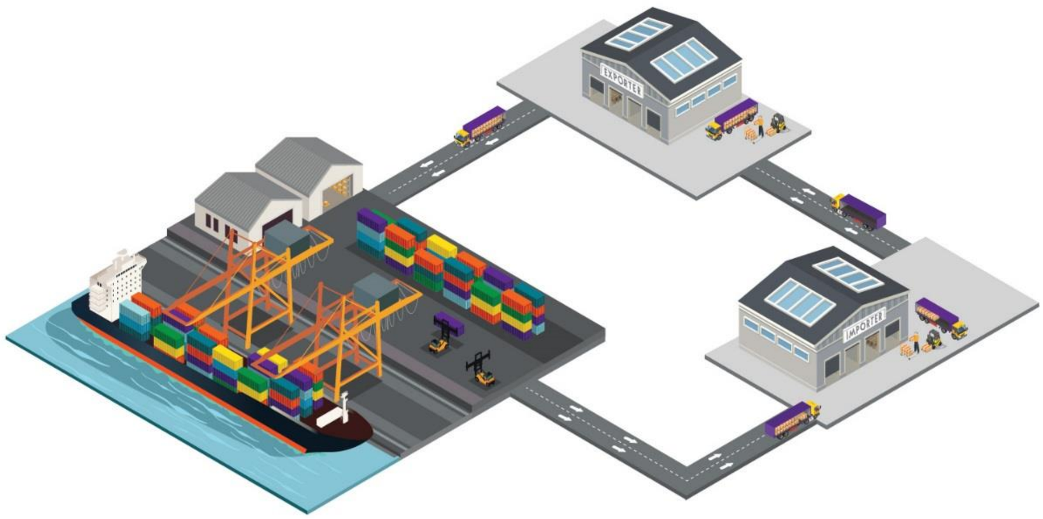


Figure 1-3. Matchback/Streetturn Concept Illustration

Unfortunately, not all the solutions identified in this study are as affordable, quick and as straightforward as the matchback solution. Others are more expensive, or more complex due to the number of stakeholders, or require a change of approach to operations and processes, while others are going to be market led and require support from transportation users to make services viable. For example, extending gate times to make use of later evening times has been attempted recently by the Port of Houston, but did not attract the level of demand to make it financially viable. Extending gate times and gate appointment systems can also be used to manage the throughput of trucks at the Port of Houston terminal gates. However, the Port of Houston recently announced a capital project to extend the number of gates at the Barbours Cut terminal increasing from 14 to 28. Until further capacity issues that may impact the flow of trucks and containers, either at the gates or elsewhere in the terminal are encountered, it is unlikely that the Barbours Cut terminal would implement extended gates or a truck appointment system.

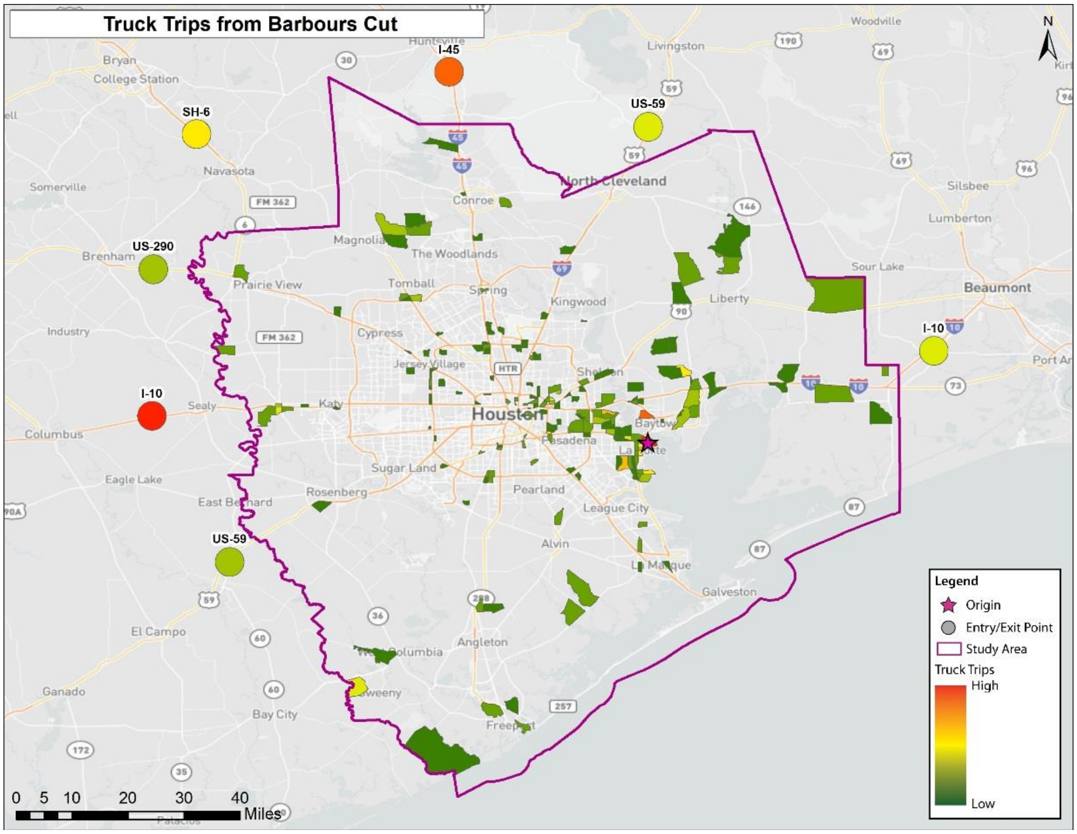


Figure 1-4. Barbours Cut Truck Trips

Other solutions, such as improving the container-on-barge system requires both a commitment of volume and longevity from transportation users to justify investment in infrastructure by the Port of Houston to better accommodate reliable container on barge operations within the Port of Houston and also potentially the Port of Freeport. The current barge service shipped 50,000 TEU, up from 10,000 TEU four or five years ago according to the Port of Houston. This investment by the Port of Houston, or the container on barge operator, could be mitigated by applying for funding from MARAD grants. In January 2020, the Port of Houston received $180,000 in grant funding from MARAD to fund the development of a business case study to explore options of creating barge berths at two container terminals.

Alternative transportation solutions, such as Freight Shuttle and Eagle Rail have similar needs for commitment from transportation users, but the level of investment for dedicated freight infrastructure is much more significant. On the other hand, the benefits of removing large numbers of trucks from the roads leading to reduced emissions, improved safety and lower congestion is also much higher. The benefit analyses as part of this study have identified the scale of those benefits. While the technology with different systems is currently going through testing phases and proving the technology can work, until a viable business case is produced that can demonstrate how alternative transportation systems can compete with trucking and provide a return on investment, it is unlikely that such a system is going to be deployed in the H-GAC region.

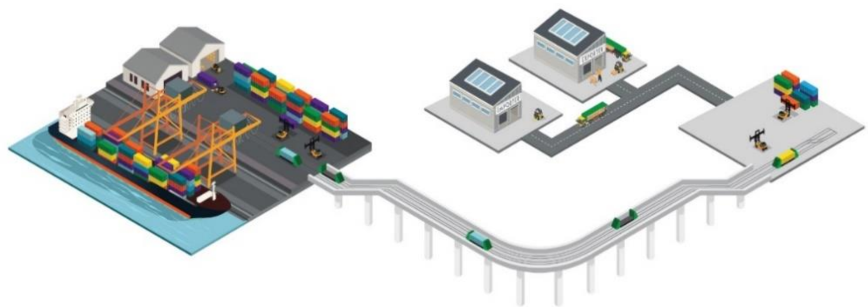


Figure 1-5. Freight Shuttle Concept Illustration

The study recognizes that the region's ports operate independently, and each has a particular emphasis on the commodities they handle now and into the future. Each port has its own plans and specific needs, which include projects associated with maritime infrastructure such as channel deepening and widening, port terminal improvements to better accommodate growth and working with partners to improve port access connections. The projects identified in this study support the region's ports and provide benefits to the region as a whole.

Figure 1-6. Alternative Freight Shuttle Concept Illustration

Key Recommendations

1. H-GAC to continue dialogue and engagement with the region's ports, port users and other key stakeholders to identify funding, implementation and support mechanisms enabling the deployment of solutions and strategies identified in this study. This dialogue could be through existing forums the Greater Houston Freight Committee, Transportation Policy Council, and Transportation Advisory Committee.
2. Continue to plan for volume growth and corresponding advances in infrastructure, technology, and logistics by the region's ports and recognize that key events, such as completion of channel expansion projects, will lead to larger vessels and therefore greater tonnage moving on the region's surface transportation system.
3. Identify funding sources, including Federal grant programs, to fund a matchback/streeturn system or manager to reduce vehicle miles travelled by empty

containers in the region, as well as discretionary grant programs for which port access projects may score well.

4. Continue to monitor progress with dedicated freight alternative system providers, including but not limited to Freight Shuttle and Eaglerail, as they develop their respective systems and business cases, to identify implementable opportunities for these systems within the Houston region.
5. Work with the Port of Houston to advance and enhance container-on-barge operations to promote port development, business development and location decisions, and reduced reliance on trucking over congested roads, especially heavyweight containers.
6. In liaison with the Port of Houston and Port of Freeport, identify mechanisms to grow the number of vehicles completing dual transactions at the port's container terminals.
7. Conduct an Inland Port Study, primarily focused on rail connections between Houston and the Dallas-Fort Worth area to better understand the success factors and potential public and private benefit value of a Houston-Dallas container rail link.
8. Work with pipeline operators, the Texas Railroad Commission and Pipeline and Hazardous Materials Safety Administration to ensure pipelines serving the region's port facilities are operated to the required regulations, ensuring pipelines are safe for both the region's population and the environment.
9. Identify improvements to the process of selecting, funding, planning, designing and constructing highway projects, to keep up with the pace of development and growth at the region's ports and integrated with other operational solutions including extended gates, truck reservation systems and improving the efficiency of container movement to deliver cost effective highway capacity enhancements.
10. This study has primarily focused on the transportation arrangements of moving goods to and from the region's ports. However, it is recognized that there is other significant transportation activity in the region associated with these goods once they have passed through import facilities, such as the final mile distribution to retail stores, other warehouses and end users. Ongoing and future regional planning should consider the growth of these secondary and final mile trips to, from and within the region.

2 Port Profiles

2.1 Key Findings

- In 2018, the region's four ports accounted for 12.9 percent of the 2.6 billion tons handled by the nation's top 150 ports. Houston was ranked 2nd in the nation, Texas City 15th, Freeport 28th and Galveston 53rd
- Petroleum products, crude oil and chemicals comprise over 85 percent of all trade flows in the region's ports, with 90 percent of domestic waterborne flows associated with these products and 74 percent of foreign trade flows.
- Increasing U.S. domestically produced crude oil has resulted in the displacement of imported crude oil to the Gulf coast's refineries. This has significantly impacted crude oil import tonnage through the Gulf Coast ports, but exports of domestically produced crude oil have increased. In late 2018, the Gulf coast became a net exporter of crude oil.
- Houston is the 5th largest container port in the country handling 2.2 million TEUs in 2018 and is the largest container port on the Gulf Coast handling about two thirds of the Gulf coast's containers.
- Freeport is ranked 35th with 66,700 TEUs in 2018 and Galveston 43rd with 24,300. The majority of which contain imported produce.
- From 2011 to 2015, the Gulf coast's containerized imports from Asia grew by 10.2%
- Each year, more than 8,300 vessels and 223,000 barges carry cargo through the Port of Houston
- 71 percent of the vessels are energy related according to Houston Pilots.
- Nearly 3 million tons of grain were exported through the Port of Galveston in 2015, though tonnage has recently dropped due to trade and tariff challenges.
- In 2019, the first export cargoes of LNG were exported from the Port of Freeport
- The region's ports rely on multimodal transportation options including rail, barge/short sea shipping, pipelines and truck to move goods to and from the ports. The region's extensive pipeline network linking ports with refineries and chemical processing plants, means that much of the imported and exported petroleum, crude oil, chemicals and gases are transported by this mode, though rail and barge movement are also important modes for these commodities.
- Containerized cargoes are overwhelmingly moved to and from the ports by truck.
- The region's public ports and private terminals are continuing to invest in both channel and landside infrastructure projects, such as the Houston Ship Channel Expansion project, to expand their capabilities and attract additional business and trade.

2.2 Introduction

This chapter provides an overview of the four ports located within the Houston-Galveston Area Council's (H-GAC) region; Port of Freeport, the Port of Galveston, the Port of Houston, and the Port of Texas City (Figure 2-1). It also identifies the commodities and the facilities and surface transportation infrastructure associated with each port, as well as proposed growth amount and investments relevant to each port. Data and information have been gathered from varying sources, including interviews with port management teams as well as publicly available data (e.g., U.S. Army Corps of Engineers Waterborne Commerce data).

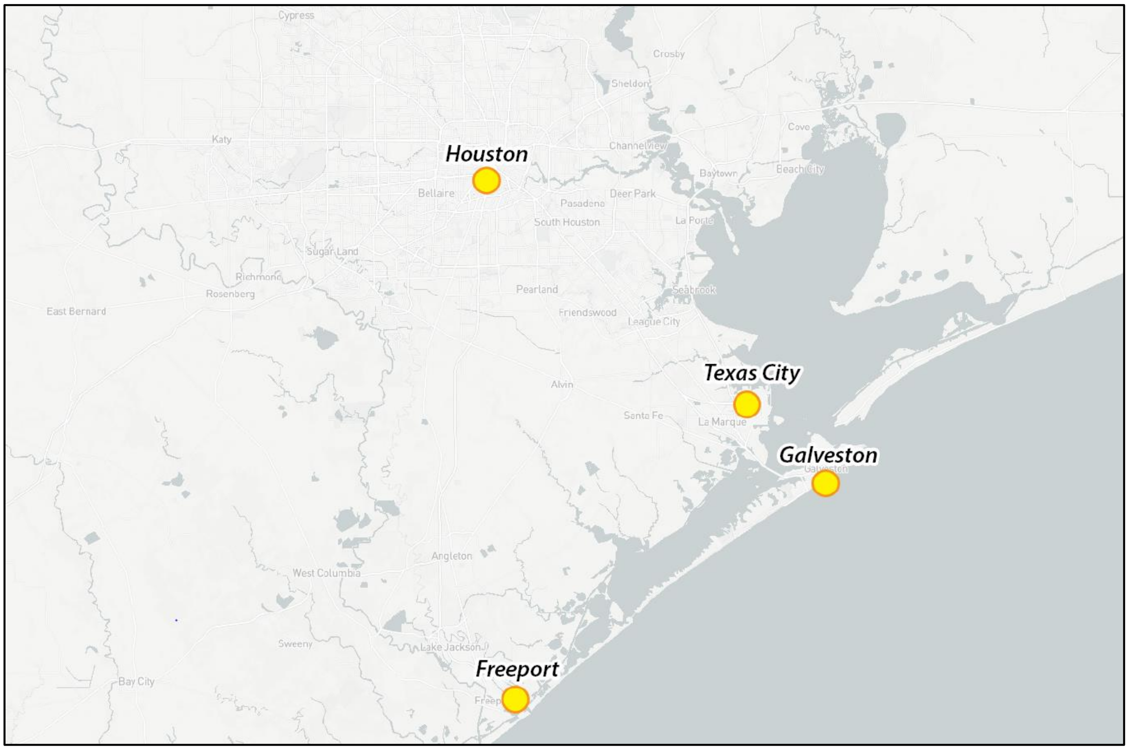


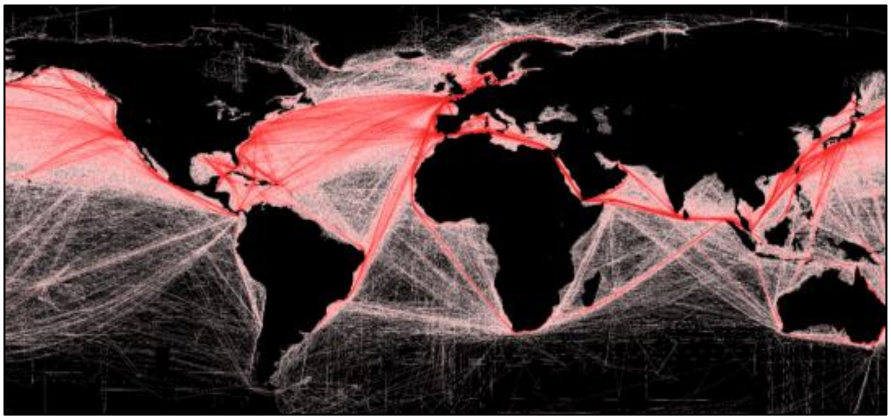
Figure 2-1. H-GAC Regional Ports

2.3 Port Industry Background

Ports are transition points between various modes of transportation in both domestic and international trade. Ports themselves comprise not only what a public port agency may control but also the connecting land and waterway corridors which include harbors, rivers, channels, collector roadways, highways, short line railroads, and intercontinental railways. Intermodal marine facilities, more commonly known as terminals, were previously considered the end of a transportation corridor whereas, today, they have become part of a worldwide system.

Ports are fundamental parts of the international transportation system, as around 95 percent of all worldwide international cargo is moved via water transport (Figure 2-2). In addition to handling domestic cargo, ports and terminals also serve as national borders and regulatory checkpoints for international trade. Terminals provide vetting locations for customs and immigration, security and cargo screening, agricultural inspection, environmental monitoring, vessel safety, port state control inspections, local fire department requirements, and law enforcement activities. There are approximately 8,000 ports in 200 countries worldwide, most engaged in some form of international trade and handling a variety of commodities.[1]

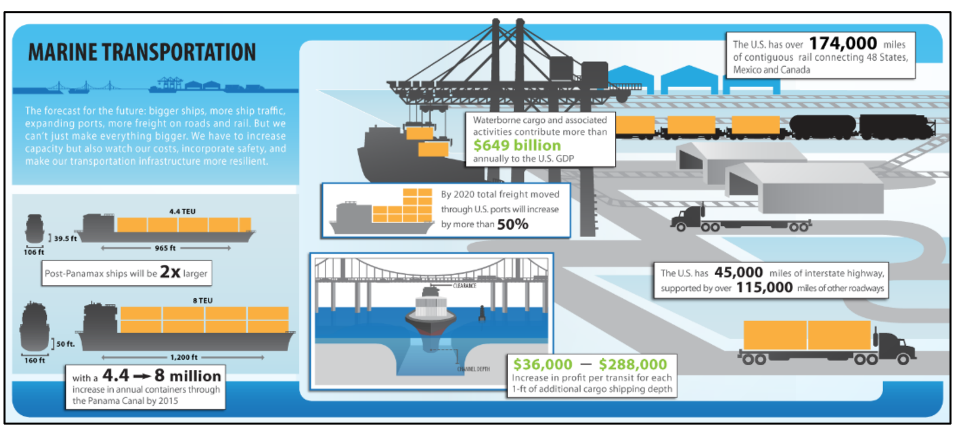
Ports are generally linked to various trade routes where they connect land and sea. Pacific Coast ports generally serve North American-Asian trade, while Atlantic Coast ports provide primary connections to Europe, Africa, South America and Asia via the Suez Canal. Gulf of Mexico ports are connected to the Caribbean, South America and to Asia via the Panama Canal.



Source: International Association of Maritime and Port Executives (IAMPE)

Figure 2-2. Worldwide Shipping Routes

The intermodal system encompasses transportation facilities of all types including trucking and rail facilities, many integrated within warehousing, and industrial and distribution complexes (see Figure 2-3). While trucking and rail also compete with maritime transportation, they are also critical of the connectivity between port facilities and the markets they serve, some many hundreds or thousands of miles away. Anything that compromises part of the network generally impacts a large portion of the entire system.



Source: U.S. Federal maritime Administration, Department of Transportation (MARAD)

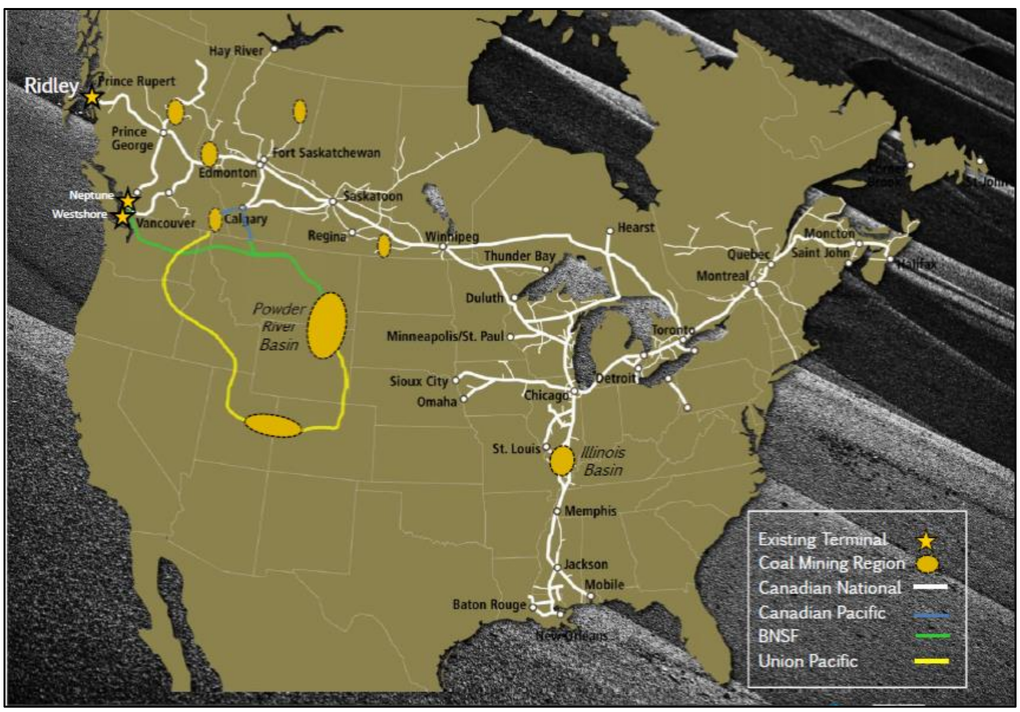
Figure 2-3. The Marine and Landside Transportation System

[1] International Association of Ports and Harbours (IAPH) 2016 data.

In North America, blue water, brown water, and coastal river ports are part of a comprehensive intermodal network that spans the U.S., Canada and Mexico. The entire network is physically linked by various modes of transportation and their interdependent means of conveyance; roads, rail corridors, and waterways to move goods between markets and ports.

Ports typically have a market that reaches beyond the local hinterland of the port. For example, the Port of Prince Rupert, located in British Columbia, can serve customers as far away as New Orleans, Louisiana, because of its intercontinental rail connections (Figure 2-4). The impact of the intermodal network fundamentally controlled by the Canadian National Railroad has changed the directional flow of cargo moving into U.S. southern markets.

Cargo transit times and costs can be lowered when the system operates effectively. Congestion or interruption in any part of the system may cause ripples throughout the entire network. Cost is often the most significant factor in determining which mode of transportation services and ports will be utilized to move products from producer to receiver.[2] Shippers and cargo owners consider all costs in the selection and movement of cargo including the cost of transportation, handling services, and other related expenses. Cargo movement is planned and determined fundamentally by cost and the reliability of delivery times, not necessarily the amount of time in transit. [3]

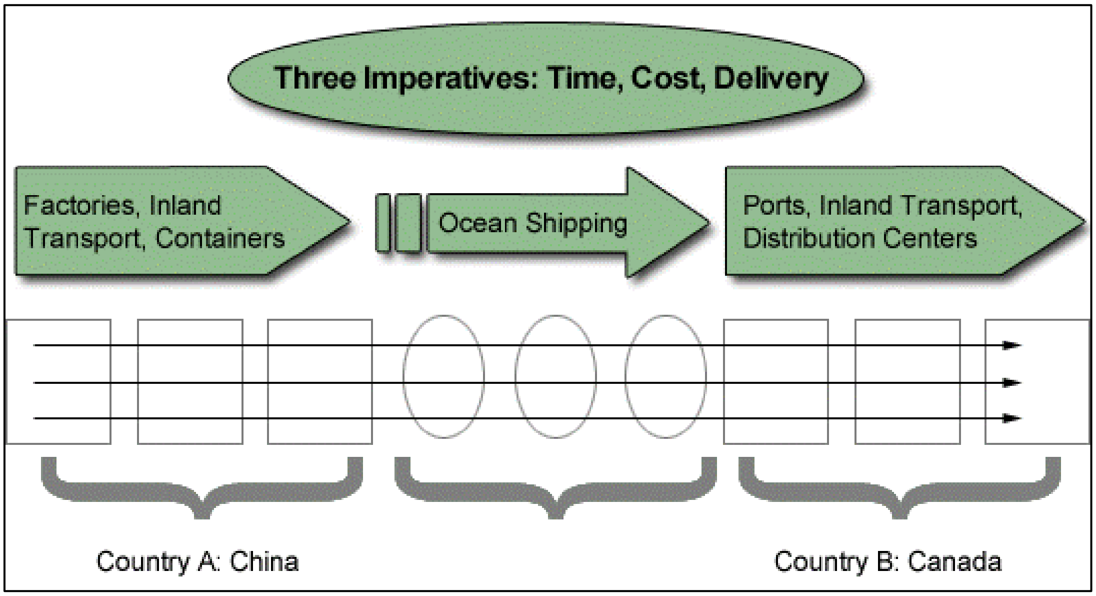


Source: Ridley Terminal

Figure 2-4. Port of Prince Rupert Systematic Market Reach

[2] NASSTRAC Freight Transportation State of the Industry Report 2016
[3] Ibid

The systematic nature of the global transportation network as shown in Figure 2-5, as well as the management of the global supply chain, puts a high demand on ports to be efficient regarding intermodal connectivity. This applies equally to domestic and international cargoes. While terminals may operate efficiently, port delays and congestion may result from issues associated with road, rail, and waterways.



Source: U.S. Department of Transportation (USDOT)

Figure 2-5. Managing the Global Supply Chain

Many ports today focus on resolving delays within the facilities they control, while also looking to work with local and state agencies to correct issues in areas where port activities impact local surface networks. Secondary truck traffic is often generated in port areas because of the industrial nature of port districts, even when those activities do not directly access or use marine facilities.

2.3.1 Cargo Movement

All cargo follows a path between the point of origin and a destination. The point of origin may be a manufacturing plant, the source of the raw materials, or an assembly point. A containerized intermodal move may involve multiple transfers with different transport modes. A scenario such as this may include an initial move by truck (i.e., dray) to an off-dock intermodal rail yard, a rail movement to an inland rail yard, followed by another move via truck to the final destination. In the case of containerized cargo, once the commodity is delivered, the empty container is returned to an intermodal facility for reuse or storage. This equates to two moves for each container, which may include a repositioning move to the delivery intermodal facility or another location. These moves increase traffic volumes because of the limited capacity of trucks within local port areas, or increased movement of containers by rail in specific corridors. The transfer of 1,000 40-foot containers could generate 2,000 truck moves in total. Truck schedules are typically flexible for pickup and delivery but are generally limited by truck weight regulations; however, some municipalities in port areas allow dispensation for higher weights for trucks involved in port cargo movement.

Bulk cargos such as minerals, agricultural crops and petroleum products are typically moved by rail directly to and from marine facilities. In the case of many bulk cargoes, rail facilities are usually located on or near marine facilities to minimize any secondary or intermediate move connecting rail and water.

Gross truck weights are generally limited on roadways to 80,000 pounds. A dry bulk ship carrying 80,000 tons of cargo could equate to 2,000 round-trip truck moves. Railcars, which can transport an average of 110 tons each, could generate in excess of 700 railcar moves in each direction from that railhead. This is similar for liquid bulk cargo as well, where a standard tank railcar may average 35,000 gallons. A small feeder ship or barge is equal to 15 railcars or 70 trucks.

2.3.2 Vessel Sizes

Modern-day vessels have become increasingly larger to keep up with the increased scale of transported goods. This has been a trend since the 1960's when the generation of World War II vessels became outdated and were placed with larger vessels. This trend has also resulted in the need to decrease infrastructure limitations at ports by deepening and widening harbor channels, raising bridges, expanding rail corridors, expanding road and highway access, and increasing the amount of property dedicated to cargo handling at marine intermodal facilities. These efforts have put a strain on the existing port networks because most North American ports were constructed in downtown areas and were designed to accommodate a generation of vessels that has been replaced by much larger vessels. Subsequently, the size of port equipment (cranes, railcars, truck capacity, shoreside transportation corridors) has also needed to increase.

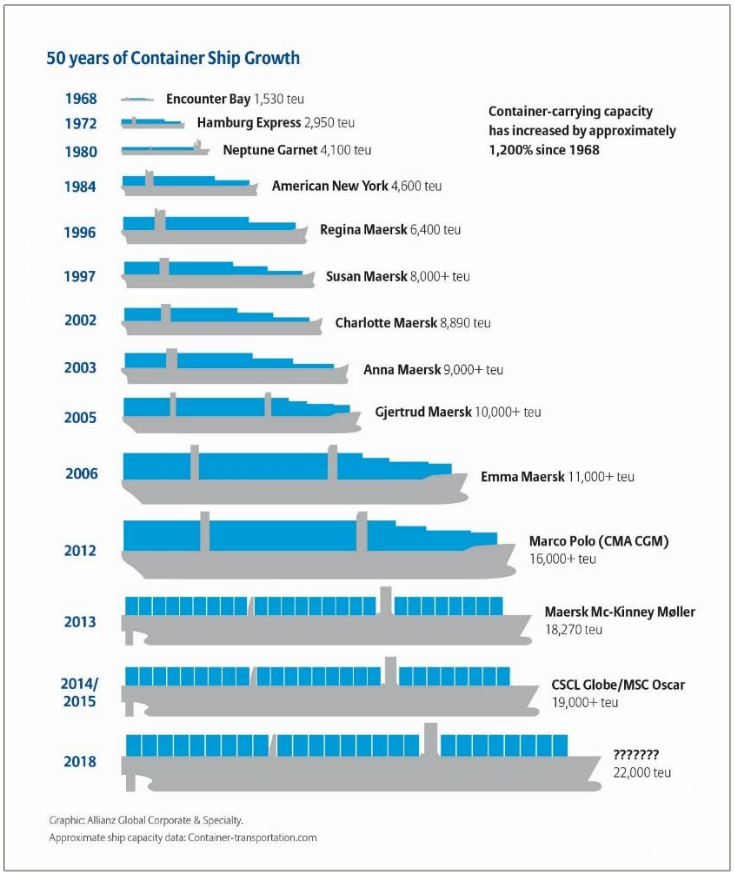
Texas ports have evolved to serve the needs of most of the state. However, they are limited in their ability to accommodate the largest bulk or container vessels now in service or projected over the next decade. Currently, the ports can handle vessels slightly above the average medium ship size in the industry.

Dry and liquid bulk ships (tankers) have also increased substantially in size over the last 40 years. The latest trend is the rapid development of larger ships associated with the container trade. Containerization dates back to the 19th century but the first successful container shipping company was launched on April 26, 1956 when trucking company owner Malcom McLean loaded 58 20-foot-long trainer vans aboard a refitted T-2 tanker renamed the IDEAL-X which sailed from Newark, NJ to Houston, TX (Figure 2-6).

Source: IAMPE

Figure 2-6. The IDEAL-X and handling the first containers aboard in 1956

The 524-foot long, 30-foot wide, 28-foot draft IDEAL-X would later be eclipsed by some of the largest ships in service (see Figure 2-7). The MSC OSCAR, for example, is 1,297 feet long, 194 feet wide, with a draft of 55 feet and carries 19,224 20-foot long containers.



Source: World Shipping Council

Figure 2-7. Growth of Container Ship Size through Time

The biggest container ships in the world are not primarily designed for the North American trade market. The largest container ships currently being built are the OOCL HONG KONG class capable of carrying 21,000 twenty-foot equivalent units (TEU's). These vessels have an overall length of 1,312 feet, a beam (width) of 194 feet and a draft of 58 feet and is deployed in the Asia-European market.

Most U.S. ports now undertaking infrastructure improvements, such as dredging channels and lifting bridges, will have the capacity to handle up to a maximum of 14,000 TEU's. U.S. east coast ports have already had container ships with capacities of 14,000 TEU's calling on major port areas including Savannah and New York. A list of some of the containerships calling on select U.S. Ports is provided in Table 2-1.

Table 2-1. US Department of Transportation (USDOT)/MARAD Capacities of Containerships Calling on Selected US Ports by TEU Per Vessel, 2016

Port Name	Maximum TEU Vessel	Average TEU Vessel	Count of Vessels
ANCHORAGE, AK	5,510	3,940	78
BALTIMORE, MD	9,400	5,534	381
BOSTON, MA	8,930	5,760	159
CHARLESTON, SC	10,700	5,791	1,377
FREEPORT, TX	2,602	2,198	107
GULFPORT, MS	2,602	1,244	130
HOUSTON, TX	6,732	4,132	935
JACKSONVILLE, FL	9,040	4,254	432
LONG BEACH, CA	17,859	6,498	927
LOS ANGELES, CA	17,859	6,473	1,169
MIAMI, FL	8,814	3,290	1,056
MOBILE, AL	6,572	4,695	222
NEW ORLEANS, LA	6,732	4,118	546
NEW YORK, NY	8,814	3,608	32
NEWARK, NJ	10,700	5,584	2,296
NORFOLK-NEWPORT NEWS, VA	10,700	5,901	1,858
OAKLAND, CA	17,859	6,637	1,735
PHILADELPHIA, PA	9,403	3,160	585
PORT EVERGLADES, FL	6,732	2,017	1,633
PORT MANATEE, FL	2,490	783	66
PORTLAND, ME	724	710	21
PORTLAND, OR	2,118	2,118	12
RICHMOND-PETERSBURG, VA	523	523	2
SAN DIEGO, CA	1,740	1,411	82
SAN JUAN, PR	5,018	1,797	263
SAVANNAH, GA	10,700	5,656	1,992
TAMPA, FL	3,426	2,868	57
WEST PALM BEACH, FL	1,147	720	234
WILMINGTON, DE	2,524	1,661	220
WILMINGTON, NC	8,452	2,821	292

Source: U.S. Customs and Border Protection Entrance Data, CBP Form 1300 & IHS Maritime

2.4 Industry Trends

2.4.1 Infrastructure

Over the last several years, ports have been challenged to meet the perceived changing demands of ever-increasing ship size and cargo volumes. Port improvements have included terminal expansion, new container cranes, harbor and channel dredging, increased rail corridor height clearances, and roadway improvements. In addition, terminals have adjusted to the new requirements for port security under the Marine Transportation Security Act of 2002. Billions of dollars have been spent on projects funded by the ports and the states in which they reside, as well as the federal government through various grant and loan programs. Port improvements have also included a number of public-private partnerships to improve port facilities.

A recent survey conducted by the American Association of Port Authorities in regard to planned port and infrastructure identified $154.8 billion in planned infrastructure investment between 2017 and 2020. Land and waterside connection investment was estimated to be $24.825 billion by the federal government. This was triple the $46 billion that was expected to be spent in a survey conducted five years ago.[4]

2.4.2 Panama and Suez Canals

International canals located on major shipping routes that connect two significant bodies of water were built to reduce sea passage time on trade routes. While there are numerous canals throughout the world, most built decades ago, two major canals impact access to North American markets related to substantive international trade. These are the Panama Canal and Suez Canal.

Both the Panama Canal's new expanded lock development and the expansion of the Suez Canal waterway to permit two-way traffic will have major impacts on trade route selection and utilization of vessels on those routes. Both of these canal projects have been undertaken to accommodate larger vessels typically used in modern bulk and container trading.

The canals are not without competition. The Chinese have built the 8,000-mile-long "Silk Railway" which connects China and Northern Europe. Construction was undertaken to ensure Chinese markets were not forced to use just one type of transportation mode in spite of the fact that over 50 percent of the world's container trade is controlled by Chinese companies. Panama Canal traffic faces competition from North American railroads, which have pledged to keep costs controlled to match or better those of the Panama Canal tolls. In both cases, the systematic approach to transportation has benefitted shippers who now have choices for all or part of their shipping requirements.[5]

[4] AAPA Member Survey on Port Infrastructure Investment, 2016
[5] Ports Prepare for Expanded Canal, Maritime Executive, June 2016

Panama Canal

The Panama Canal lock expansion project was concluded in 2016 (Figure 2-8). Prior to the completion of the improvements, the Panama Canal handled approximately 3 percent of the world's total maritime trade. Due to the size of the original locks, vessels sizes were limited to 965 feet in overall length, 106 feet in breadth, 40 feet in draft, and had a 190-foot air draft restriction. These Panamax Class ships, carrying up to 10-12,000 TEU's, were outsized by larger ships proposed by ocean carriers at that time.[6]

Source: Panama Canal Authority

Figure 2-8. The Panama Canal

The new locks completed in 2016 can accommodate vessels up to 1,201 feet in length, 161 feet in breadth and 50 feet in draft, accommodating vessels of nearly 16,000 TEU's, known as Neopanamax vessels (formerly called post-Panamax).

Based upon the Canal's projections in 2012, the Panama Canal Authority expected an increase of 4,750 ships per year which would accommodate 4-5 percent of the world's total international commerce. In 2014 the Panama Canal handled 13,481 vessels and in 2016, the year the new locks opened, the canal posted 13,114 vessels for the year. In fiscal year 2019 (October through September) the Panama Canal accommodated 12,311 oceangoing commercial vessels alone.[7](Table 2-2).

[6] Panama Canal Authority

[7] Panama Canal Authority

Table 2-2. Oceangoing Commercial Vessels Transiting the Panama Canal FY 2019 (October through September)

Vessel Type	Panamax	Neopanamax	Panamax % Total	Neopanamax % Total	TOTAL
Dry Bulk	2,362	295	25.3%	10.0%	2,657
Liquid Natural Gas	0	393	0.0%	13.3%	393
Liquid Petroleum Gas	373	714	4.0%	24.1%	1,087
Container	1,241	1,334	13.3%	45.0%	2,575
Reefer	668	0	7.1%	0.0%	668
General Cargo	654	0	7.0%	0.0%	654
Cruise	230	12	2.5%	0.4%	242
Chemical Tankers	2,062	9	22.1%	0.3%	2,071
Crude Product Tankers	566	149	6.1%	5.0%	715
Vehicle Carriers/RORO	826	54	8.8%	1.8%	880
Other	366	3	3.9%	0.1%	369
TOTAL	**9,348**	**2,963**			**12,311**

Source: Panama Canal Authority

The Panama Canal Authority is currently considering additional and larger locks and has been assessing the development of transload facilities within the Panama Canal and on the east and west coasts of Panama. These areas would be connected by the 47.6-mile Panama Railroad, which is partly owned by Kansas City Southern. A second canal has also been proposed for construction in Nicaragua by Chinese and Russian interests; however, aside from government approvals, little actual construction has taken place to date.

In 2016, 66.4 percent of the cargo moving through the Panama Canal either originated or had a final destination in the United States.[8] (Table 2-3). Dry and liquid bulk ships accounted for a significant number of transits, carrying mostly minerals, grains, fertilizers, ores, metals, petroleum products, and liquefied gases and chemicals. Container vessels were the fourth largest vessel type transiting the Panama Canal.[9]

[8] Panama Canal Authority
[9] Ibid

Table 2-3. Top 15 Countries by Origin and Destination of Cargo Transiting the Panama Canal FY 2019

Rank	Country	Origin	Destination	Intercoastal	Total	Total Excluding Intercoastal	Percent of Total
1	United States	109,117,170	60,411,664	2,015,223	169,528,834	167,513,610	66.4
2	China	20,893,644	13,314,706	-	34,208,350	34,208,350	13.6
3	Japan	6,511,797	27,622,221	-	34,134,018	34,134,018	13.5
4	Chile	13,632,171	16,878,918	-	30,511,089	30,511,089	12.1
5	Mexico	7,427,862	21,343,346	492,169	28,771,208	28,279,039	11.2
6	Korea	10,054,726	15,889,433	-	25,944,159	25,944,159	10.3
7	Colombia	16,241,809	7,411,879	612,930	23,653,688	23,040,758	9.1
8	Peru	8,677,054	13,224,465	-	21,901,519	21,901,519	8.7
9	Canada	10,006,157	4,183,314	45,524	14,189,471	14,143,947	5.6
10	Ecuador	4,904,326	7,880,689	-	12,785,015	12,785,015	5.1
11	Panama	1,604,679	7,335,695	68,090	8,940,374	8,872,284	3.5
12	Guatemala	1,164,558	6,745,365	-	7,909,923	7,909,923	3.1
13	Trinidad and Tobago	5,020,097	235,788	-	5,255,884	5,255,884	2.1
14	Spain	1,956,680	2,832,217	-	4,788,897	4,788,897	1.9
15	Taiwan	2,051,034	2,518,470	-	4,569,504	4,569,504	1.8

Source: Panama Canal Authority

Suez Canal

One of the most frequently used waterways in the world is the Suez Canal. The Suez Canal is a man-made sea level waterway extending north to south across the Isthmus of Suez in Egypt. The canal, which runs between Port Said Harbor and the Gulf of Suez, connects the Mediterranean Sea and the Red Sea and provides the shortest waterway route between Europe and the Indian and western Pacific Ocean nations. It also allows for the fastest ocean crossing from the Atlantic Ocean to the Indian Ocean.

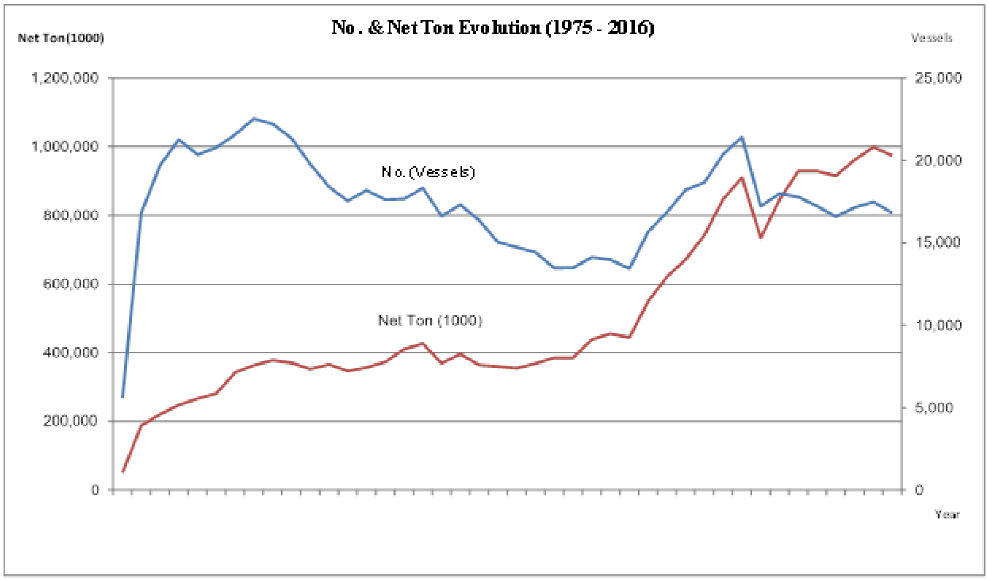
The Suez Canal is 120 miles long, 79 feet deep, and 673 feet wide. In 2015, the single direction flow of traffic was changed when the canal was widened to allow room for vessels to transit in both directions at the same time. In 2016, the canal handled an average of 46 ships per day and a total of 16,833 ships during the year. The canal can accommodate ships up to 240,000 DWT with unlimited length and proportional beam that are up to 66 feet in draft. The air draft clearance is 223 feet and except for the very largest crude carriers, the Suez Canal can handle most of the world's largest ships, including the largest container ships now in service. The transit history of the Suez Canal from 2000 to 2016 is provided in Table 2-5 and is depicted graphically on Figure 2-9.

Table 2-4. Vessel Transits by Type 2015-2019

Ship Type	Number of Vessels				
	2015	2016	2017	2018	2019 (Jan-Nov)
Tankers	4,316	4,292	4,537	4,724	4,681
LNG	670	575	567	691	686
Bulk Carriers	2,878	2,801	3,288	3,821	3,792
General Cargo	1,527	1,662	1,542	1,330	1,367
Container Ships	5,941	5,414	5,568	5,706	4,952
Roll on/roll off (Ro-Ro) Ships	387	461	370	315	203
Car Carriers	939	875	885	868	809
Passenger Ships	68	70	82	96	98
Others	757	683	711	623	641
Total	**17,483**	**16,833**	**17,550**	**18,174**	**17,229**

Table 2-5. Suez Canal Transit History 2000-2019

Year	Number of Vessels		Net Ton (1000)	
	Total	Daily Avg.	Total	Daily Avg.
2002	13,447	36.8	444,786	1,218.6
2003	15,667	42.9	549,381	1,505.2
2004	16,850	46.0	621,253	1,697.4
2005	18,224	49.9	671,951	1,841.0
2006	18,664	51.1	742,708	2,034.8
2007	20,384	55.8	848,162	2,323.7
2008	21,415	58.5	910,059	2,486.5
2009	17,228	47.2	734,453	2,012.2
2010	17,993	49.3	846,389	2,318.9
2011	17,799	48.8	928,880	2,544.9
2012	17,224	47.2	928,472	2,543.8
2013	16,596	45.5	915,468	2,508.1
2014	17,148	47.0	962,747	2,637.7
2015	17,483	47.9	998,654	2,736.0
2016	16,833	46.0	974,184	2,661.7
2017	17,550	48.1	1,041,573	2,853.6
2018	18,174	47.1	1,139,629	3,122.3
2019 (Jan-Nov)	17,229	47.2	1,103,218	3,022.5



Source: Suez Canal Authority

Figure 2-9. New Suez Canal Vessel and Tonnage Trends

Overall, given the larger size of the Suez Canal, Asia sourced or bound bulk commodities that either originate or are destined for Gulf of Mexico ports may most likely use the Suez Canal. This is particularly true of commodities related to the Middle East or India. Many of the larger ships that are able to transit the Suez Canal are too large for U.S. Gulf Coast ports; however, the overall number, capacity, and size of vessels transiting both the Suez Canal and the Panama canals continue to increase.

2.5 Cargo Trends

In 2008, the U.S. economic downturn reduced the volume of containers moving in and out of North America; however, liquid and dry bulk commodity transport remained relatively steady. This included crude oil, petroleum products and chemicals, liquefied gases and agricultural products such as grains. While North America is a significant consumer market, Europe remains the focus of commodity shipment, partly because North America also produces and consumes its own commodities such as crude oil, natural gas, and coal. Slow recovery in Europe has caused growth to lag behind North American recovery. Overall, Asia and Europe dominate the international commodity market (see Table 2-6).[10]

In 2015-2016, estimated world seaborne trade volumes surpassed 10 billion tons. The number of shipments grew by 2.1 percent, a pace notably slower than the historical average. The tanker trade segment recorded its best performance since 2008, while growth in the dry cargo sector, including bulk commodities and containerized trade in commodities, were lower than expected. Of note was an economic slowdown in China

[10] UNCTAD Review of Maritime Trade, 2016

and reduction of trade. Additionally, other trades have continued slow growth, particularly between the southern and northern hemispheres.[11]

Table 2-6. World Trade Origin and Destination Region by Category

Category	Dry Cargo	Crude Oil	Oil Products
Origin			
#1Region	Asia	Asia	Asia
#2 Region	Europe	Africa	Europe
Destination			
#1 Region	Asia	Asia	Asia
#2 Region	Europe	North America	Europe

Source: UNCTAD

In addition, bulk dry and liquid bulk cargo movement remains strong or is increasing. This includes the shipment of liquefied gas products. Of note is the shift for the United States from a net importer of liquefied natural gas (LNG) and crude oil to an increasing exporter due to shale oil and gas production.

The world fleet grew by 3.5 percent in the 12 months prior to 1 January 2016 (in terms of dead-weight tons (dwt)). This was the lowest growth rate since 2003, yet still higher than the 2.1 percent growth in demand, which has led to a continued situation of global overcapacity. Most shipping segments, except for tankers, suffered historic low levels of freight rates and weak earnings, triggered by weak demand and oversupply of new tonnage. The tanker market remained strong, mainly because of the continuing and exceptional fall in oil prices. In the container segment, freight rates declined steadily, reaching record low prices as the market continued to deal with weakening demand and the presence of ever-larger container vessels that had entered the market during the year. This was one of the reasons for the failure of the South Korean container line Hanjin in 2015, which removed from service 600,000 containers with little impact on existing low container rates. In an effort to deal with low freight rate levels and reduce losses, carriers continue to consider measures to improve efficiency and optimize operations. Efforts include cascading, idling, slow steaming, consolidation and integration and restructuring of new alliances.[12]

Of note is the trend in perishable transportation which is currently undergoing a change from refrigerated (reefer) ships to specialized reefer containers (reefer boxes) (Figure 2-10). Perishable cargo mostly includes agricultural and seafood products, but temperature sensitive commodities also include wine and beer, consumable oils and temperature sensitive chemicals. The number of containerships equipped to carry reefer boxes increased by 6 percent in 2015.[13] By 2018, that number is expected to increase by 20 percent. Due to the increased availability of container slots worldwide and

[11] UNCTAD Review of Maritime Trade, 2016

[12] Drewry Annual Review of the Reefer Market, 2016.

[13] Global Trade Report on Reefer Cargo Trends, January 2016.

containerized capacity, cargo has begun to shift from conventional break bulk reefer ships to containers.

Figure 2-10. Reefer Boxes (white) Stowed on a Container Vessel

The leading container carriers are expanding reefer carriage capacity on vessels and adding reefer box connections and monitoring equipment. As of 2015, over 72 percent of reefer transport capacity was containerized. As a result, the reefer sector is reporting continued cargo growth which is filling empty units and available slots on ships.[14] This trend is impacting containerized marine terminals, which are handling more reefer containers and are required to provide power units for connection of the boxes to shore plugs.

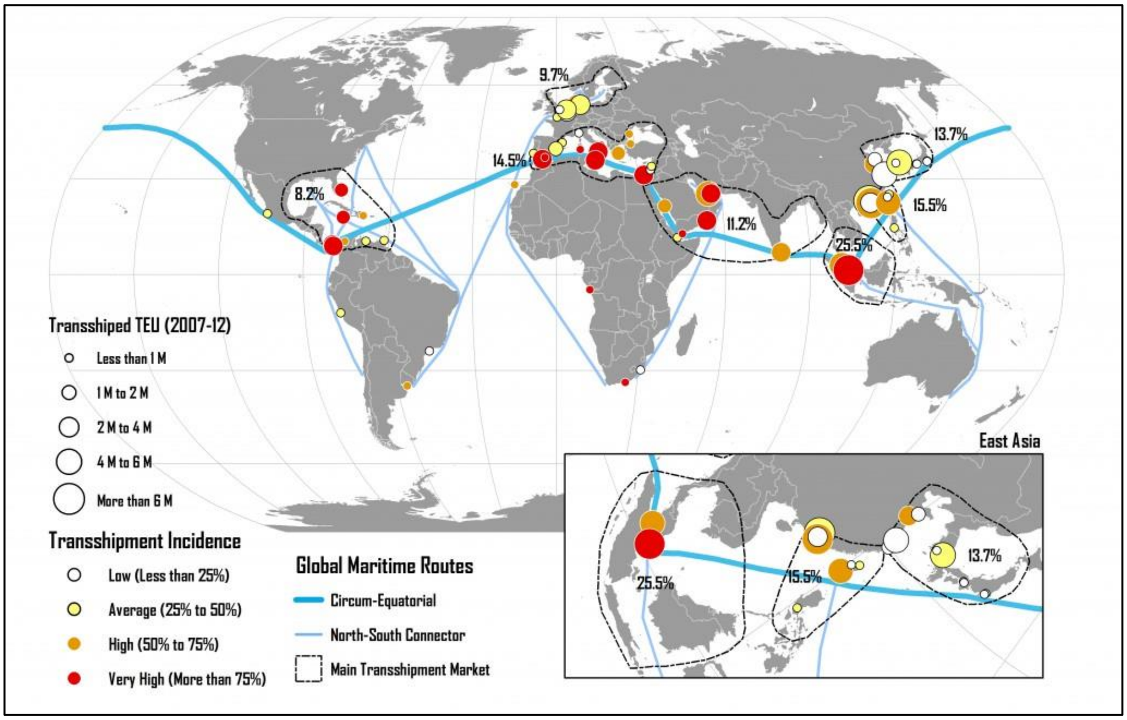
It is widely recognized that many ports cannot handle the largest ships and that marine transportation networks must include small to mid-size ports as well. In a 2016 study, it was found that using larger ships (>18,000 TEU's) did not return a significant cost benefit to shippers because of the decreased service frequency and the higher supply chain risks associated with ships carrying larger volumes that are concentrated on fewer vessels. Ports face a challenge in keeping up with continual growth of vessel sizes.

Additionally, there are environmental issues associated with required harbor dredging and terminal expansion. Ports and terminals must make significant investment in infrastructure to accommodate those larger vessels. This results in higher port costs that are passed onto shippers.[15] The study echoes an earlier concept advanced by the International Association of Maritime Economists in 1998.

---

[14] Drewry Annual Review of the Reefer Market, 2016.
[15] Drewry Study on the Impacts of Ultra Large Container Ships on Shipper Costs, 2016.

The industry is also seeing the emergence of the hub and spoke system in containerized marine transportation that was anticipated 25 years ago, whereby ultra-large container ships (ULCS) serve fewer ports and transload to mid-size and smaller ships. Similar to the system used in aviation for aircraft deployment, the hub and spoke system has provided new opportunities for small to mid-size ports that did not previously handle containers. As Figure 2-11 shows, these transload ports are predominately located along key shipping routes.



Source: porteconomics.eu

Figure 2-11. Worldwide Container Transload Ports

Some companies like the Mediterranean Shipping Company (MSC) are widening existing vessels to increase their capacity by up to 30 percent without resulting in a substantial change in draft (Figure 2-12). MSC is also planning to build a total of eight 9,500-TEU ships, Maersk is planning seven 3,000-TEU ships and CMA CGM has built and deployed the first of 28 ships that are designed to handle between 9,400 and 10,900 TEU's. These ships are ideal for U.S. Gulf Coast ports that have channel depth/width and air draft restrictions and limited shoreside infrastructure such as adequate land, cranes and ground equipment and restricted rail and road connectivity.

Source: MSC Source: CMA CGM

Figure 2-12. (Left) MSC's Widened Ship – before and after; (Right) CMA-CGM 10,000 TEU Danube Class Vessel

Channel size and depth of water are not the only issues for ports. The terminals must be equipped with the proper equipment including cranes and ground equipment. Modern container ships require large gantry cranes that exceed 25 rows in reach from the edge of the pier to the outside edge of the ship (Source: Port of Savannah

Figure 2-13).

Source: Port of Savannah

Figure 2-13. Gantry Cranes

Currently, existing gantry cranes at ports around the world are being replaced by taller cranes with extended reach to meet the demands of larger ships. Ports in the cities of New York, Norfolk, Charleston, Savannah, Jacksonville, Port Canaveral, Miami, Tampa and Houston have ordered new gantry cranes within the last several years for their container terminals. The newer container cranes are faster, more technologically advanced, and can load and unload vessels at a much faster pace than the last generation of Panamax gantry cranes. Gantry crane dimensions are provided in Table 2-7. Recently in the Port of Savannah, port productivity reached 200 container moves per hour using six cranes on a single vessel.[16]

[16] Port of Savannah Georgia.

Table 2-7. Gantry Crane Dimensions

Dimensions	Panamax	Neo-Panamax	Megamax
Outreach	30-40 Meters	40-46 Meters	46-69 Meters
Lift Height	24-30 Meters	30-35 Meters	35-49 Meters
Capacity (Safe Working Load)	40-65 Metric Tons (MT)	40-65 MT	65-80 MT
Hoisting Speed	50-125 M/min	60-150 M/min	70-175 M/min
Trolley Speed	150-180 M/min	180-210 M/min	210-240 M/min
Travel Speed	45 M/min	45 M/min	45 M/min
Wheel Load	30-45 MT/m	40-55 MT/m	60-80 MT/m

Source: IAMPE 1 Meter=3.28 Feet

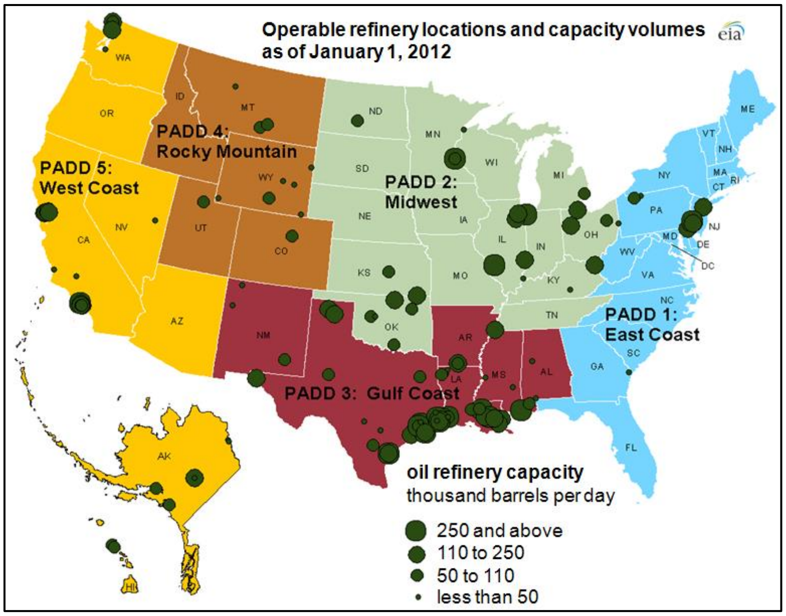
2.5.1 Trends and Impacts of Trade on Texas Ports

The Texas ports handle a large and diverse mix of commodities, particularly fossil fuels and their related refined products, and are strong contenders for continued growth and increased throughput. This is mostly a result of an increased consumer base in and around key Texas communities. In addition, increased energy production in the U.S. has resulted in a shift to export rather than import petroleum and gas. The most significant factors that impact handling capacity for all commodities include harbor infrastructure, road and rail connections, and expandability of port property.

The flow of commodities into and out of the region is not just tied to Texas ports. Due to the extent of the intermodal transportation network, Texas ports compete with ports throughout North America to attract and retain shippers. Texas has a strong petrochemical and gas production capability which provides the state with a solid industrial base to meet domestic and international demand. Container capacity and throughput, while increasing in the region, are very competitive in regard to handling among ports in the US. The need to accommodate larger containerships has evolved as the strategic focus for numerous coastal ports including those in Texas and the Gulf. This has created new investment requirements and has increased capital and operating costs at those ports. To remain competitive, ports are focused equally on expanding throughput volumes in both the local and in-transit markets to keep the per unit, or per ton costs low. In-transit volumes have created the capacity to expand volumes when local regional market needs have been met. While the resulting advantage is lower costs to shippers, the disadvantage is higher traffic volumes and related congestion in associated port areas.

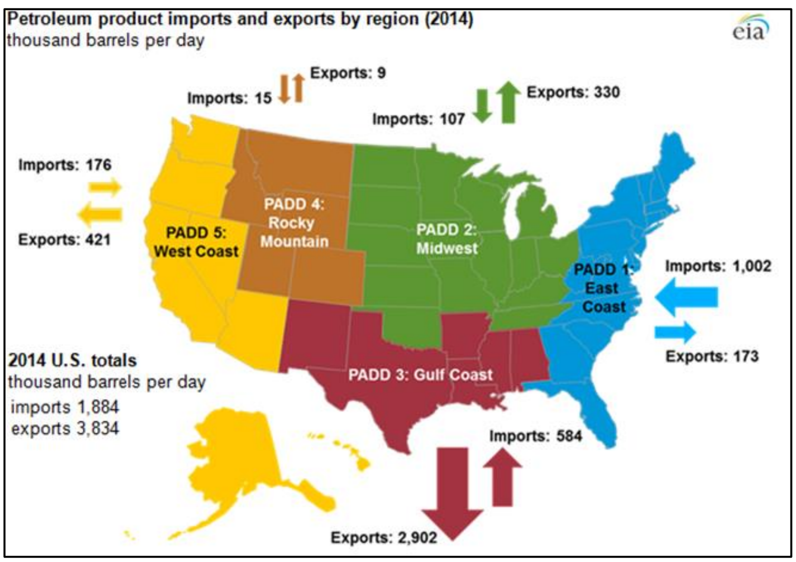
Crude Oil and Refined Products

Over 45 percent of total U.S. petroleum refining capacity and 51 percent of total U.S. natural gas processing plant capacity is located along the Gulf coast. Many of these facilities are concentrated within the Houston region (Figure 2-14 and Figure 2-15). This geographic concentration results in multiple product flows to and from these refineries, using multiple modes of transportation.



Source: Energy Information Administration (EIA)

Figure 2-14. U.S. Refinery Locations and Capacity Volumes

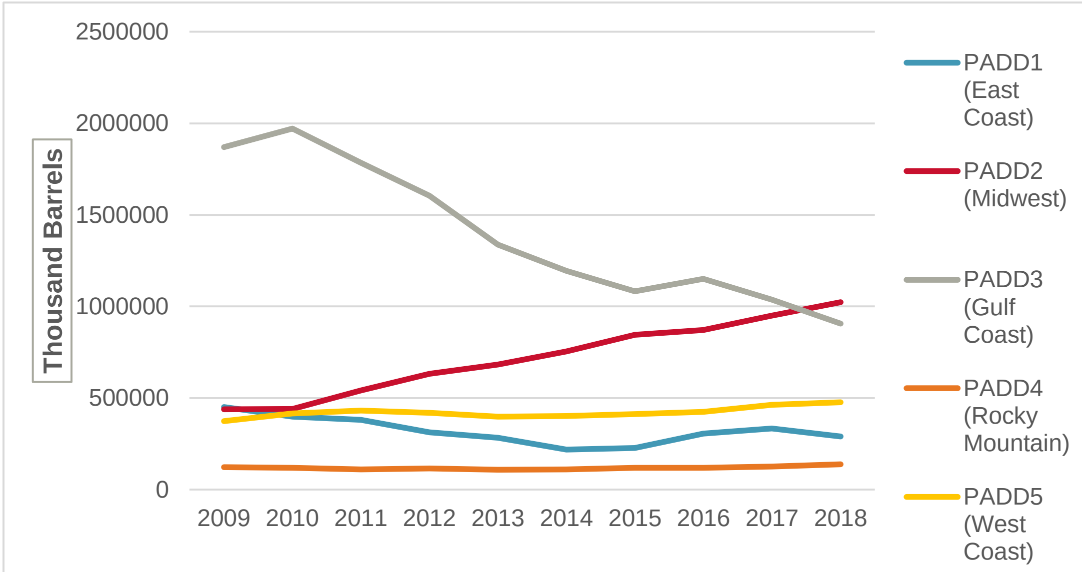


Source: EIA

Figure 2-15. U.S. Petroleum Import and Exports by Region

In 2016, two commodities, crude oil and oil (not crude) from petrol and bituminous minerals, accounted for nearly 80 percent of the Houston region's ports of non-containerized imports. Petroleum products, crude oil and chemicals comprise over 85 percent of all trade flows in the region's ports.

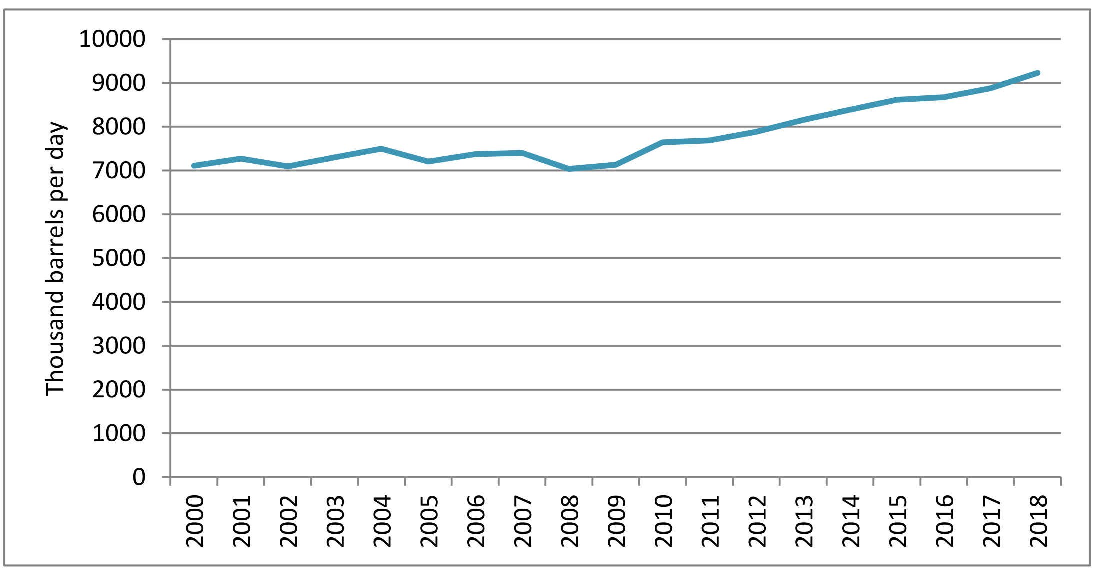
Increasing U.S. domestically produced crude oil has resulted in the displacement of imports. This has significantly impacted crude oil import tonnage through the Gulf Coast ports as shown in Figure 2-16.



Source: EIA

Figure 2-16. U.S. Crude Oil Import Tonnage

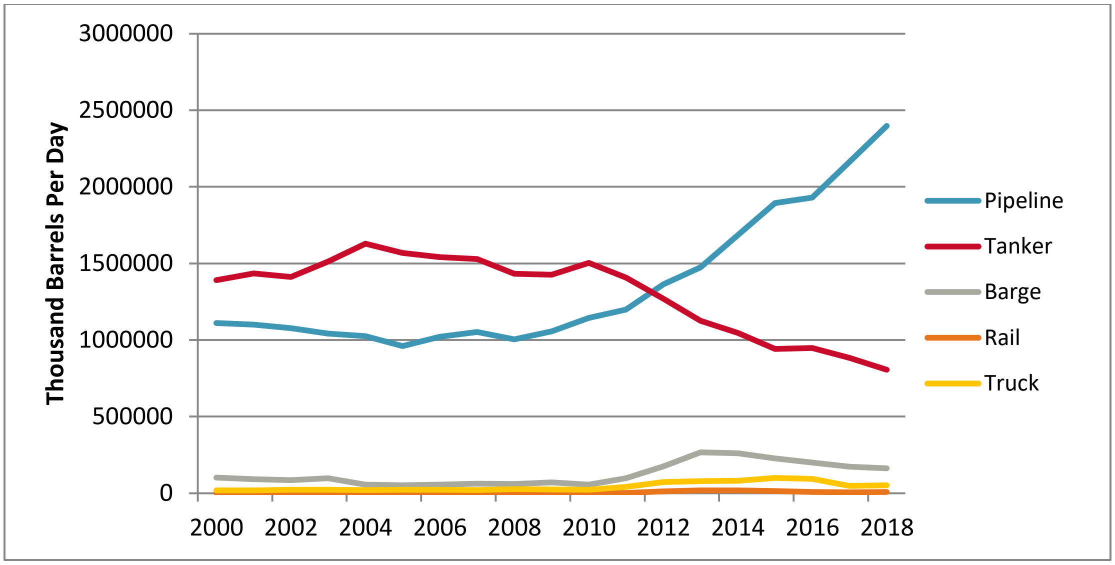
Despite the drop in import volume, the gross inputs to the Gulf Coast refineries (PADD 3 area) have been increasing as shown in Figure 2-17



Source: EIA

Figure 2-17. Gulf Coast Refineries – Gross Inputs

The displacement of crude oil imports to domestic production has also resulted in significant shifts in the mode of transportation supplying crude oil to the Gulf Coast refineries as shown in Figure 2-18



Source: EIA

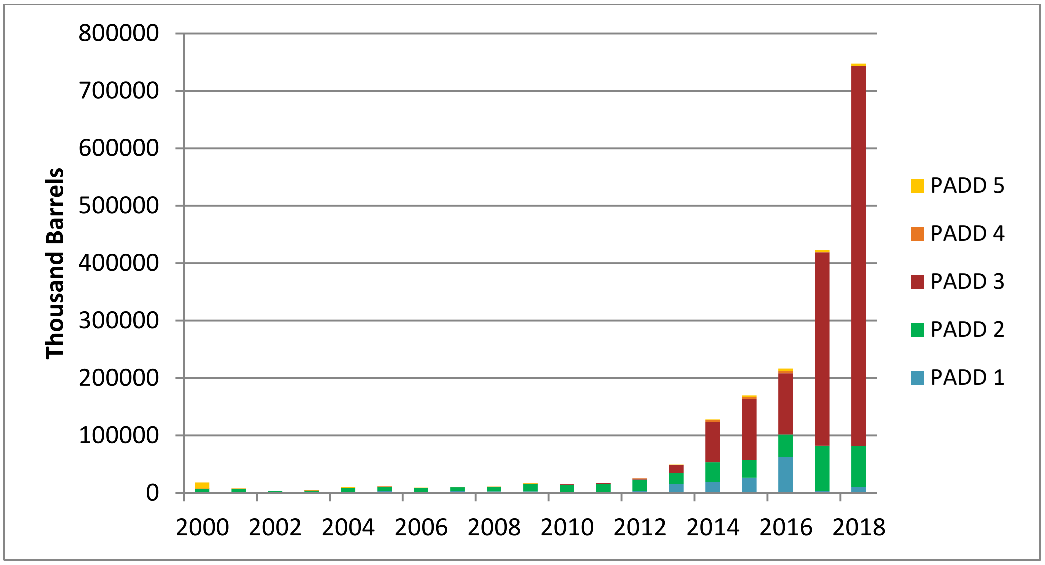
Figure 2-18. PADD 3 Refinery Receipts of Crude Oil by Mode of Transportation

Greater onshore production from across North America has resulted in the increased use of rail and barges to move oil from the wellhead to refineries and terminals for distribution to the final consumer. Although pipelines continue to be the predominant mode for moving both crude oil and refined products, rail shipments had increased substantially in recent years, especially in the north eastern region of the U.S. U.S. regional oil shipments by rail increased from less than 1 percent in the first 6 months of 2010 to 22.6 percent in the first 6 months of 2015.Tankers and barges also move crude oil on U.S. inland waterways, from port to port along the coast, or on the Great Lakes. The use of tankers and barges for oil transport has risen as well, from 2.1 percent in the first 6 months of 2010 to 3.2 percent in the first 6 months of 2015.17 Total oil shipments by rail, increased from 20 million barrels in 2010 to 384 million barrels, or more than 1 million barrels/day, in 2014/15.18 However since more pipeline capacity has come online in recent years to feed the Gulf refineries, the use of rail and barge for crude oil movements supplying the Gulf Coast refineries has dropped.

Prior to December 2015, crude oil exports were restricted to exports from Alaska, certain domestically produced crude oil destined for Canada, shipments to U.S. territories, and California crude oil to Pacific Rim countries. Since the growth in domestic crude oil production and the enacted legislation authorizing the export of U.S. crude oil without a license, exports through the Gulf Coast ports have grown rapidly (Figure 2-19). Export destinations of U.S. crude are shown in Figure 2-20. In late 2018, the Gulf coast became a net exporter of crude oil.

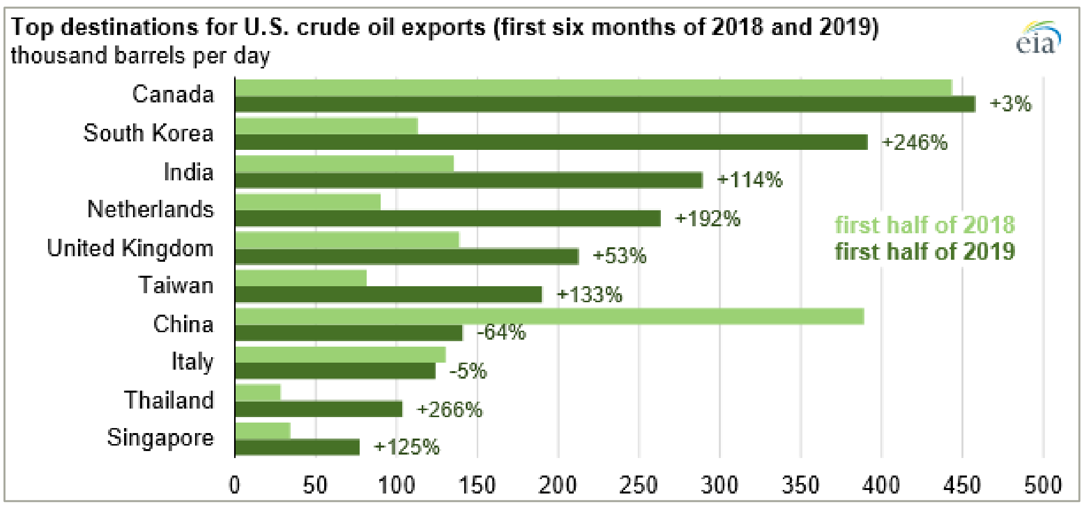
[17] Ibid

[18] Energy Information Administration, 2015



Source: EIA

Figure 2-19. Exports of Crude Oil by PADD Region



Source: EIA

Figure 2-20. U.S. Crude Oil Exports

Liquefied Gases

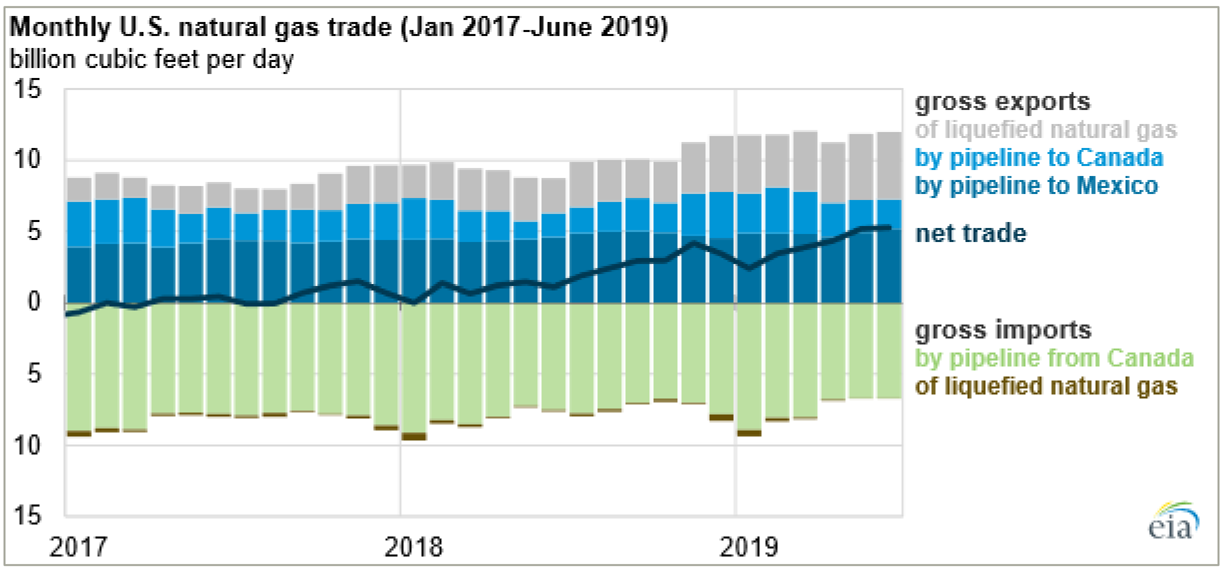
The U.S. is currently the world's largest natural gas producer, having surpassed Russia in 2009. Natural gas production in the U.S. increased from 55 billion cubic feet per day (Bcf/d) in 2008 to 83.8 Bcf/d in 2018. Most of this natural gas, about 96 percent in 2016, is consumed domestically.[19]

Liquefying natural gas serves as a way to transport natural gas long distances when pipeline transport isn’t feasible. Stranded markets that are geographically isolated and

[19] Ibid

too far from producing regions to be connected directly to pipelines have access to natural gas because of LNG. In its liquid form, natural gas can be shipped in special tankers to and from terminals in the U.S. and in other countries. At these terminals, the LNG is stored and returned to its gaseous state prior to transport by pipeline to residential and industrial consumers, as well as directly to thermal power plants. The volume of natural gas in its liquid state is about 600 times smaller than its volume in its gaseous state.

In 2017, the U.S became a net exporter of natural gas export more natural gas than it imports. The trend (Figure 2-21) is expected to continue because of growing U.S. natural gas exports to Mexico, slightly declining pipeline imports from Canada, and increasing exports of LNG.[20]

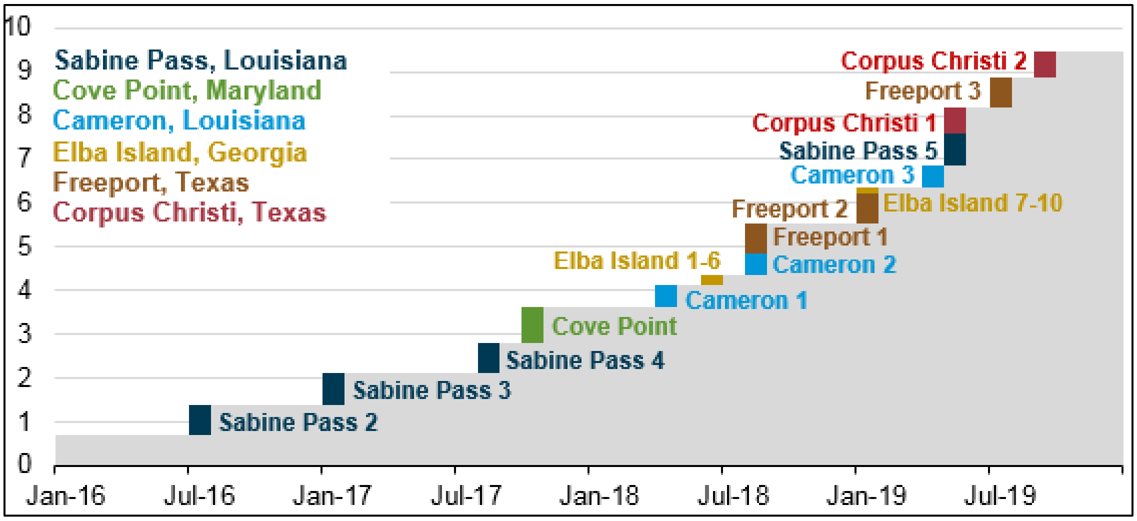


Source: EIA

Figure 2-21. U.S. Natural Gas Net Trade 2016-2018 projected

U.S. exports of LNG are expected to increase as U.S. liquefaction capacity continues to expand. Five new projects currently under construction, Cove Point, Cameron, Elba Island, Freeport, and Corpus Christi and will come online in the next three years (Figure 2-22). This will increase total U.S. liquefaction capacity from 1.4 Bcf/d at the end of 2016 to 9.5 Bcf/d by the end of 2019.[21]

[20] U.S. Energy Information Administration's Natural Gas Annual 2018 Report.
[21] U.S. Energy Information Administration's Short-Term Energy Outlook, 2017.

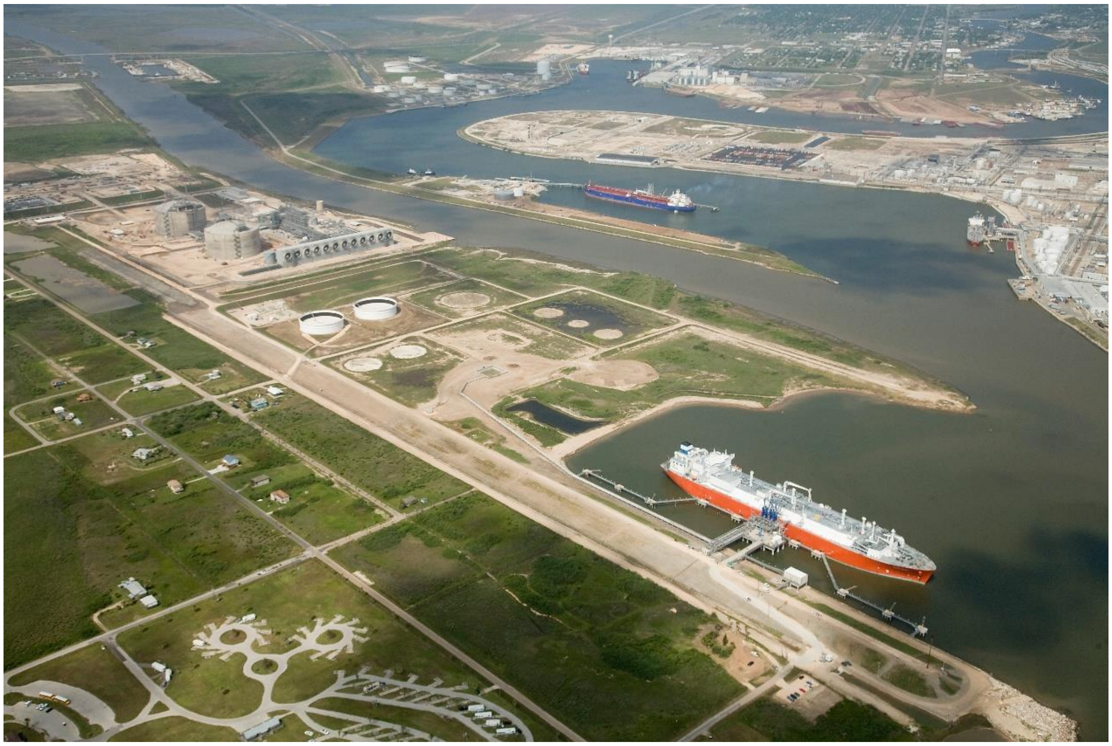


Source: EIA

Figure 2-22. U.S. LNG Capacity 2016-projected to 2019 Billion Cubic Feet per Day

In 2002, Freeport LNG was established to construct an LNG import and regasification facility at Quintana Island near Freeport. In 2014, the facility was permitted by the Federal Energy regulatory Commission (FERC) to become an export facility. In September 2019 it shipped the first LNG commissioning cargo of 150,000 cubic meters of LNG. Freeport's Train 2 is advancing pre-commissioning to support an in-service date of January 2020. Train 3 is nearing completion to support an in-service date of May 2020. By 2020 it is anticipated that the U.S. will have the third largest LNG export capacity in the world (after Australia and Qatar). However, actual use of U.S. LNG export terminals will be affected by the rate of global LNG demand growth and competition from other global LNG suppliers.[22]

[22] U.S. Energy Information Administration's Short-Term Energy Outlook 2017.



Source: Freeport LNG Development, L.P.

Figure 2-23. Freeport LNG Facility

Container Trade

IMPORTS

Houston ranks fourth in overall containerized import tonnage, as shown in Table 2-8. The U.S. South Atlantic port region has shown the strongest growth in containerized imports over the recent years with a 7.4 percent Compound Annual Growth Rate (CAGR), compared to all the Gulf Coast ports at 0.9 percent. The overall CAGR across all regions was 3.4 percent. For all U.S. containerized imports, the Gulf Coast ports accounted for 11.1 percent. Imports into the South Atlantic and North Atlantic Ports displayed significant growth between 2014 and 2015 (Table 2-9, Table 2-10). The growth in Asian cargo at Atlantic and Gulf Coast ports reflects increased use of all water services as beneficial cargo owners diverted from west coast ports due to reliability and congestion issues on the west coast during labor contract negotiations. Overall, Gulf Coast ports have shown sustained growth with Asian trade (Table 2-11).

Table 2-8. Leading U.S. Ports Import Container Tonnage

	2013	2014	2015	2016	2017	2018
Los Angeles/Long Beach	47,932,867	51,029,012	51,381,823	51,702,665	53,901,664	56,231,748
New York/New Jersey	27,049,235	28,501,213	31,111,135	29,491,940	31,061,250	32,498,672
Savannah, GA	9,378,331	10,936,153	12,522,571	13,120,850	14,113,011	15,593,967
Houston, TX	**9,164,241**	**10,871,750**	**11,106,971**	**10,063,169**	**11,977,040**	**12,920,695**
Norfolk-Newport News, VA	7,782,339	8,452,593	9,151,189	9,840,910	10,517,446	10,720,965
Charleston, SC	5,788,518	6,808,932	7,860,249	7,791,446	9,137,012	8,782,736
Oakland, CA	6,435,992	6,909,218	6,901,979	7,068,215	7,273,579	7,363,529
Seattle, WA	4,614,508	3,850,138	3,707,356	3,775,605	4,687,410	5,423,651
Tacoma, WA	4,898,992	5,668,682	5,894,051	6,199,011	5,129,118	5,079,972
Baltimore, MD	4,039,852	4,426,493	4,987,755	5,019,547	5,656,409	5,979,093
Miami, FL	2,767,898	2,931,658	3,575,891	3,606,890	3,694,004	3,845,579
New Orleans, LA	3,049,175	4,063,590	3,745,658	3,168,154	2,942,090	2,945,250
Port Everglades, FL	2,692,631	3,143,495	3,197,989	3,458,950	3,447,555	3,573,189
Philadelphia, PA	2,443,601	2,845,488	3,305,134	3,371,097	3,593,451	3,542,665
Mobile, AL	1,569,416	1,100,686	1,384,428	1,417,035	1,603,962	1,342,107
Jacksonville, FL	1,317,076	1,466,637	1,768,542	1,890,498	1,953,515	2,200,621
Wilmington, DE	1,290,712	1,275,751	1,449,238	1,473,583	1,286,571	1,643,073
Boston, MA	918,708	1,118,249	1,225,362	1,091,974	1,169,258	1,240,988
Gulfport, MS	850,155	1,141,598	1,013,090	1,083,713	981,820	908,867
All Other	9,595,193	9,338,500	8,749,241	8,203,455	8,120,960	8,584,363
Grand Total	**153,579,441**	**165,879,836**	**174,039,654**	**172,838,705**	**187,131,787**	**196,984,843**

Table 2-9. U.S. Port Region Import Tonnage

Region	2013	2014	2015	2016	2017	2018
Pacific SW	48,714,742	52,021,038	52,519,597	52,882,288	54,883,071	57,367,732
North Atlantic	44,510,064	47,735,275	52,385,230	51,565,230	54,955,125	56,877,251
South Atlantic	23,565,074	26,876,199	30,618,458	31,253,646	33,430,045	35,586,775
Gulf	18,693,564	19,800,583	20,350,626	19,124,414	21,238,215	22,049,600
Pacific NW	10,816,879	10,713,821	9,879,940	10,155,377	9,983,039	10,555,085
NOCAL	7,280,511	7,508,469	7,692,857	7,715,940	7,953,729	8,461,077
Other	4,205,494	4,487,977	4,390,451	4,555,125	4,688,564	6,087,323
Grand Total	**157,786,329**	**169,143,362**	**177,837,158**	**177,252,020**	**187,131,787**	**196,984,843**

Table 2-10. U.S. Port Regions by Share of Import Tonnage

Region	2013	2014	2015	2016	2017	2018
Pacific SW	30.9%	30.8%	29.5%	29.8%	29.3%	29.1%
North Atlantic	28.2%	28.2%	29.5%	29.1%	29.4%	28.9%
South Atlantic	14.9%	15.9%	17.2%	17.6%	17.9%	18.1%
Gulf	11.8%	11.7%	11.4%	10.8%	11.3%	11.2%
Pacific NW	6.9%	6.3%	5.6%	5.7%	5.3%	5.4%
NOCAL	4.6%	4.4%	4.3%	4.4%	4.3%	4.3%
Other	2.7%	2.7%	2.5%	2.6%	2.5%	3.1%

Table 2-11. U.S. Port Region Containerized Imports from Asia (China, SE and SW Asia, Japan, Korea) Short Tons

Port Region	2013	2014	2015	2016	2017	2018
Pacific SW	43,143,939	45,545,253	46,225,230	45,813,249	47,998,153	50,129,672
North Atlantic	17,684,028	19,290,225	21,361,962	21,823,469	24,007,298	25,465,366
South Atlantic	11,710,303	13,375,396	15,802,574	16,210,740	17,643,248	19,228,531
Pacific NW	9,821,282	9,565,558	8,585,615	8,747,684	8,341,725	8,909,157
Gulf	4,582,258	5,106,792	5,760,873	6,044,743	7,875,865	8,793,557
NOCAL	4,626,966	4,930,086	5,085,713	5,311,179	5,333,441	5,563,037
Other	677,584	685,781	773,637	700,742	1,292,886	1,655,658
Grand Total	**92,246,360**	**98,499,090**	**103,595,605**	**104,651,805**	**112,492,616**	**119,744,979**

All-water services via the Panama Canal and the Suez Canal have increased in response to beneficial cargo owners desire to minimize future U.S. west coast reliability issues. All-water service growth also reflects growth in distribution centers and warehousing at Atlantic and Gulf Coast ports.

Beneficial cargo owners located in close proximity to Atlantic and Gulf Coast ports are most likely to use all-water services for Asian cargo as this minimization of transit time differentials is critical and the farther west from the port the import location, the greater the competition with land bridge via the west coast ports, especially Los Angeles and Long Beach, California.

China dominates the source of all U.S imports, followed by Northern Europe and Southeast Asia. Southwestern Asia, Middle East and SE Asia appear to be growing trading partner regions, though the Southeast Asia trade sources favor Suez routings.

Northern Europe is the key source of containerized imports into Houston, followed by China and the Mediterranean. Imports from China have shown growth, along with imports from the Med and Middle East. Trade with Central America has also been strong and growing. Houston has lost market share on the South American East Coast import sourcing (Table 2-12; Table 2-13).

Table 2-12. Containerized Imports (Short Tons) into Houston by Trade Lane

Trade Lane	2013	2014	2015	2016	2017	2018
China	1,438,366	1,598,950	2,054,187	2,434,220	3,089,889	3,455,007
North Europe	2,392,525	2,612,260	2,461,160	2,054,448	2,413,684	2,452,345
Mediterranean	1,311,037	1,563,841	1,639,121	1,368,848	1,818,336	1,717,400
South America	1,467,584	1,310,886	1,356,038	1,391,987	1,508,713	1,627,769
SW Asia	768,497	975,949	917,827	727,320	938,536	1,051,519
SE Asia	310,476	202,743	362,539	392,079	617,331	793,561
Central America	332,059	462,977	733,328	714,412	569,604	539,781
Middle East	264,831	299,502	334,275	367,862	401,377	514,896
Japan/Korea	512,542	296,904	216,205	280,232	316,703	457,102
Australia/NZ	114,766	146,867	163,713	110,861	89,371	136,833
Africa	164,329	158,890	176,761	119,315	129,342	105,521
Caribbean	85,820	43,954	55,465	53,241	82,576	67,203
All Other	52	6	95	189	449	1,078
Canada	1,442	2,677	886	4,052	1,128	679
Grand Total	**9,690,285**	**9,164,324**	**9,676,406**	**10,471,601**	**10,019,066**	**11,977,040**

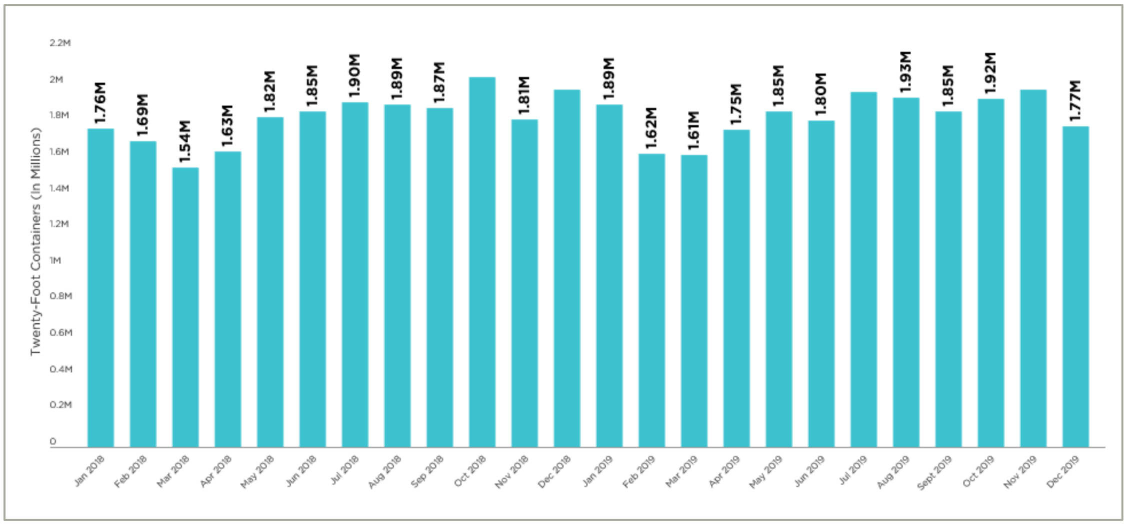
Table 2-13. Containerized Imports into Houston by Commodity (Short Tons)

Commodity	2013	2014	2015	2016	2017	2018
73 Articles Of Iron, Steel	880,289	1,013,760	954,059	879,205	1,118,023	1,314,689
44 Wood And Articles Of Wood; Wood Charcoal	381,396	450,292	529,996	679,045	833,629	895,903
29 Organic Chemicals	812,789	825,139	759,363	592,190	758,445	860,250
84 Nuclear Reactors, Boilers, Machinery etc.; Parts	449,417	524,952	649,368	566,937	654,224	809,974
39 Plastics And Articles Thereof	409,949	483,037	463,301	524,677	656,109	792,685
68 Art Of Stone, Plaster, Cement, Asbestos, Mica etc.	548,272	588,273	692,972	661,736	756,470	750,289
22 Beverages, Spirits And Vinegar	827,729	538,489	909,114	841,711	764,305	712,237
69 Ceramic Products	485,710	488,782	472,498	539,286	602,306	582,381
94 Furniture; Bedding etc; Lamps Nesoi etc; Prefab Bd	175,004	193,222	245,723	313,129	483,410	550,709
76 Aluminum And Articles Thereof	215,059	184,347	183,620	258,896	315,497	454,516
38 Miscellaneous Chemical Products	248,194	282,236	379,141	263,427	357,530	371,596
85 Electric Machinery etc; Sound Equip; Tv Equip; Pts	127,297	166,644	306,932	247,044	298,602	316,709
72 Iron And Steel	224,874	367,373	243,486	251,690	349,625	308,554
40 Rubber And Articles Thereof	183,603	242,906	278,440	280,649	278,378	303,737
25 Salt; Sulphur; Stone; Cement; Lime	238,539	284,251	229,683	177,039	293,747	288,399
Other	2,956,202	3,042,702	3,168,432	2,938,478	3,447,965	3,601,51
Grand Total	**9,164,324**	**9,676,406**	**10,466,128**	**10,015,140**	**11,968,264**	**12,914,143**

The Port of Houston currently underperforms in terms of retail imports and containerized perishables. This is surprising given recent data that in 2019, container imports are expected to set a new annual high for ports tracked by the National Retail Federation (NRF). The ports tracked by the NRF are expected to handle 21.9 million TEU, up from 21.8 Million TEU in 2018 which in itself was an increase of 6.2 percent above 2017 volume.[23] Container tracking included the U.S. ports of Los Angeles/Long Beach, Oakland, Seattle and Tacoma on the West Coast; New York/New Jersey, Hampton

[23] Global Port Tracker, National Retail Federation and Hackett Associates, Aug 2017

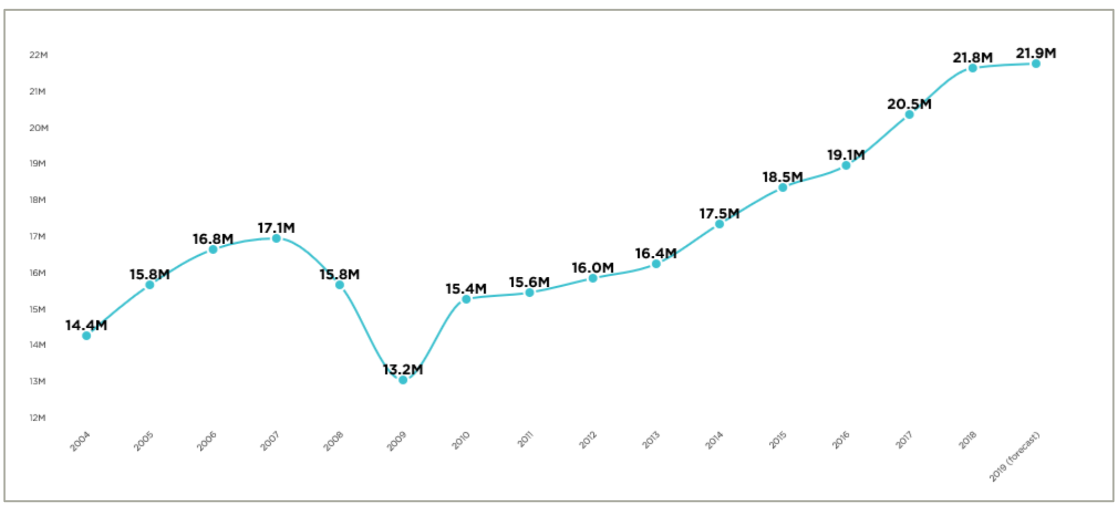
Roads, Charleston, Savannah, Port Everglades and Miami on the East Coast, and Houston on the Gulf Coast. Figure 2-24 and Figure 2-25 illustrate trends in retail imports.



Source: National Retail Federation

Figure 2-24. Monthly Retail Imports 2018-2019 (TEU - Millions

Retail sales and import numbers though ports have a direct correlation and have continued to show a long-term pattern of increase. Total retail sales have grown year-over-year every month since November 2009, and retail sales, excluding automobiles, gasoline stations and restaurants, have increased year-over-year in all but three months since the beginning of 2010.



Source: Global Port Tracker

Figure 2-25. Retail Imports and Trend 2004-2019 (TEU – Millions)

Exports

Houston is the second largest U.S. port for containerized exports, as shown in Table 2-14). Since 2011, Gulf coast ports have increased market share significantly in containerized exports, narrowing the gap with the Pacific South West and South Atlantic ports (Table 2-15; Table 2-16).

Table 2-14. Leading U.S. Ports Export Container Tonnage

	2013	2014	2015	2016	2017	2018
Los Angeles / Long Beach CA (Port)	27,887,128	28,071,094	23,673,301	28,781,226	30,986,725	33,637,251
Houston, TX (Port)	13,799,406	11,268,687	12,399,017	12,398,542	13,735,276	16,897,909
Savannah, GA (Port)	11,939,888	12,463,108	11,770,994	12,032,727	13,609,133	15,396,344
Norfolk-Newport News, VA (Port)	7,600,130	8,011,786	7,951,255	8,426,316	9,419,715	11,842,421
New York / New Jersey (Port)	9,639,910	9,224,749	9,439,195	10,497,412	11,683,276	13,751,707
Oakland, CA (Port)	7,260,291	7,075,866	6,540,787	7,846,088	8,180,562	8,600,720
Charleston, SC (Port)	5,124,441	5,582,200	6,014,037	6,340,474	7,272,743	8,042,054
Tacoma, WA (Port)	5,430,215	5,692,962	5,465,082	7,084,078	6,608,374	7,139,629
Seattle, WA (Port)	4,913,401	4,375,012	4,018,116	4,323,145	5,070,470	5,258,345
New Orleans, LA (Port)	2,693,379	2,974,459	3,620,223	3,827,152	4,125,728	4,622,531
Baltimore, MD (Port)	1,657,038	1,588,354	1,586,584	2,160,135	2,511,936	2,710,980
Miami, FL (Port)	2,025,444	1,989,171	1,974,872	2,321,167	2,478,916	2,537,676
Port Everglades, FL (Port)	1,755,167	1,831,937	2,257,581	1,940,408	2,142,382	2,298,476
Mobile, AL (Port)	1,556,319	1,652,510	1,401,173	1,542,018	1,756,278	1,822,596
Freeport, TX (Port)	222,615	489,847	1,131,506	1,412,020	1,408,315	1,601,404
Wilmington, NC (Port)	1,090,431	1,052,966	978,832	1,032,162	1,226,586	1,561,076
Jacksonville, FL (Port)	1,192,299	1,170,334	965,194	1,107,214	1,193,225	1,174,001
Boston, MA (Port)	512,975	523,823	538,025	776,130	926,724	914,614
All Other	7,560,408	8,886,849	8,233,764	8,531,668	8,460,827	8,754,716

Table 2-15. U.S. Port Region Export Tonnage

Region	2013	2014	2015	2016	2017	2018
Pacific SW	27,944,363	28,157,513	23,786,270	28,888,663	31,110,752	33,757,233
South Atlantic	23,752,721	24,808,322	24,671,974	25,511,792	28,690,623	31,707,829
North Atlantic	20,528,145	20,545,721	20,732,709	23,057,845	26,045,769	30,761,032
Gulf	21,344,931	20,127,140	22,314,392	22,775,782	24,477,710	28,715,482
Pacific NW	11,476,004	10,899,265	9,939,325	12,189,677	12,209,277	12,947,903
NOCAL	7,560,234	7,553,248	6,890,170	8,087,613	8,713,463	9,034,257
Other	1,254,485	1,834,503	1,624,698	1,868,711	1,549,599	1,640,715
Grand Total	**113,860,883**	**113,925,713**	**109,959,538**	**122,380,083**	**132,797,192**	**148,564,450**

Table 2-16. U.S. Port Regions by Share of Import Tonnage

Region	2013	2014	2015	2016	2017	2018
Pacific SW	24.5%	24.7%	21.6%	23.6%	23.4%	22.7%
South Atlantic	20.9%	21.8%	22.4%	20.8%	21.6%	21.3%
North Atlantic	18.0%	18.0%	18.9%	18.8%	19.6%	20.7%
Gulf	18.7%	17.7%	20.3%	18.6%	18.4%	19.3%
Pacific NW	10.1%	9.6%	9.0%	10.0%	9.2%	8.7%
NOCAL	6.6%	6.6%	6.3%	6.6%	6.6%	6.1%
Other	1.1%	1.6%	1.5%	1.5%	1.2%	1.1%

The year 2015 indicates an overall decline in U.S. exports due to strength of the U.S. dollar and international economic troubles. Exports to the east coast of South America grew between 2014 and 2015. Overall, Central America, the Mediterranean and South American west and east coasts appear to be growth markets, despite lower economic conditions in 2015 (Table 2-17).

Table 2-17. U.S. Containerized Exports by Trade Lane

Trade Lane	2013	2014	2015	2016	2018	2018
China	33,532,919	35,647,937	34,665,040	31,599,817	39,151,533	41,073,535
SE Asia	10,642,195	10,731,717	11,306,099	11,445,234	15,223,119	16,244,421
Japan/Korea	15,369,347	14,403,853	15,058,601	14,397,894	14,836,073	15,948,164
North Europe	11,977,354	12,291,872	12,634,771	12,483,540	12,335,371	13,888,913
South America	11,025,430	11,297,038	11,265,843	11,528,794	9,970,205	10,264,976
SW Asia	4,909,105	4,562,059	4,778,591	4,963,116	6,222,212	8,102,305
Mediterranean	6,844,675	7,147,056	6,988,289	6,266,802	6,375,641	7,372,046
Central America	5,303,150	5,903,781	5,362,361	5,551,634	5,885,305	6,024,371
Middle East	3,297,857	3,477,658	3,631,650	3,680,621	4,091,002	4,519,241
Caribbean	2,856,931	3,024,312	2,958,999	3,097,270	3,464,618	3,497,053
Africa	2,410,544	2,804,861	2,661,231	2,558,825	2,574,866	3,144,511
Australia/NZ	2,437,678	2,440,844	2,485,171	2,258,478	2,114,531	2,575,078
All Other	132,986	127,823	128,902	127,300	135,429	142,434
Canada	103	71	164	213	179	144
Total	**117,134,948**	**110,740,275**	**113,860,883**	**113,925,713**	**109,959,538**	**122,380,083**

Compared to the overall U.S. containerized exports, Houston underserves China, Southeastern Asia and Japan/Korea (Table 2-18).

Table 2-18. Containerized Export Short Tons through Houston

Region	2013	2014	2015	2016	2017	2018
South America	3,655,391	3,312,973	3,337,373	2,999,096	3,061,919	3,417,887
North Europe	2,410,674	1,880,837	2,035,107	1,969,178	2,123,083	2,496,651
Mediterranean	1,549,436	1,350,834	1,382,080	1,340,013	1,482,837	1,669,616
China	791,941	789,586	1,137,963	1,155,493	1,467,273	1,462,356
Japan/Korea	343,303	227,523	344,163	281,693	257,893	1,374,765
Central America	1,687,353	956,894	921,839	1,010,238	1,003,708	1,365,404
Africa	1,181,766	982,194	1,046,092	1,101,934	1,276,221	1,329,554
SE Asia	234,335	243,243	505,429	646,258	621,262	1,249,037
SW Asia	464,904	375,916	478,465	701,317	1,348,377	1,168,524
Middle East	725,170	701,439	708,367	766,979	662,643	701,312
Caribbean	531,951	316,197	359,814	358,061	352,337	548,944
Australia/NZ	221,475	129,563	138,826	66,047	74,796	111,833
All Other	1,707	1,487	3,498	2,236	2,927	2,026
Grand Total	**13,799,406**	**11,268,687**	**12,399,017**	**12,398,542**	**13,735,276**	**16,897,909**

Houston's containerized exports are highly concentrated in plastics and organic chemicals, as indicated in Table 2-19.

Table 2-19. Containerized Exports from Houston by Commodity (Short Tons)

Commodity	2013	2014	2015	2016	2017	2018
39 Plastics And Articles Thereof	4,277,923	3,727,885	4,525,395	4,747,151	4,747,978	6,145,575
29 Organic Chemicals	1,160,971	1,427,629	2,011,650	2,210,895	3,811,854	2,100,264
27 Mineral Fuel, Oil Etc.; Bitumin Subst; Mineral Wax	2,800,316	590,808	809,760	694,545	737,305	916,058
38 Miscellaneous Chemical Products	583,336	652,501	667,756	581,761	626,670	652,354
52 Cotton, Including Yarn And Woven Fabric Thereof	220,582	275,964	326,014	396,921	680,185	603,919
10 Cereals	451,592	394,414	353,732	629,456	476,270	455,001
40 Rubber And Articles Thereof	382,044	376,144	404,618	448,088	413,428	376,046
02 Meat And Edible Meat Offal	257,220	255,103	226,720	230,031	283,369	319,680
84 Nuclear Reactors, Boilers, Machinery Etc.; Parts	358,568	366,757	312,484	248,489	250,282	276,889
72 Iron And Steel	250,032	178,872	214,755	250,202	230,260	265,471
87 Vehicles; and Parts and Accessories Thereof	118,577	110,041	118,913	134,343	175,723	250,357
7 Vegetables and Certain roots and Tubers; Edible	125,528	95,555	136,729	184,398	178,325	179,220
25 Salt; Sulfur; Earth & Stone; Lime & Cement Plaster	126,024	175,830	175,278	137,104	138,505	173,485
34 Soap etc; Waxes, Polish etc; Candles; Dental Preps	135,923	151,788	173,751	146,691	161,354	163,197
73 Articles Of Iron Or Steel	162,174	164,357	139,619	128,270	117,719	149,965
Other	2,388,596	2,325,039	2,090,831	1,698,416	1,575,354	1,629,582
Grand Total	**13,799,406**	**11,268,687**	**12,688,006**	**12,866,761**	**14,604,582**	**14,657,063**

Expanded plastics and resin capacity from Houston area producers is expected to drive future growth in exports. This will require supply of empty equipment, carrier capacity, chassis and aggressive rates to compete with railing of boxcars to Dallas for stuffing and use of intermodal to the west coast ports of Los Angeles and Long Beach and then to China/Northeast Asia/Asia.

Cruise Trade

The Port of Galveston has established itself as a premier cruise ship port and this, similar to freight requirements, has driven the rapid increase of ship size, which also requires new and expanded infrastructure at the port. Cruise ships, which at one time, would handle only hundreds of passengers a decade ago, have grown to handle nearly 6,000 passengers on a single trip. Mid-size cruise ships, common to Texas, can generate 3,000 or more private vehicle or bus moves on a single vessel turnaround every week... Since 1980, the industry has experienced an average annual passenger growth rate of approximately 7 percent per annum.[24] In the United States, 11.9 million people cruised in 2019. A total of 18 new ocean and specialty ships were deployed into worldwide markets in 2019. Nearly 34 percent of cruises serve the Caribbean market from ports from the U.S. Gulf and east coasts. Worldwide, cruising is expected to exceed 30 million passengers in 2019.[25]

Cruise ships are either “Homeported”, where complete passenger exchanges and servicing is handled or do “Port of Calls” where stays are just long enough for passengers to enjoy shoreside attractions. Homeport vessels generate the highest level of economic impact and fees and also generate the highest level of traffic. Galveston is situated near the Houston metro area and airports for cruise ship homeport operations in addition to handling cargo traffic. Houston, Freeport, and Port of Texas City are better suited and planned for domestic and international cargo operations. While cruise ships and their operations are outside the context of this particular freight study, it should be noted that a key enabler of cruise ship operations is the efficient supply and on-time replenishment of consumables to the ship, including food and beverages which are typically delivered by truck.

Automotive

Automotive production and distribution require a global transportation network, with the main car manufacturers having production plants across the globe that produce cars for different national and regional markets. Cars are shipped in roll-on roll-off vessels called Pure Car Carriers (PCC) or Pure Car Truck Carrier (PCTC). An average vessel is designed to carry a wide range of vehicles including automobiles, trucks, buses, agricultural and plant equipment. An average 50,000 Gross Ton PCTC, capable of carrying 6,000 car equivalent units (ceu), measures approximately 600 to 625 feet in length with a beam of 95 to 100 feet. These vessels tend to operate on a fixed schedule and may be chartered by one car manufacturer or the vessel owners sell space to different manufacturers. Post-Panamax PCTC’s will have a capacity of 8,500 ceu.

---

[24] Cruise Line International State of the Cruise Industry Report 2019.

[25] Ibid

In 2018, 8.2 million new passenger vehicles were imported to the U.S. United States passenger vehicle sales for 2016 amounted to 17.5 million vehicles. Table 2-20 identifies the top car importing countries to the U.S.

Table 2-20. Origin and Volume of Top Automotive Importing Countries to U.S.

Origin Country	Number of Vehicles Imported to U.S. in 2018
Mexico	2,663,804
Japan	1,724,404
Canada	1,673,287
Korea	831,090
Germany	451,486
United Kingdom	230,021
Italy	148,279

Source: U.S. Department of Commerce

In 2016, the U.S. exported 2,054,906 new passenger vehicles (Table 2-21).

Table 2-21. Top Destinations and Volumes of U.S. Car Exports

Destination Country	Number of Vehicles Exported from the U.S. in 2018
Canada	861,042
China	163,618
Germany	149,035
Mexico	140,585
Saudi Arabia	61,068
Korea	53,273
Australia	48,446

Source: U.S. Department of Commerce

There is also a market for exporting used cars from the U.S. In 2018, 799,470 used cars were exported, with the majority of cars destined for Mexico, United Arab Emirates, Georgia, Nigeria, and Jordan.

The vast majority of vehicle imports arrive by ship into a network of ports across the U.S. Rail is used to transport most vehicles from Canada and Mexico to the U.S., but short sea shipping routes are also used between Mexico and the U.S. due to limited rail capacity and congestion issues within Mexico. According to Kansas City Southern, short sea shipping vehicle exports account for 10 percent of Mexico's vehicle exports to the U.S. while rail accounts for 90 percent[26].

Table 2-22 contains import and export vehicle data for U.S. ports that contributed to the Automotive Logistics' annual survey.

Table 2-22. 2016 U.S. Import and Export Vehicle Ports and Volumes

Port	2016 Import Vehicle Volume	2016 Export Vehicle Volume
Baltimore, MD	561,069	170, 681
Jacksonville, FL	485,657	166,608
Brunswick (including Savannah), GA	440,473	191,240
New York/New Jersey	447,329	57,822
San Diego, CA	352,846	38,108
Portland, OR	240,686	50,556
Charleston, SC	19,348	245,579
Long Beach, CA	253,437	10,557
Davisville, RI	214,189	0
Los Angeles, CA	176,422	22,605
Tacoma, WA	165,687	0
Philadelphia, PA	138,872	0
Richmond, CA	123,457	0
Vancouver, WA	87,600	0
Houston, TX	83,324	2,175
Freeport, TX	19,200	33,800
Grays Harbor, WA	15,126	33,555
Wilmington, DE	0	41,849
Galveston, TX	15,933	0

Source: Automotive Logistics

The Automotive Logistics survey also identified that despite the overall import market to the U.S. may be slowing (volumes were down by 2 percent from 2015), the Houston area

[26] https://automotivelogistics.media/data/north-american-ports-slowdown-growth-tests-capacity-cope

market increased by 23 percent, with a 33 percent increase associated with imports. Particular automotive flows in the Houston region's ports include:

- Freeport – Imports from South Korea, General Motor exports to the Middle East
- Galveston – BMW and Minis from Germany and the UK, Hyundai-Kei vehicles from Mexico.
- Houston – Major import center for Volkswagen Audi Group which receives vehicles by sea from Europe and Mexico and rail imports from Mexico. Fiat Chrysler vehicles are also imported.

Ports not only serve as entry points for import cars, they are increasingly being used as short term storage facilities by the car companies and for undertaking a range of services before the car is received by the dealership. Services include pre-delivery inspections, minor repairs such as paint chips, and fitting accessories.

To facilitate car imports and exports and to provide the necessary storage and processing capacity requires a significant amount of hard standing in close proximity to vessel berths. The use of larger post-Panamax vessels is also likely to have an impact on storage capacity as these larger vessels will discharge more cars in a shorter period of time. For land constrained ports looking to expand auto-handling, this presents a challenge, though other measures such as reducing the dwell time of vehicles, increasing the amount of rail movement rather than trucks, reconfiguring terminals, repurposing redundant space, and employing multi-level car storage facilities are options to increase capacity.

2.6 Regional Historical Trends

The recent history of overall cargo tonnage moving through H-GAC regional ports indicates that the overall volume is relatively static and the respective port's regional market share is also fairly constant (Figure 2-26).

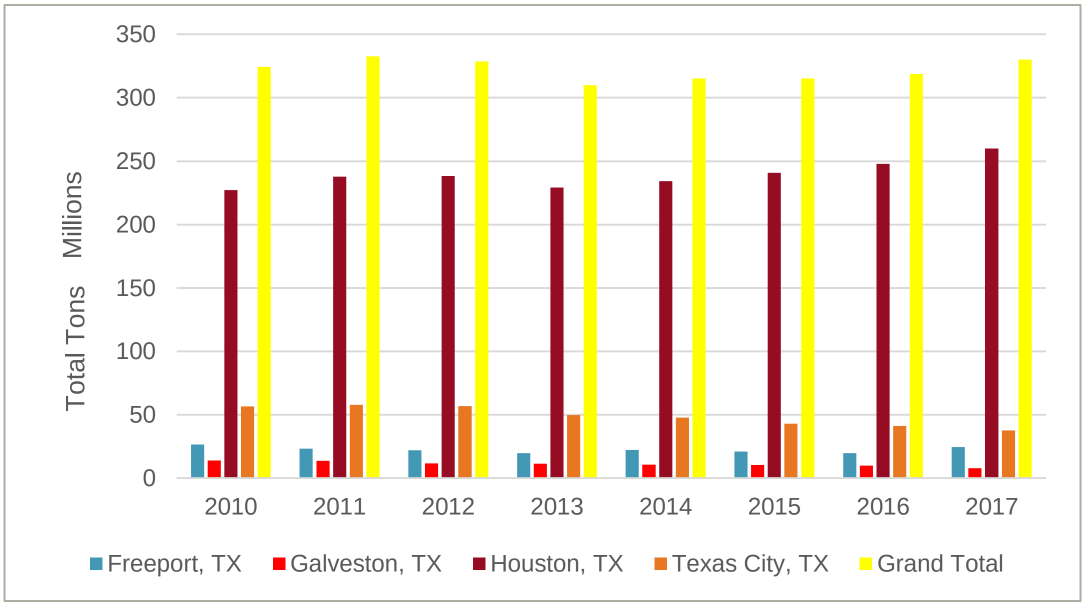


Figure 2-26. Port Tons (Domestic & Foreign)

The various terminals, wharves and piers in the Port of Houston handle 70-75 percent of the total H-GAC region's tonnage (Figure 2-27). Shipments have been increasing as a share of the total as shown in Figure 2-28.

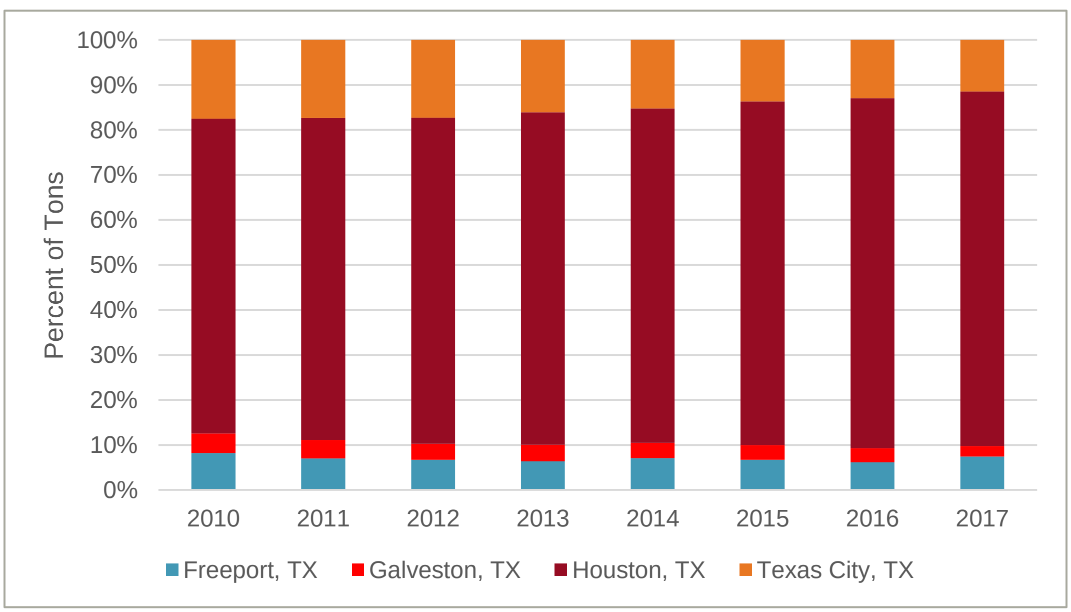


Figure 2-27. Port regional share – All commodities, all types, all directions

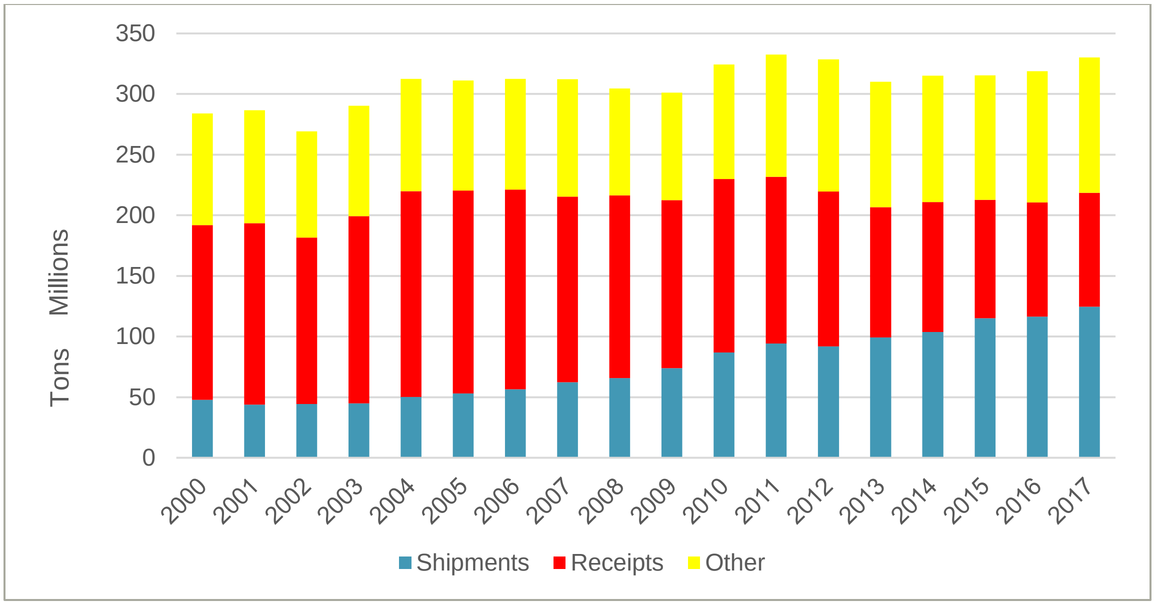


Figure 2-28. All ports, all commodities all directions

Foreign trade across the region's ports accounts for nearly 70% of total tonnage. Ninety five percent of the domestic waterborne trade flows through the region's ports are associated with petroleum products, chemicals and crude oil, whereas these products constitute 74.5% of the foreign trade flows as shown in Figure 2-29. Detailed commodity data associated with foreign, domestic receipt and shipment flows for the region's ports are contained in the Appendix.

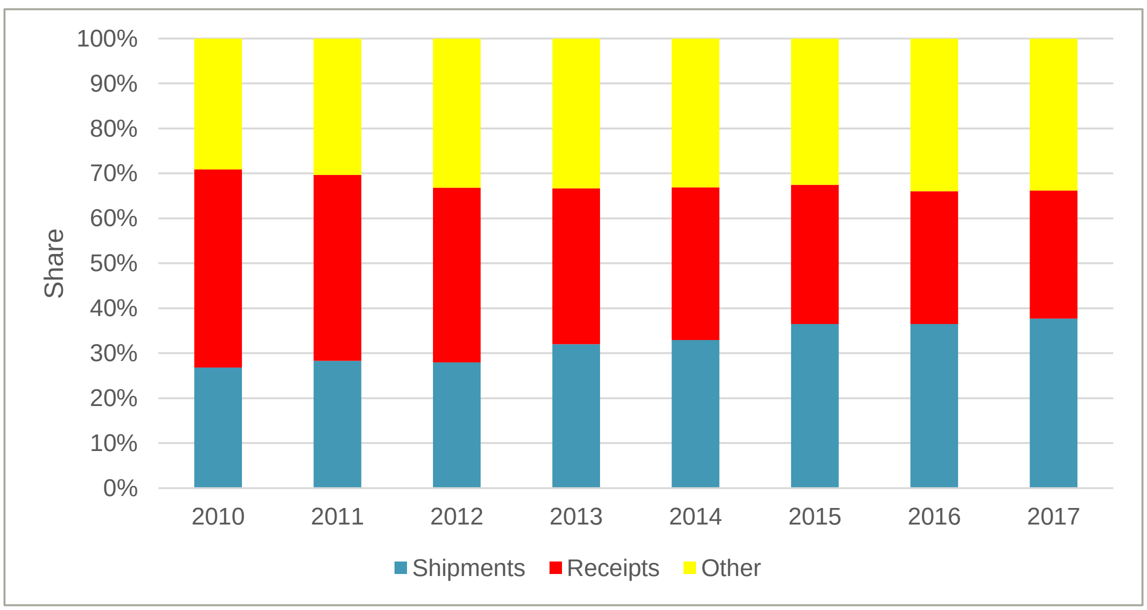


Figure 2-29. Share of Tonnage

2.7 Port of Houston Profile

2.7.1 Description

The Port of Houston is a river port on the Gulf of Mexico in Harris County, Texas and is one of 10 sea ports along Texas' 367 mile-long coastline along the Gulf of Mexico.[27] It is accessed via the Gulf Intercostal Waterway and the Houston Ship Channel, connecting through Galveston Bay. The Port of Houston is located about 290 nautical miles northeast of the Texas/Mexican border and about 470 nautical miles from the mouth of the Mississippi River. Houston is the largest city in the state, and the fourth most populous city in the United States.

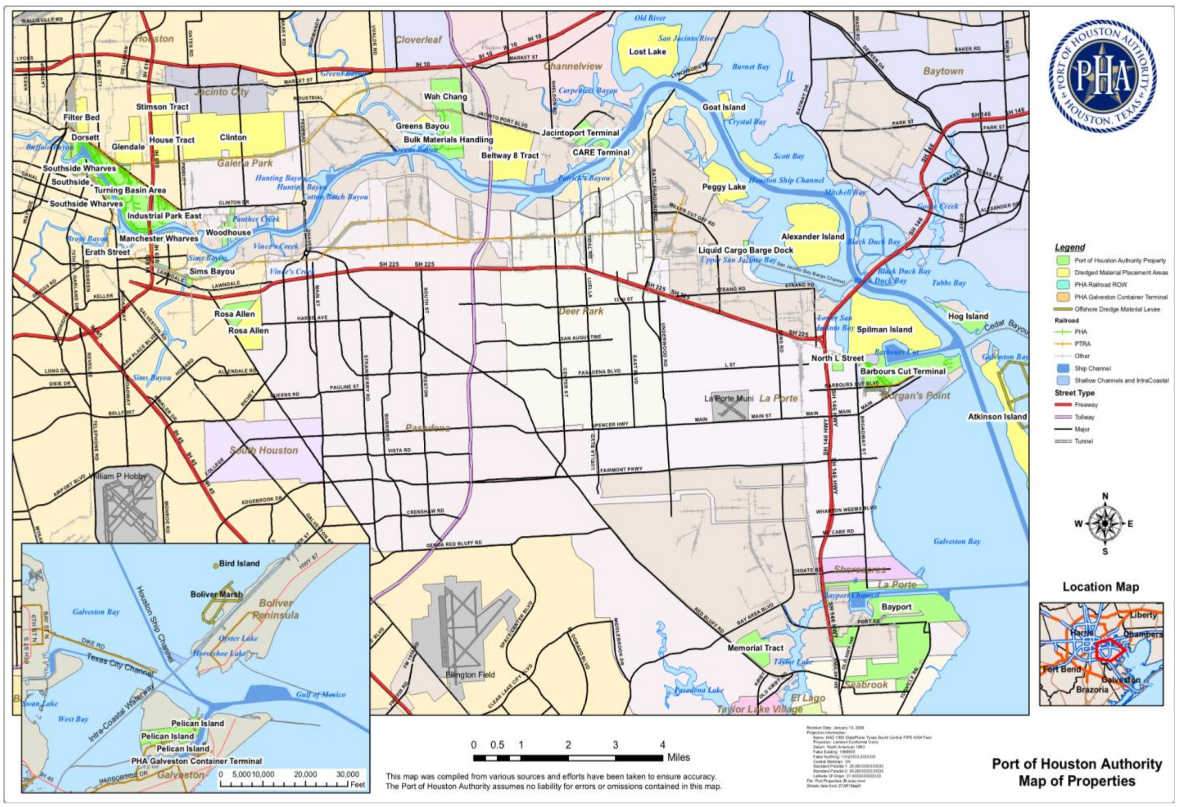


Figure 2-30. Map of Port of Houston

Officially opening in 1914, the Houston Ship Channel is 52 miles in length from the Galveston Sea Buoy to Turning Basin. Since its inception, the Port of Houston has grown to be one of the busiest waterways in the U.S. There are 270 port facilities on the Houston Shipping Channels and 190 manufacturing companies in the port district.[28] The initial channel width is 350 feet and has a depth of 45 feet. From mile 0 at the Galveston Channel entrance to mile 40, the authorized channel depth is 45 feet with width of 530 feet. The remaining channel depth from mile 40 to 52 varies from 36 to 40 feet with a

[27] https://comptroller.texas.gov/economy/economic-data/text-only/houston.php
[28] Houston Port Bureau Interview

width of 300 feet.[29] The 52 miles from the Galveston Sea Buoy to the Turning Basin requires an 8-hour transit to navigate from the sea buoy to the channel end. The Channel is broken into 2 sections: 26 miles in Galveston Bay, and 26 miles through the Bayou. Geographically, the Port consists of three districts. The upper third handles break bulk project cargo and Ro-Ro cargo, the middle third handles petroleum, and the lower third handles container ships.

The Port of Houston also manages Foreign Trade Zone #84, which includes many privately owned and port-owned sites located throughout Houston and Harris County.

2.7.2 Facilities

The Greater Houston Port Bureau monitors vessel movements into 40 different terminals in the Port of Houston. The two container terminals are located relatively close to the Gulf of Mexico. The majority of the terminals are located in the Bayou part of the Houston Shipping Channel. The most common terminals are bulk liquids terminals handling petrochemical products, chemicals, and edible oils. The multipurpose terminals process amongst others agricultural bulk products, steel products, containers, and provide ro/ro-facilities for cars and heavy equipment.

Table 2-23 Port of Houston Terminals by Commodity (December 2017)

	Houston Ship Channel			
Terminals	**Bayport**	**Barbours Cut**	**Bayou**	**Total**
Containers	1	1	-	2
Dry Bulk	-	-	9	9
Bulk Liquids	2	1	15	18
Breakbulk	-	-	5	5
Multipurpose	-	-	6	6

The Port of Houston hosts eight public terminals which are owned, operated, managed, or leased by the Port of Houston Authority and include the general cargo terminals at the Turning Basin, Care, Jacintoport, Woodhouse, and the Barbours Cut and Bayport container terminals. The remainder of the facilities are private.

Storage assets for the Port of Houston include 359 paved outdoor storage facilities. In addition, there is 6,200,000 bushels of elevator storage, 200,000 square feet of cold storage, and 2,872,900 square feet of transit sheds and warehouses.

2.7.3 Statistics

The Port of Houston is consistently ranked 1st in the U.S. in foreign waterborne tonnage; 1st in U.S. imports; 1st in U.S. export tonnage and 2nd in the U.S. in total tonnage

[29]http://www.swd.usace.army.mil/Portals/42/docks/civilworks/Fact%20Sheets/Galveston/FY13%20Houston%20Ship%20Channel,%20TX.pdf

behind the Port of South Louisiana, north of New Orleans. It is also the nation's leading break-bulk port, accounting for 41 percent of project cargo, break bulk and neo-bulk at Gulf Coast ports. The port is the 5th largest container port in the country with a total twenty-foot equivalent unit (TEU) capacity, handling over 2.2 million TEUs in 2018[30], amounting to over 230 million tons of cargo. Each year, more than 8,300 vessels and 223,000 barges carry cargo through the Port of Houston. In comparison, New York handles 4,600 ships, Los Angeles-Long handles 4,300 ships, and the Port of New Orleans handles 6,700 ships. Thirty-eight percent of all ships received enter the port after passing through the Panama Canal.[31]

The Port of Houston's 23 million tons of total trade is valued at $53.5 billion and has an annual statewide economic impact of $178.5 billion. The Port of Houston is responsible for 53,952 direct jobs, 71,065 inducted jobs, and 49,835 indirect jobs. In 2017, Port of Houston's trade was up 16.89 percent from the same point last year, from $45.85 billion to $53.6 billion.[32]

[30] US Army Corps of Engineers, U.S. waterborne container traffic by port/waterway, 2018.

[31] Texas Office of the Governor, "2015 Texas: The Logistical Heart of North America," https://texaswideopenforbusiness.com/sites/default/files/12/03/15/logistics_report.pdf; and Dug Begley, "Port Freeport States Its Claim on Cargo Boom," Houston Chronicle, May 9, 2016.

[32] https://www.ustradenumbers.com/ports/port/port-of-houston/

All Activity:

Merchandise Received	Exports	Employees
$25,000-50,000 mil	$1,000-5,000 mil	13,001-14,000

Warehouse/Distribution Activity:

Number of Companies	Merchandise Received	Exports	Total Shipments
103	$1,000-5,000 mil	$250-500 mil	$1,000-5,000 mil

Production Activity:

	Company	Merchandise Received	Exports	Total Shipments
84	Mitsubishi Caterpillar Forklift America Inc.	$100-250 mil	$0	$100-250 mil
84	MHI Compressor International Corporation	$25-50 mil	$0	$25-50 mil
84H	Varco Shaffer, Inc.	$500-750 mil	$750-1,000 mil	$750-1,000 mil
84I	Tuboscope Vetco International	$0-.5 mil	$0-.5 mil	$0-.5 mil
84J	Shell Oil Company	$5,000-10,000 mil	$0	$5,000-10,000 mil
84K	Dril-Quip, Inc.	$50-75 mil	$10-25 mil	$75-100 mil
84M	Hydril Company	$100-250 mil	$500-750 mil	$750-1,000 mil
84O	ExxonMobil Corporation	$10,000-25,000 mil	$750-1,000 mil	$10,000-25,000 mil
84P	Houston Refining LP	$1,000-5,000 mil	$0	$1,000-5,000 mil
84R	Michelin North America, Inc.	$1,000-5,000 mil	$5-10 mil	$1,000-5,000 mil
84T	Toshiba International Corporation	$25-50 mil	$0	$25-50 mil

Figure 2-31. FTZ# 84 activities

2.7.4 Commodities and Trade Flows

Houston’s overall tonnage has been relatively stable since 2010 (Figure 2-32) though in recent years, shipments have been gaining slightly more of the percentage share of total tonnage.

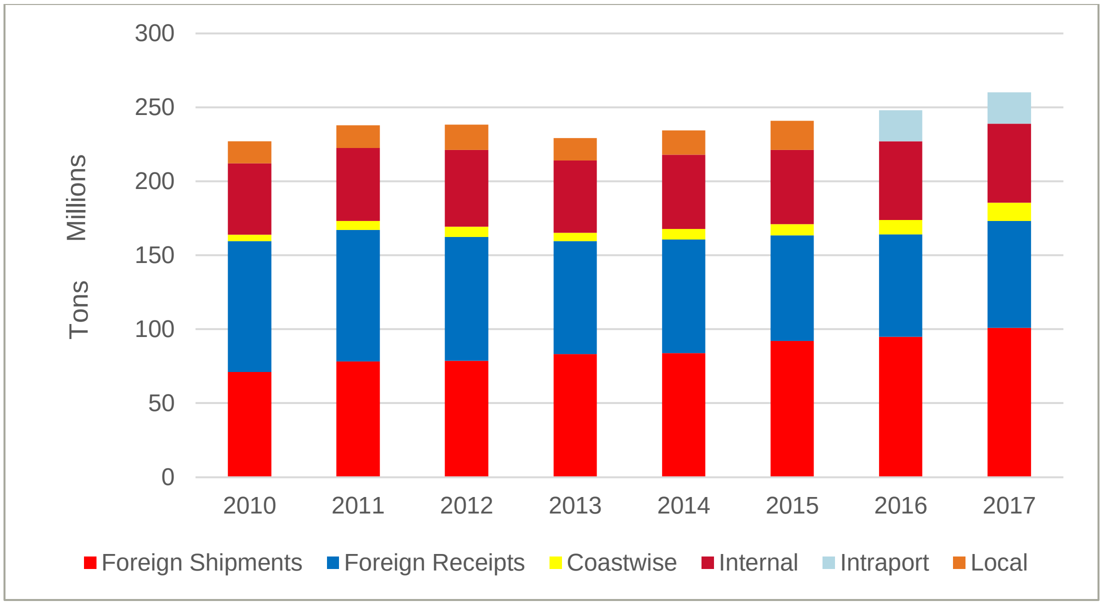


Figure 2-32. Port of Houston - Tonnage 2010-2017

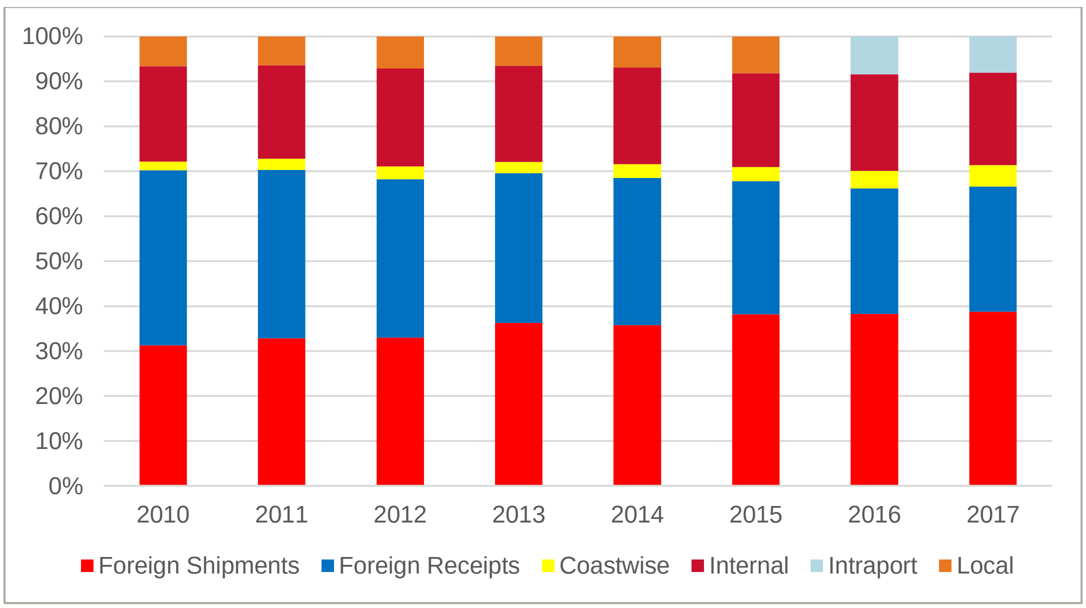


Figure 2-33. Port of Houston - Share of Tonnage

Foreign tonnage accounts for nearly 70 percent of the port's volume. Petrol, crude and chemicals comprise 85 percent of all cargoes. These products account for 76.6 percent of foreign traded cargoes and 94.4 percent of domestic receipts and shipments. Steel and manufactured products account for 6 percent of all flow. Further details of the Port of Houston commodity flows are contained at Appendix B.

Container commodities passing through the Port of Houston are identified in Table 2-24.

Table 2-24. 2016 Top Containerized Commodities (Total TEUs)

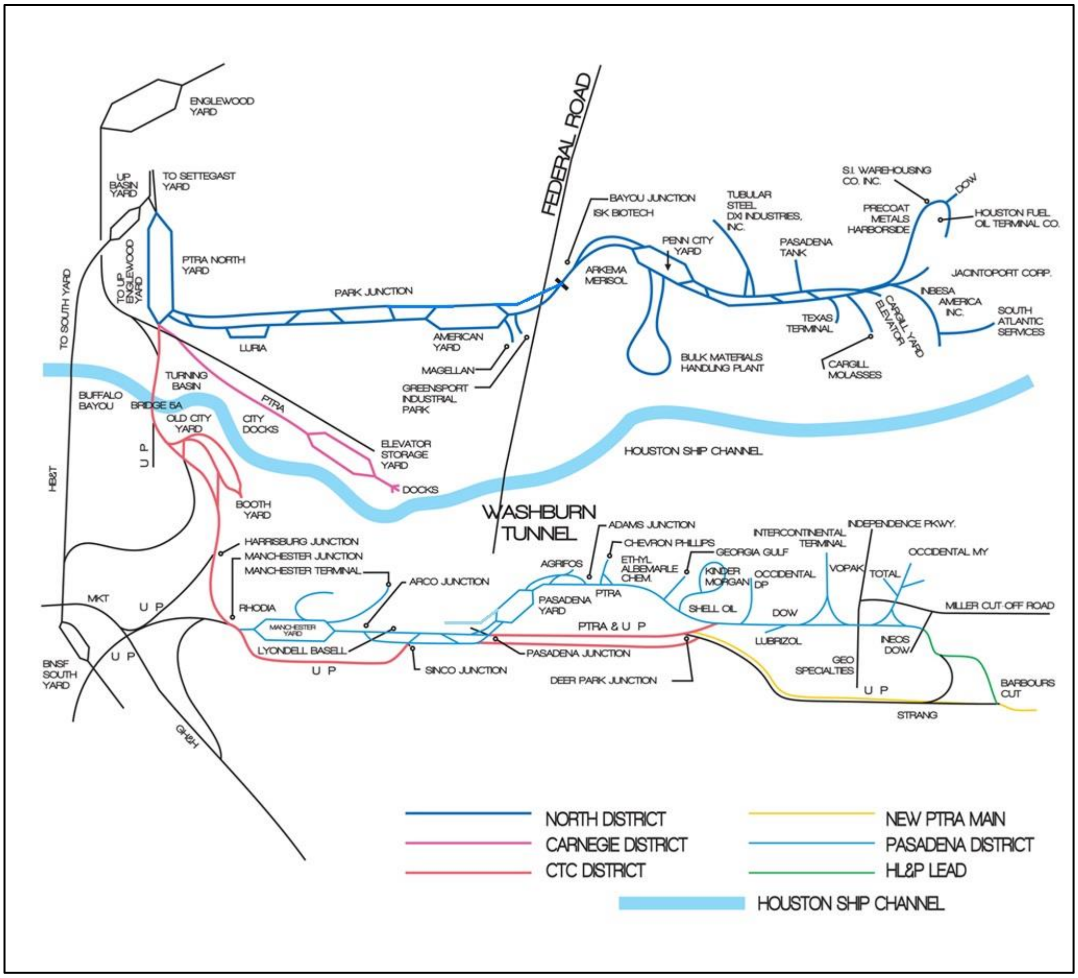
Exports		Imports	
Resins & Plastics	275,779	Food & Drink	136,433
Chemicals & Minerals	149,384	Hardware & Construction Materials	113,186
Food & Drink	78,317	Machinery, Appliances & Electronics	101,568
Machinery, Appliances & Electronics	65,367	Retail Consumer Goods	89,082
Automotive	60,311	Steel & Metals	76,853
Fabrics (incl. raw cotton)	37,830	Furniture	62,342
Steel & Metals	27,127	Resins & Plastics	53,346
Retail Consumer Goods	23,275	Chemicals & Minerals	53,002
Apparel & Accessories	19,632	Automotive	49,947
Hardware & Construction Materials	18,338	Apparel & Accessories	15,867
Furniture	3,925	Fabrics (incl. raw cotton)	15,139
Other	150,147	Other	125,370
Total	**909,433**	**Total**	**892,134,433**

2.7.5 Surface Transportation

Railroads

The port terminals contain access to three Class I railroads and direct pipeline network access. Formed in 1924, the Port Terminal Railroad Association (PTRA) is made up of the Port of Houston Authority of Harris County, Houston Belt & Terminal Railway Co. and three Class I railroads: Union Pacific Railroad, BNSF Railway, and Kansas City Southern Railway Company (Figure 2-34). Operating on both sides of the Ship Channel, the PTRA has as total Yard Capacity of 5,000 railcars and pulls an average of 2,500 cars per day. The PTRA services 226 local customers from 7 serving yards and maintains 154 miles of track and 20 bridges. They are able to service the entire U.S., Canada, and Mexico through its interchange connections.[33]

[33] http://www.ptra.com/index.php/about-us/ptra-operationsinfrastructure.html



Source: PTRA

Figure 2-34. PTRA Rail Network Map

The Barbours Cut container terminal is adjacent to a rail ramp (Figure 2-35). This consists of 42.1 acres with four working tracks (each approximately 2,700 feet in length), five storage tracks (each approximately 2,250 feet in length) and 730 wheeled container spaces. The entire facility is paved with concrete and sustains wheeled operations only. The container handling method is three Mi-Jack 1000R series overhead cranes and each capable of 30 moves per hour.

Figure 2-35. Rail Ramp at Barbours Cut

Highways

The Port of Houston is accessed by multiple major highways including four interstates: I-10, I-45, I-69 and the I-610 Loop. In 2010, there were about 10,000 trucks per day serving the port. By 2015, according to the Economic Alliance Houston Port Regions, that number had grown to 25,000-30,000 trucks per day using the same roads. With increasing trade and tonnage passing through the port, especially with commodities that move predominantly by road such as containers, the number of trucks could significantly increase.

Key to long term planning on the state level is determining the best way to allocate funds. For example, consideration should be given to whether $10 billion is better spent on a single project, like the I-45 corridor, or on 27 smaller projects which enhance overall Houston freight movement.[34] The state has recently approved funding for port projects in the forms of Legislative Rider 45 and Rider 48, which included the expansion of Peninsula Street to four lanes, an expansion of Jacintoport Boulevard to five lanes with associated curb, gutter and storm sewer improvements, and the installation of rail gate arms at six rail crossings.

There is significant competition for road space between commuter and freight journeys in the Port area. This has led to traffic congestion during peak commuter periods that coincide with port traffic. Even though Houston is a diversified port handling mostly petroleum-based tonnage, a great deal of the port related traffic however is related to containerized cargo. While Houston's container terminals typically have a 25-minute

[34] Houston Port Authority Interviews, July 2017

truck turnaround, overall journey time for trucks serving the container terminals can be much longer due to traffic and highway congestion

Figure 2-36 and Figure 2-37 provide information and updates regarding critical priorities along the Houston Shipping Channel for the Houston Port Region Freight Improvement Strategic Plan.

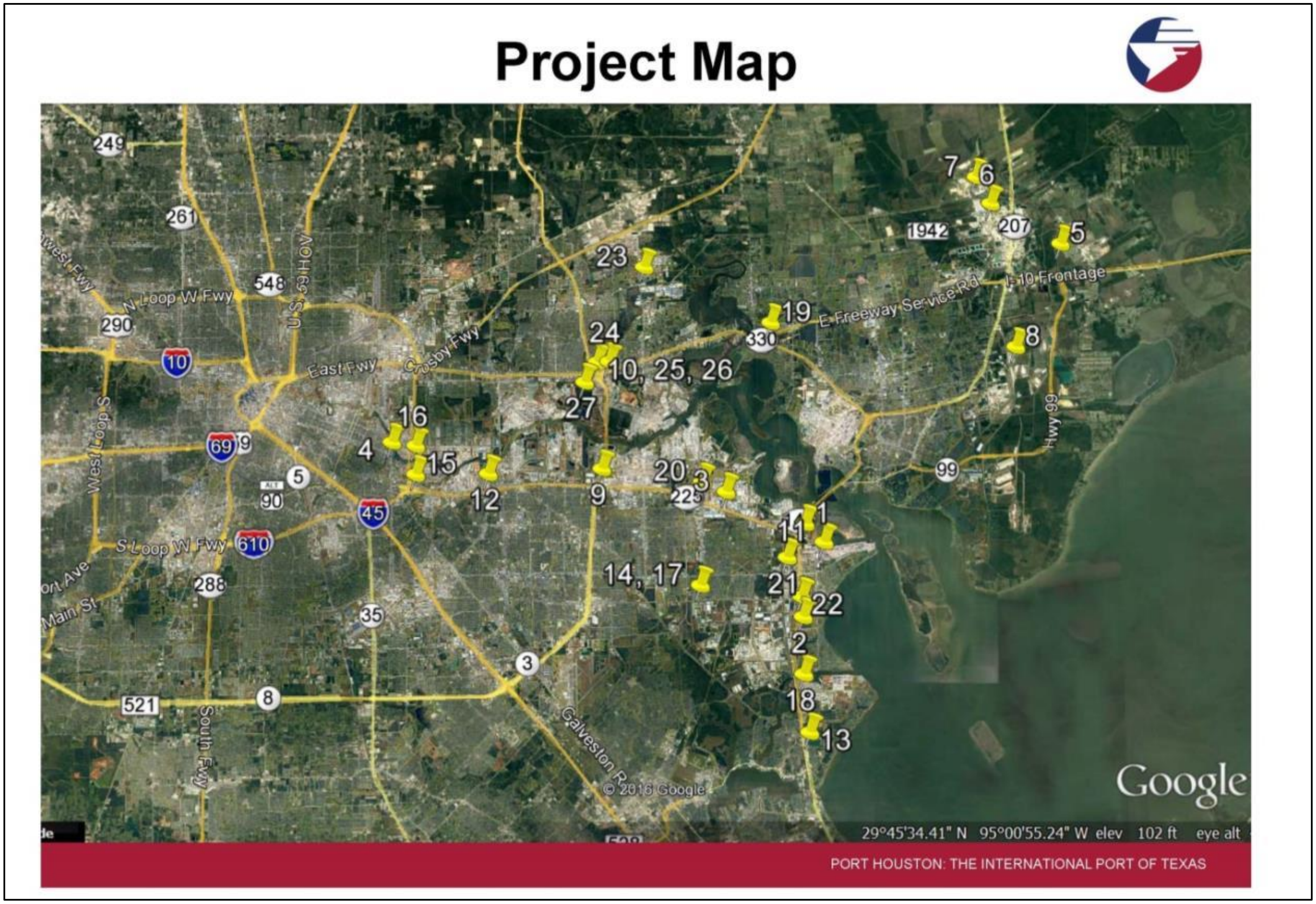
Houston Port Region Freight Improvement Strategic Plan

#	Project	Priority	Info & Updates
1	Barbours Cut Direct Connectors	H/S	• Attempting to get in call for projects in September 2017 • TxDOT is working with Texas A&M Transportation Institute to study Origin/Destinations between the Barbour's Cut Terminal and the SH 146/SH 225 interchange to determine the impacts of a direct connector
2	SH-146 Widening - Spencer Highway to Port Road	H/S	• TxDOT is currently preparing detailed design plans for the project • Anticipated letting for construction in FY 2023 scheduled for 2018
3	SH-225 expansion/improvement (8-East 146)	H/S	• TxDOT is working on a feasibility study for SH 225 from I-610 to SH 146. completion Q3 2018
4	Broadway Double Track Project	H/S	
5	Grand Parkway NE Segments	H/S	
6	FM-1942 from Hatcherville Road to SH-146 – road improvement	H/S	
7	Hatcherville Rd from FM-1942 to Liberty/Chambers Co.Line – road widening	H/S	• No improvements are currently planned
8	FM 565 from SH-146 to SH-99 – widening and addition of turning lanes	H/S	• Project from FM 1409 to SH 99: Reconstruct and realign roadway is anticipated to let for construction in FY 2018
9	BW-8 Direct Connectors @ SH-225: Westbound on 225 to 8 N, Northbound on 8 to E/W 225, Eastbound on 225 to 8S	H/M	• TxDOT is working with the Harris County Tollroad Authority to advance the construction of an interchange
	SH146 from I10 to Business 146 (Alexander Drive)		The grade separation/freeway starts at Alexander and continues all the way to Red Bluff. There probably needs to be some work on SH146 North of 110 through Mont Belvieu also
10	Penn City Connector	H/M	
11	Barbours Cut Blvd expansion to 6 lanes	H/M	No discussions yet of who champions this effort
12	SH-225 expansion/improvement (8-West 610)	H/M	
13	I-69 Bypass	H/M	• TxDOT is procuring a design –build contract for SH 99 Seg. H and I from I-69 to SH 146 which would make up the northern section of an I-69 Bypass with conditional award anticipated Spring 2017 • Southern Section of an I-69 Bypass is being discussed through H-GAC
14	Fairmont Parkway (Turning improvements)	H/M	County and La Porte funded through TxDOT Grant
15	SH-225 and I-610 Interchange	H/L	• TxDOT is working with H-GAC to begin a feasibility study for SH 225 from I-610 to SH 146
16	I-610 bridge at HSC	H/L	• Additional meetings with the Economic Alliance are requested to identify the needs and project scope at this location
17	Fairmont Parkway (Widening)	H/L	
18	Port Road Phase 3 & Drainage	M/M	County roadway / POHA Drainage
19	SH-330 (improve northbound connectivity to I-10 - 2 lanes or direct connect)	M/M	• TxDOT has prepared the Preliminary Engineering and Environmental for additional ramp access to I-10 and is working to secure construction funding
20	Independence Parkway (improve Northbound connectivity to SH-225)	M/M	• Additional meetings with the Economic Alliance are requested to identify the needs and project scope at this location
21	Spencer Highway Bridge (Bayport Rail Mainline)	M/L	
22	Bayport Mainline Rail Track	M/L	
23	Sheldon Road expansion	M/L	
24	Applet Road (Sheldon to Market)	M/L	
25	Jacintoport Road Improvement	L/L	
26	Jacintoport Direct Connectors	L/L	Direct Connect makes it a TxDOT/HCTRA discussion
27	Haden Rd (extension to Penn City Rd)	L/L	County roadway/POHA

TxDOT Projects shaded
Harris County Projects

Priority Level:		Time Frame Required:
H - HIGH Priority	/	S - SHORT Term 0-5 yrs
M - MEDIUM Priority	/	M - MID Term 5-10 yrs
L - LOW Priority	/	L - LONG Term 10+ yrs

Figure 2-36. Houston Port Region Freight Improvement Strategic Plan

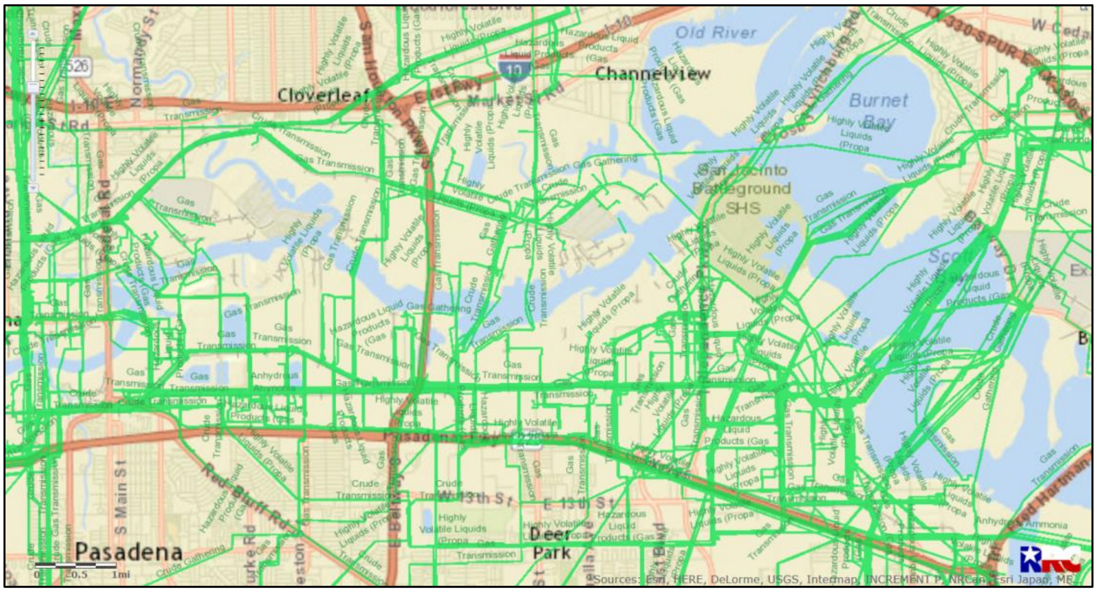


Source: Table and Map-Port of Houston Authority

Figure 2-37. Port Houston Prioritized Project List

Pipelines

The Port of Houston is served by an extensive network of pipelines, which carry a wide range of products including crude oil, natural gas, highly volatile liquids and hazardous liquid (Figure 2-38). These pipelines serve to move various products to, from, and within the region and also within the port and city of Houston. Many of these pipelines directly link ship berths and terminals with bulk liquid storage and processing facilities and are enabled to handle both import and export flows.

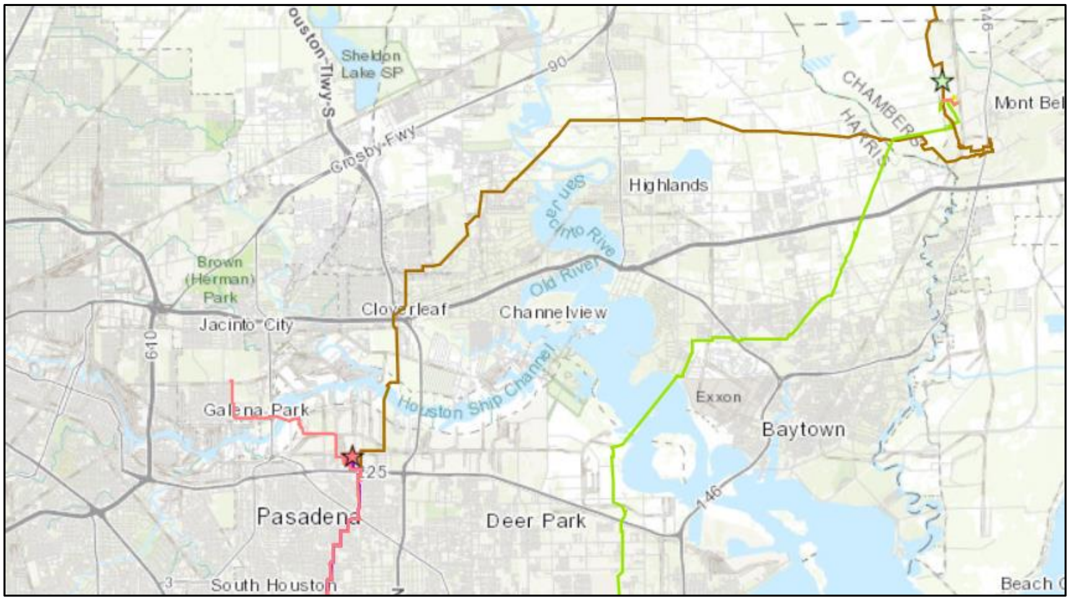


Source. Texas Rail Road Commission

Figure 2-38. Pipelines in the Port of Houston

Examples of pipeline networks in the Port of Houston include:

- **Houston Ship Channel Pipeline System**. A 288-mile system connecting Enterprise's Mont Belvieu, Texas facility with Houston Ship Channel import/export terminals and various other petrochemical plants, refineries and other pipelines located along the Houston Ship Channel.
- **Kinder Morgan Crude & Condensate Pipeline**. This 250-mile pipeline delivers crude and condensate products to multiple terminals, refineries and docks including those on the Houston Ship Channel.
- **Phillips 66 pipeline network**, including the 5-mile-long Cross Channel Connector (Figure 2-39).



Source: Phillips66pipeline.com

Figure 2-39. Phillips 66 Pipeline Network

- **Houston Fuel Oil Terminal Company**. Two large diameter 16-inch and 24-inch diameter pipelines serve terminals and refineries in the Houston area (Figure 2-40).

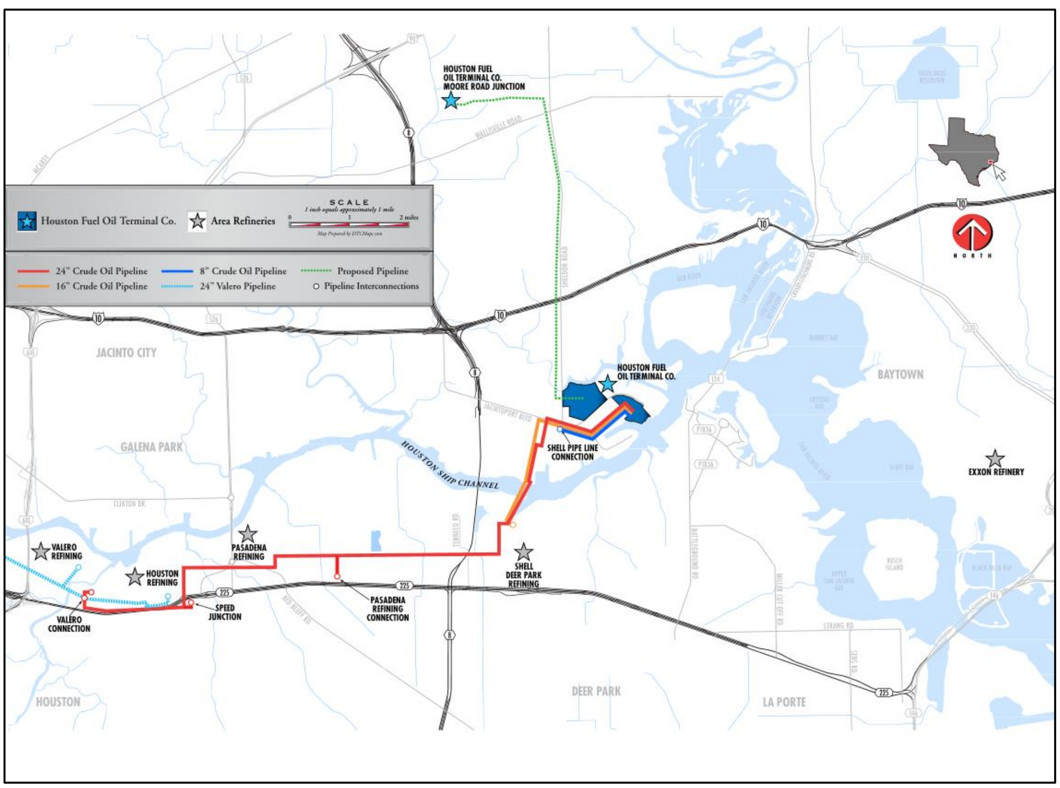


Figure 2-40. Houston Fuel Oil Terminal Company

2.7.6 Growth and Development

Port of Houston and Private Terminal Projects

There are several projects planned or under development in the Port of Houston. The Port of Houston will be investing in its own projects and plans to spend $1.6 billion over the next 5 years on the expansion of its Barbours Cut and Bayport container terminals.[35] The plan includes upgrading to three Super (Post) Neopanamax cranes which are capable of reaching across 22 containers with 160 feet under the spreader (Figure 2-41). They are replacing older units at Barbours Cut and this investment paves the way to boost the terminal's annual capacity from 1.2 million TEUs to over 2 million TEUs.[36] On the landside, expansion of gate facilities has been planned for Barbours Cut Terminal to accommodate its future growth.[37] At the east end of Bayport Container Terminal 42 acres of container yard (18" roller compacted concrete) will be constructed.

In addition, there are many private projects planned along the port. Recently, Magellan Midstream announced plans for a $335 million marine terminal on 200 acres along the Houston Ship Channel in Pasadena which will include 1 million barrels of storage for refined petroleum products, as well as a new marine dock.

Source: Houston Port Authority

Figure 2-41. Super Post-Panamax cranes en route to Houston

Texas Deepwater Partners, a joint venture of USDG and Pinto Realty, is developing 998-acres capable of supporting a rail terminal for liquid hydrocarbons and tank storage for up to 10 million barrels.[38] The development will include numerous pipeline rights-of-way

---

[35] "Houston Ready for Port-Panamax Vessels," The Maritime Executive (October 1, 2015), http://www.maritime-executive.com/article/houston-ready-for-p "Houston Ready for Port-Panamax Vessels," The Maritime Executive (October 1, 2015), http://www.maritime-executive.com/article/houston-ready-for-post-panamax-vessels; and Texas Department of Transportation, "Overview of Texas Ports and Waterways."post-panamax-vessels; and Texas Department of Transportation, "Overview of Texas Ports and Waterways."

[36] http://www.joc.com/port-news/us-ports/port-houston/houston-container-volumes-soar-result-new-petrochemical-plants_20160220.html

[37] https://porthouston.com/future-projects/

[38] http://usdg.com/terminal/houston-ship-channel/

and could potentially provide connectivity to nearly all major liquid hydrocarbon inbound pipelines throughout the U.S. and Canada.

Also, Enterprise Products Partners and Navigator Holdings have announced plans to develop an ethylene marine export terminal. The facility will have a 45-foot draft berth and capacity to handle approximately 600 million pounds of ethylene with an injection/withdrawal rate of 210,000 pounds per hour expandable to 420,000 pounds per hour. The facility will be connected to multiple producers and consumers via the Kinder Morgan Crude & Condensate Pipeline, which transports products from the Eagle Ford shale area, which is currently under construction.[39]

Houston Ship Channel Expansion Channel Improvement Project

In the summer of 2019, the Texas Governor signed a law that prohibited vessels of more than 1,100 feet (equivalent to a 9,500 TEU vessel) from entering the HSC without the approval of port pilots. The law was enacted to alleviate concerns that the larger and growing numbers of container vessels, were disrupting other HSC users due to the narrowness of the channel. A combination of the wide container vessels and narrow shipping channel mean that other vessels are not able to occupy the channel at the same time, resulting in inefficient vessel movement.

The existing HSC system has inefficiencies due to the current channel configuration. The system has constrained vessel sizes, draft restricted areas in the upper channel, inadequate channel configurations for vessels currently using the channel, including the width and size of channel bends and turns, and these inefficiencies are contributing to congestion along the waterway, especially with the high volume of barge and deep-draft vessel traffic on the HSC.

The existing channel depth, width, and configuration result in inefficient deep and shallow-draft vessel utilization of the HSC system. There are navigation safety concerns for deep and shallow-draft vessel traffic, and it is a challenge to identify environmentally acceptable areas for dredged material placement (PA/BU) with capacity to serve the system.

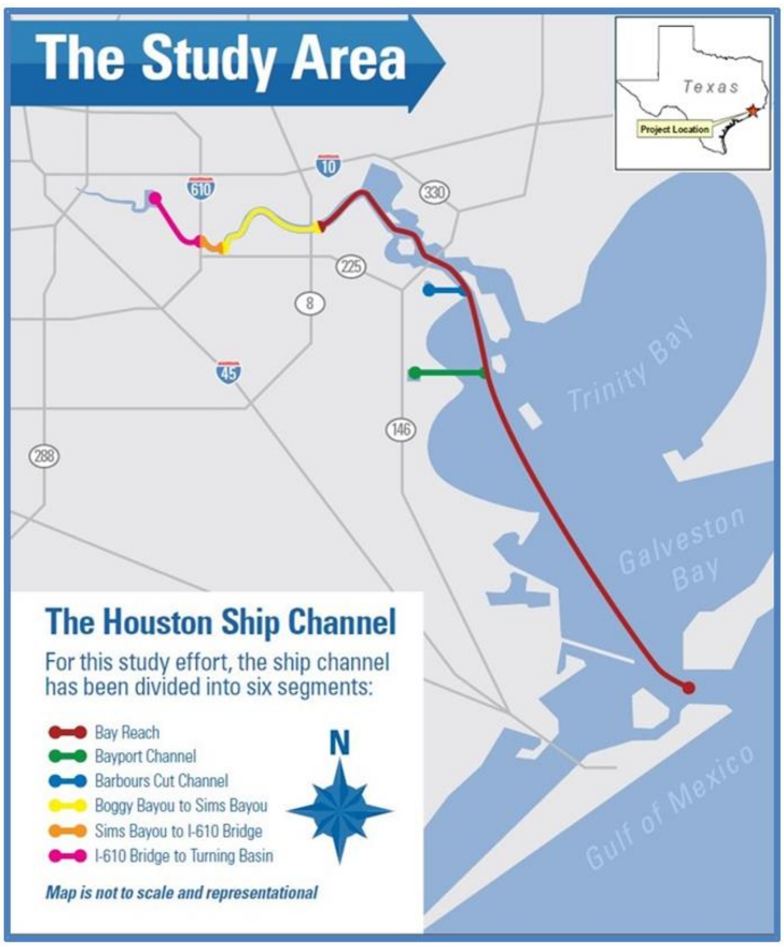
As per the US Army Corps of Engineers, the following problem statements have been identified:

- Very Large Crude Carriers (VLCC) require lightering in order to economically move products to Port of Houston refineries;
- Barges have inefficient movement due to the shallow draft of the barge lanes. Barges may run aground due to the drawdown of the surrounding water when faster deep-draft traffic passes. Due to this risk of drawdown, barges many times utilize the deep draft channel for transit, thus reducing vessel speeds in the deep draft channel, increasing congestion and decreasing safety;
- A safety concern exists near the intersection of the HSC and Bayport Ship Channel (BSC) as confirmed in the HSCPDR, which recommended an interim corrective action; however, a more complete corrective action is needed;

---

[39] https://www.bizjournals.com/houston/news/2017/07/13/enterprise-products-partners-london-co-plan-new.html

- Channel configurations cause slowing and tug assistance for larger vessel classes:
    - Vessels longer than 1200-feet length overall (LOA) cannot transit the HSC due to four undersized bends between Bolivar Roads and Morgans Point;
    - Vessels longer than 1100-feet LOA are restricted to one-way traffic due to the undersized bends and narrow width of the channel;
    - Containership movements are width-restricted by narrow channels at the BSC and Barbours Cut Channel (BCC). Significant tug assistance is required for Post Panamax Containerships, and some larger Post Panamax vessels (beams exceeding 141 feet) are not allowed to transit the channel. Vessel movements can also face delays while Post Panamax vessels are at berth due to the width constraints of the channel;
    - A loaded Suezmax tanker may not meet any vessel with a beam greater than 106-feet.



Source: US Army Corps of Engineers

Figure 2-42. Houston Ship Channel Study Area

The Houston Ship Channel Expansion Channel Improvement Project features the following improvements:

- Widen the HSC to 700 feet through Galveston Bay from Bolivar Roads near the Entrance Channel to the BCC, and provide bend easings at four bends along the channel;
- Widen the HSC from Boggy Bayou to Greens Bayou from its current 300 to 400-foot width to 530 feet;
- Widen the BSC and BCC to 455 ft wide, and construct a combination turning basin and bend easing at the BCC;
- Deepen the HSC from Boggy Bayou to Hunting Bayou to -46.5 ft MLLW, and from Sims Bayou to the Main Turning Basin to -41.5 ft MLLW;
- Expand and shift the Brady Island Turning Basin in the upper HSC to a larger diameter;
- Construct a shoaling attenuation feature to address excessive shoaling occurring in the Bayport Flare.

2.8 Port of Galveston Profile

2.8.1 Description

The Port of Galveston is located at the mouth of Galveston Bay along the Upper Texas Coast in Galveston County. It occupies the north side of Galveston Island as well as the south shore of Pelican Island. The Port of Galveston is about 9.3 miles from the open Gulf and about 50 miles south of Houston (Figure 2-43).

The Port of Galveston has a channel width of 1,000 feet and channel depth of 45 feet. The Port is municipally owned by the City of Galveston and is managed by the Board of Trustees of the Galveston Wharves which is the formal corporate title of the Port of Galveston. The Port also hosts a Foreign Trade Zone.

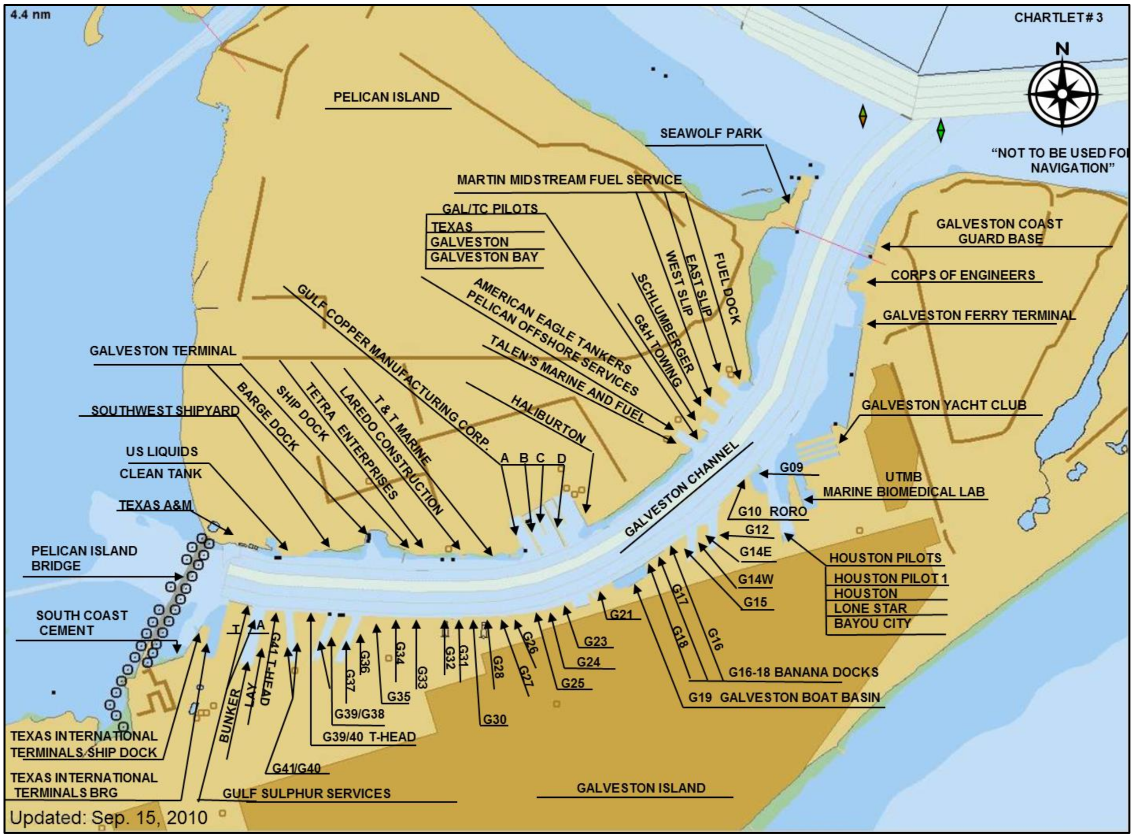


Figure 2-43. Map of Port of Galveston

2.8.2 Facilities

Wharves exist along the north side of Galveston Island and along the Harborside shoreline of Pelican Island near the entrance to Galveston Bay. The Port of Galveston consists of 850 acres of facilities and property, 300 acres are on Pelican Island and 550 acres are on Galveston Island[40]. The south side of Galveston Island faces the Gulf and is protected by a 17- foot- high concrete seawall. Some additional port properties and facilities are located on Pelican Island including a large greenfield site held by the Port of Houston Authority for the potential future development of port facilities.

To help service the 60 wharves and piers in the Port of Galveston, facilities include a 300-ton capacity crane and a 200-floating crane. Port of Galveston's 20 berthing spaces can house vessels to a maximum length of 1,509 feet and in most locations a berthing depth of 45 feet. The Port contains 13 general docks, one liquid bulk dock, two cruise ship docks, and one berth for grain vessels. The Port also owns its own dredged material placement area, which is a feature unique to Texas ports.

Storage assets for the Port of Galveston includes 23 paved outdoor storage facilities. In addition, there are 3,000,000 bushels of elevator storage, 110,000 square feet of cold storage, and 145,000 square feet of transit sheds and warehouses. The port has a reefer warehouse for fruit, mobile harbor crane, military cargo storage, automobile and Ro-Ro

[40] https://www.h-gac.com/taq/transportation-committees/TAC/2015/11-nov/docs/ITEM-11B-HGAC-TPA-111815.pdf

handling facility and 2 shipyards. A container crane at Pier 16/18 handles fruit-laden containers imported by the Del Monte Company.[41]

In 2016, Port of Galveston held a ribbon-cutting for its $13 million Terminal 2 cruise terminal expansion project. The project expanded the terminal by about 60,000 square feet (for a total of 150,000 square feet), quadrupled the number of seats from 500 to 2,000, and added more than 16 check-in booths.

2.8.3 Statistics

Cruise Ship Industry

The Port of Galveston is the fourth busiest passenger cruise port in the nation, and seventh busiest in the world[42]. The port hosts three homeported Carnival vessels — the CARNIVAL FREEDOM, CARNIVAL BREEZE and CARNIVAL VALOR. In addition, the Royal Caribbean's LIBERTY OF THE SEAS and VISION OF THE SEAS are homeported in Galveston. Disney Cruise Lines' DISNEY WONDER sails seasonally (November through January) from the Port. On-shore spending generated from cruise activity was $56 million, and another $18.1 million was spent on cruise-related services provided at the port[43]. Cruise ships count for half of the Port's revenue. According to a Galveston Parks Board study on the Economic Impact of Tourism on Galveston, Galveston's cruise industry has an estimated impact to Texas in excess of 22,600 jobs contributing $1.42 billion to the Texas economy.[44] The cruise-related passenger and vehicle count data from 2007 through 2016 are provided in Table 2-25. An example of the cruise call schedule for 2019 is provided on Figure 2-44 and terminal map is shown on Figure 2-45.

[41] Feedback from Port of Galveston.

[42] Port of Galveston, 2015 Comprehensive Annual Financial Report, Galveston, Texas, pp. ix and xi, http://www.portofgalveston.com/DockumentCenter/View/1503.

[43] Tourism Economics, The Economic Impact of Tourism on Galveston Island, Texas: 2015 Analysis, p.9, http://www.galvestonparkboard.org/ArchiveCenter/ViewFile/Item/53.

[44] The Economic Impact of Tourism on Galveston Island, Texas. 2015 Analysis. http://www.galvestonparkboard.org/ArchiveCenter/ViewFile/Item/53

Table 2-25. Port of Galveston Cruise-Traffic related data (2007-2018)

Year	Cruise Ship Calls	Embarking Cruise Passengers
2007	207	523,303
2008	133	376,815
2009	139	394,640
2010	152	434,524
2011	152	459,448
2012	174	604,272
2013	179	604,994
2014	181	641,650
2015	232	834,616
2016	235	868,923
2017	255	933,818
2018	268	985,163

The Port of Galveston's draft Strategic Master Plan, published in 2019, identifies that vessel calls could reach 466 in 2038, and nearly 5 million passengers.

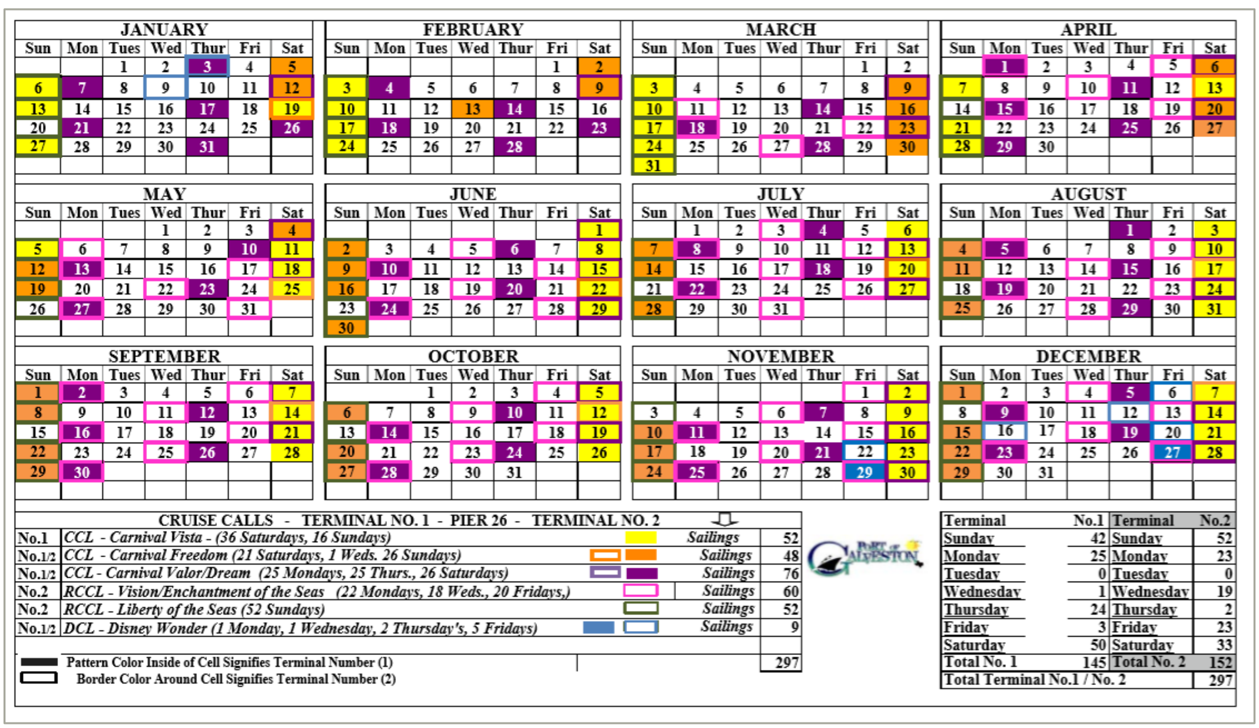


Figure 2-44. Port of Galveston Cruise Call Schedule - 2019

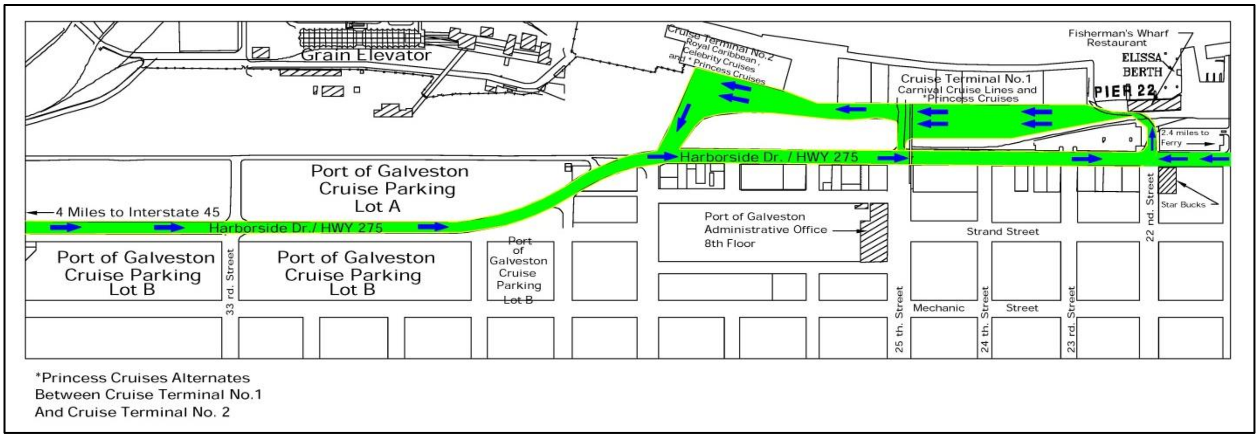


Figure 2-45. Cruise Terminal Map

Cargo Industry

In 2018, the Port of Galveston ranked 53rd in the nation. In 2017, the Port handled nearly 3.5 million tons of cargo. In 2018, the Port of Galveston serviced 324 cargo ships, 268 cruise ships, and 248 lays and rigs. Principal industries for the port include shipping, boat building and repairing, grain elevators, machine shops, fishing, and agriculture. The port is equipped to handle nearly all types of cargo including containers, dry and liquid bulk, break-bulk, RO-RO, refrigerated, and project cargoes.

The Port's Foreign-Trade Zone activities are typically focused on imported products, though some export related activity is identified in Figure 2-46.

FTZ 36, GALVESTON

GRANTEE: BOARD OF TRUSTEES OF THE GALVESTON WHARVES

All Activity:

MERCHANDISE RECEIVED	EXPORTS	EMPLOYEES
$100-250 mil	$1-5 mil	1-25

Warehouse/Distribution Activity:

NUMBER OF COMPANIES	MERCHANDISE RECEIVED	EXPORTS	TOTAL SHIPMENTS
5	$100-250 mil	$1-5 mil	$50-75 mil

Production Activity:

	COMPANY	MERCHANDISE RECEIVED	EXPORTS	TOTAL SHIPMENTS
36B	M-I LLC	$10-25 mil	$0	$10-25 mil

Figure 2-46. FTZ #36 Activities

2.8.4 Commodities and Trade Flows

Petrol, crude and chemicals comprise nearly 60 percent of total cargo tonnage while grain and fertilizer account for 25 percent. Nearly 3 million tons of grain were exported through the port in 2015. Overall total tonnage has decreased since 2010 (see Figure 2-47 and Figure 2-48). Further details associated with the Port of Galveston's commodity flows are contained in Appendix C.

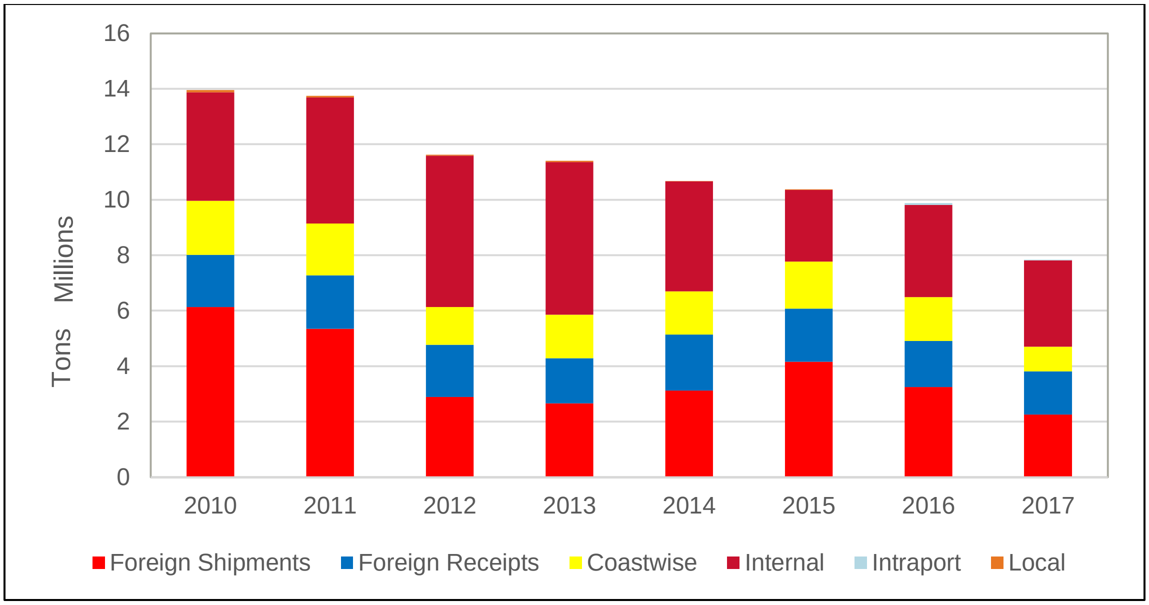


Figure 2-47. Port of Galveston - Tonnage 2010-2017

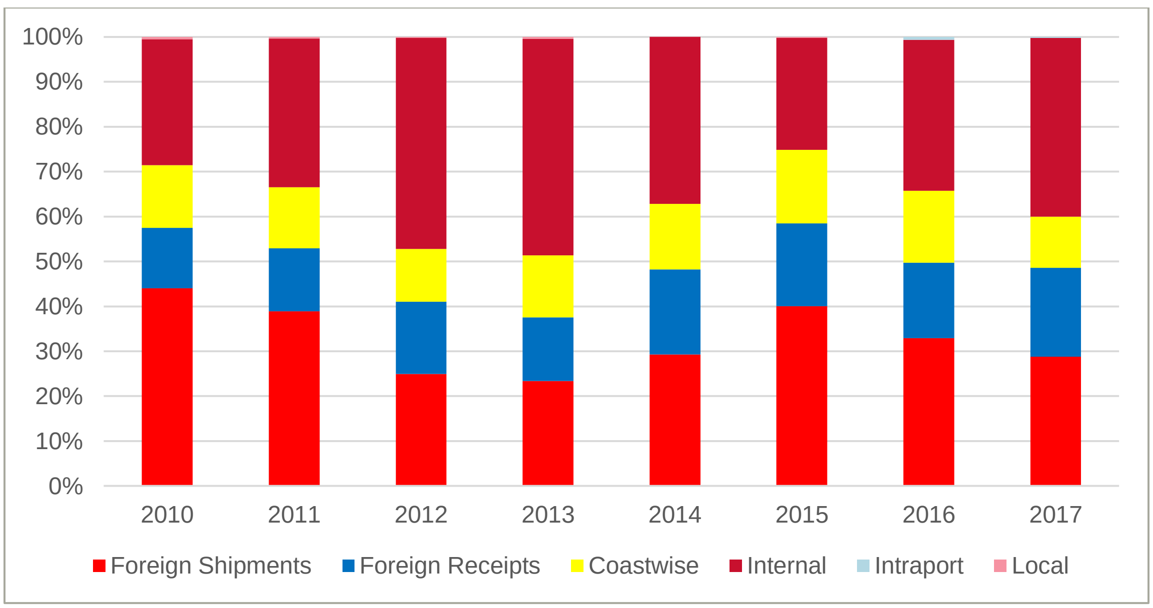


Figure 2-48. Port of Galveston – Share of Tonnage

2.8.5 Surface Transportation

Railroads

The Port of Galveston is served by the port-based Galveston Railroad, L.P. which serves the port facilities on Galveston Island. There is no rail access to Pelican Island. The Galveston Railroad provides rail connections to two Class I railroads which include the Union Pacific Railroad and the Burlington Northern Santa Fe Railroad (Figure 2-49). These railroads have the capability to directly service the western half of the U.S. and Canada and can facilitate service to the rest of the U.S. and Mexico. The Port owns the rail infrastructure inside the Port, but leases it to the Galveston Railroad company, a subsidiary of the Genesee & Wyoming Railroad. Revenue from rail cargo movement tonnage provides income to the Port. The Port has a total of 22.75 miles of track inside the Port, enabling tenants and users to build multiple unit trains of different commodities on the inland Port rail network. In addition, both the Union Pacific and Burlington-Northern Santa Fe railroads have large marshalling yards on Galveston Island.

Source: Galveston Railroad

Figure 2-49. Galveston Railroad

Highways

In 2014, the Port of Galveston experienced 135,000 vehicles in public and private truck traffic volume[45]. Access to the port through Interstate 45 is considered good. The main roadways are sufficient; however, there is consistent flooding on the main waterfront route off I-45 along Harborside Drive as well as congestion within 1 mile of cruise terminals during periods when cruise ships are undergoing turnarounds. A separate study is currently underway to address these issues. In addition, the Pelican Island

[45] Texas DOT

Bridge needs to be replaced with 4-lane bridge and railroad corridor which would allow the north side of the port to fully develop.

There are several other highway projects underway, and an estimated billion dollars or more will be spent on Galveston County transportation infrastructure over the next decade.[46]

The state funding for port projects contained within Legislative Rider 45 and Rider 48 identified improvements to Old Port Industrial Road, 33rd Street, and the intersection of 28th Street and Harborside Drive to improve traffic flow.

There will also be major improvements to the two main roadways heading through the county, I-45 and SH146. The I-45 project will expand I-45 from 6 lanes to 8 lanes between NASA 1 in southern Harris County and FM1764 in Texas City. This work should be completed in fall of 2018. Once this phase is completed, the expansion will continue from Texas City to Galveston, slated to take place between 2019 and 2021.

SH146 work includes expansion from 2 lanes to 6 lanes, which will facilitate access from Port of Houston and southern Galveston County via a limited access highway. Construction is slated to take place in two phases, with estimated completion in 2022.

Pipeline

The Port of Galveston is not served by any product pipeline with the exception of natural gas for local consumption.

2.8.6 Growth and Development

At the port itself, pier work needs to be completed, which will include in-filling of several berths at the cargo piers as well as the redevelopment of a portion of the cargo terminals into an additional cruise terminal. The Strategic To accommodate the cargo and passenger trade additional parking and near waterfront storage will be required. The Port is addressing pier damage from hurricane Ike (September 2008) and are awaiting Federal Emergency Management Agency (FEMA) funds from the state.

In 2015, Port of Galveston entered into a revised agreement with grain exporter Archer Daniel Midland to increase minimum annual guaranteed revenue and to invest $10 million in capital improvements at the ADM facility within the Port. The Port expects growth in its refrigerated fruit/bananas business, in part to a $12 million facility investment, and $10 million wharf improvement and expansion, made by Del Monte Fresh Produce, N.A.[47]

In 2016, Wallenius Wilhelmsen Logistics opened a vehicle distribution center to handle BMW imports. This facility can import and process 32,500 vehicles annually. It serves 45 BMW and Mini dealers across Texas, Oklahoma, Louisiana and Arkansas. This complements a facility already operated by Wallenius Wilhemsen Logistics that can provide storage for 7,000 units of construction, agricultural and mining equipment

---

[46] http://www.developgalvestoncounty.com/road-improvements

[47] Port of Galveston 2015 Comprehensive Annual Financial Report. http://www.portofgalveston.com/DockumentCenter/View/1503

The Port of Galveston's 10 largest revenue generating customers in 2015 are listed in Table 2-26 and operating revenue from 2007 through 2016 is depicted on Figure 2-50.

Table 2-26. 2015 Schedule of Ten Largest Revenue Generating Customers

Customer name	Amount
Carnival Cruise Lines	$7,343,314
Royal Caribbean, Int'l	$4,959,418
ADM Grain Co.	$2,219,254
Galveston Railroad	$1,371,311
Del Monte Fresh Fruit	$1,300,454
Wallenius Wilhelmsen	$964,918
Gulf Copper	$958,238
Argilliance/CHS	$784,729
Malin Int'l	$720,769
Norton Lilly Int'l	$650,181

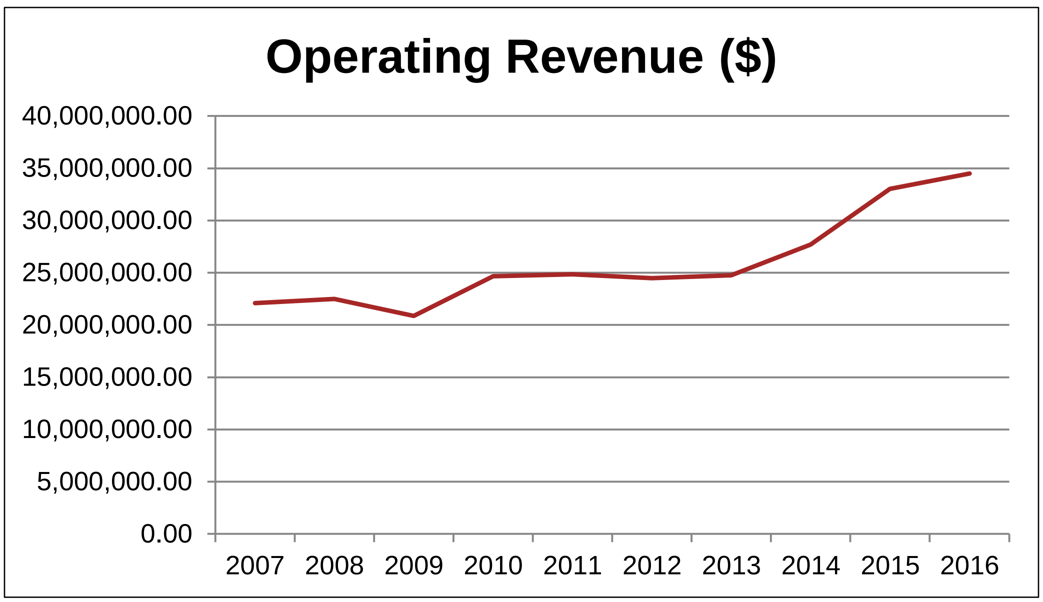


Figure 2-50. Port of Galveston Operating Revenue

2.9 Port of Texas City Profile

2.9.1 Description

The Port of Texas City is located on the southwest shore of Galveston Bay with access to the Gulf Intercostal Waterway Gulf of Mexico, and the Houston Ship Channel. The Port of Houston lies approximately 42 nautical miles to the north and the Port of Galveston about 6.5 nautical miles to the southeast (Figure 2-51). The Port has a channel depth of 45 feet, channel width of 1,200 feet and a 1,000-foot turning basin. The Port of Texas City is private and jointly owned by the Union Pacific Railroad and the

BNSF Railroad. The Texas City Port Authority owns most of the Port's property and it is Texas' only privately-owned port.

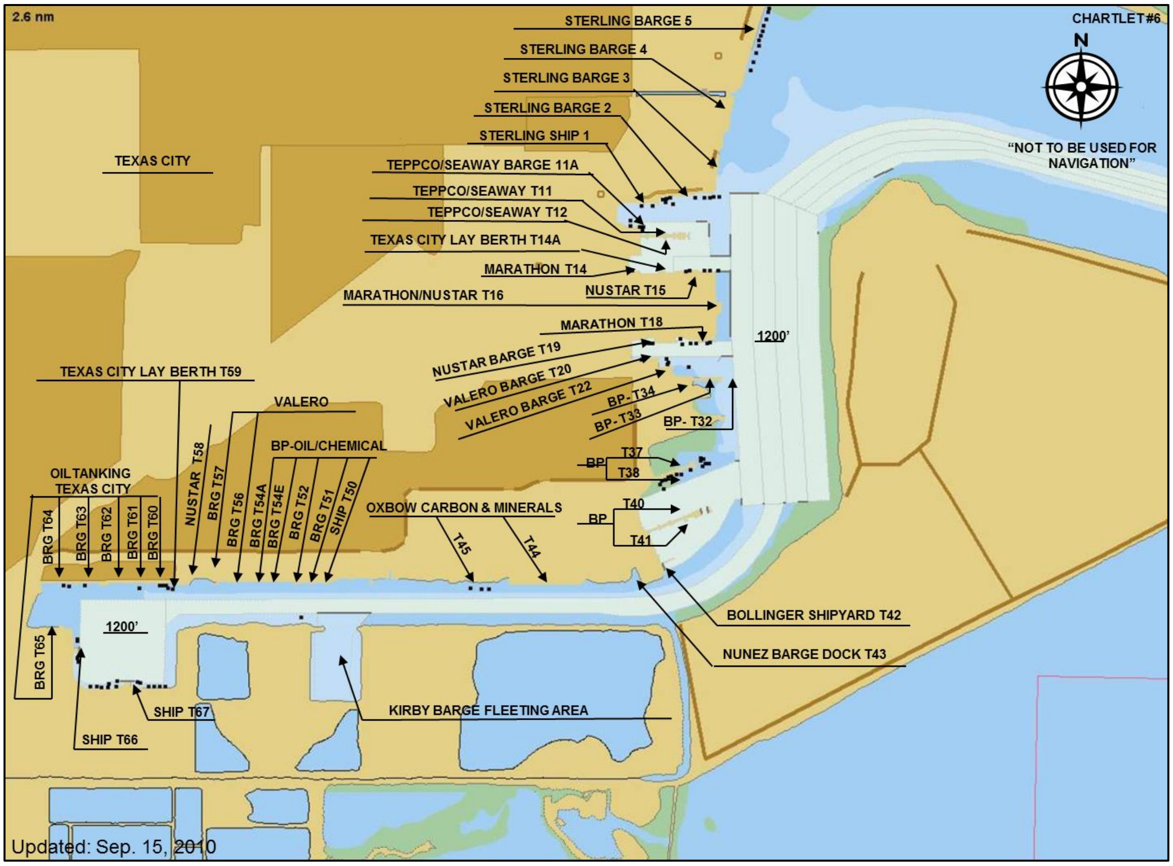


Figure 2-51. Port of Texas City Map

2.9.2 Facilities

The Port of Texas City almost exclusively handles very large volumes of liquid bulk cargoes. Subsequently, the port contains just one dry cargo dock and 21 liquid bulk docks. There is also a former shipyard in the Port of Texas City. There are 11 primary port users that utilize the port's 1000 acres.

The Port of Texas City is also home to Foreign-Trade Zone #199 (Figure 2-52

2.9.3 Statistics

In 2015, the Port of Texas City had 6,723 total vessel calls. Of those, 1,148 were ships and less than 1 percent of those were dry bulk vessels. In 2016, the port handled 4,318 barges and 1,109 ships.

The Port of Texas City is the 15th largest port in the U.S. and the 4th largest port in Texas, with over 42 million tons of waterborne tonnage in 2018.

FTZ 199, TEXAS CITY
GRANTEE: TEXAS CITY FOREIGN-TRADE ZONE CORPORATION

All Activity:

MERCHANDISE RECEIVED	EXPORTS	EMPLOYEES
$10,000-25,000 mil	$1,000-5,000 mil	6,001-7,000

Warehouse/Distribution Activity:

NUMBER OF COMPANIES	MERCHANDISE RECEIVED	EXPORTS	TOTAL SHIPMENTS
0	$0	$0	$0

Production Activity:

	COMPANY	MERCHANDISE RECEIVED	EXPORTS	TOTAL SHIPMENTS
199A	Marathon Petroleum Corporation	$10,000-25,000 mil	$1,000-5,000 mil	$10,000-25,000 mil
199C	Valero Refining - Texas, LP	$1,000-5,000 mil	$1,000-5,000 mil	$1,000-5,000 mil

Figure 2-52. FTZ#199 Activities

2.9.4 Commodities and Trade Flows

Key commodities passing through the Port of Texas City include the import of crude petroleum oil and exporting of refined petroleum products, including gasoline, diesel, jet fuel and intermediate chemicals.[48] The sole dry cargo, controlled by Oxbow, provides receipt, storage, and vessel loading of coal and petroleum coke, which is sold for export and domestic consumption. The facility is permitted for one million tons of storage, and seven million tons of coal and petroleum coke throughput. Exports, which include outbound cargo such as chemicals, liquid plastics, styrene, ethanol and acid are handled by ship, barge and domestically pipeline. In 2015, 86.3 percent of commodities were petroleum and related products and 13.2 percent were chemicals and related products. [49]

A majority of the port's cargo movement has shifted to domestic product handling, mostly by pipeline resulting in reduced ship traffic. Where foreign crude import was the basis for processing and handling of petroleum cargo, most crude now comes in from domestic sources by pipeline and rail and in turn moves out in the same manner which also includes truck. The import of foreign crude has decreased from 70 million tons to 45 million tons in the last several years. (Figure 2-53 and Figure 2-54).

Further detail of the Port of Texas City commodity flows are contained in Appendix D.

[48] Guide to the Economic Value of Texas Ports
[49] https://www.bts.gov/archive/publications/port_performance_freight_statistics_annual_report/2016/ch5/TexasCity

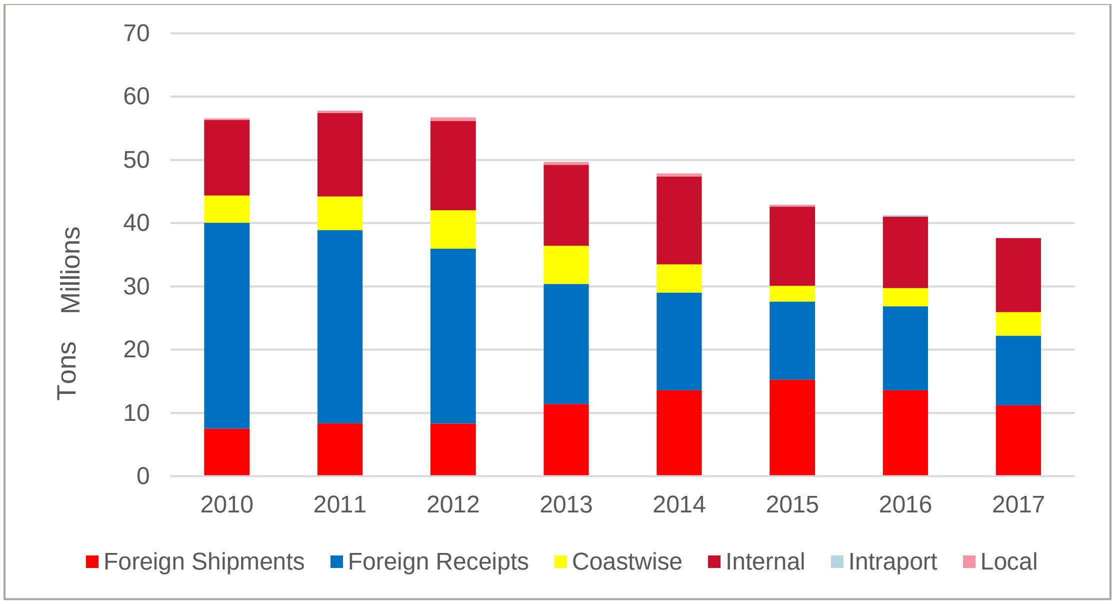


Figure 2-53. Port of Texas City – Tonnage 2010-2015

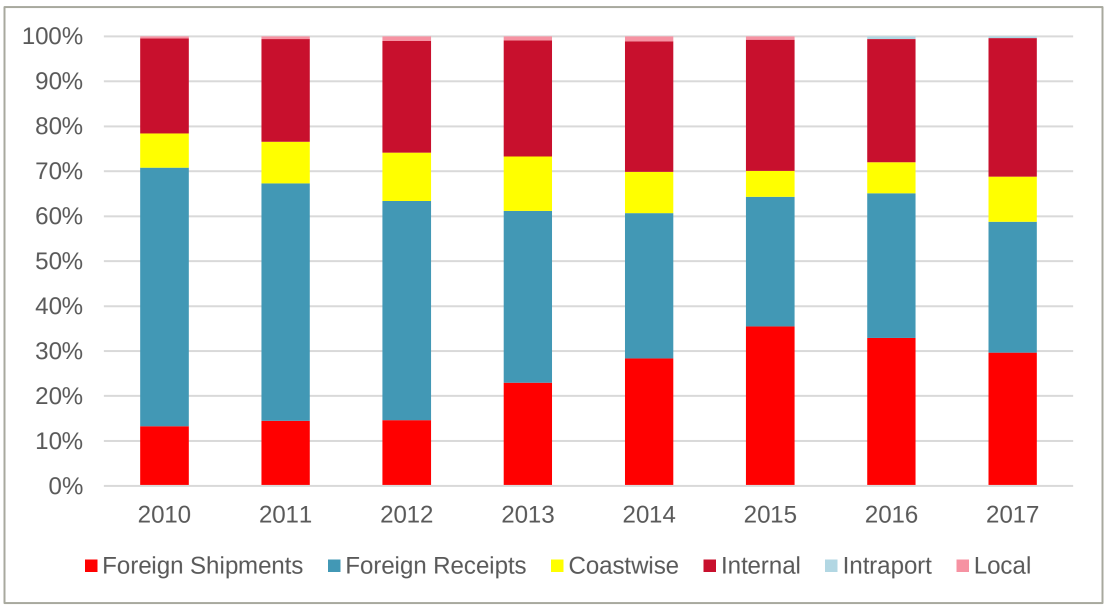


Figure 2-54. Port of Texas City – Share of Tonnage

2.9.5 Surface Transportation

Rail

The Port of Texas City operates three MP1500 horsepower locomotives and 31 miles of tracks to serve its customers. The Texas City Terminal Railway Company handles over 25,000 carloads per year with about 46 rail cars per unit train.[50] Rail line haul volume is flat, having only 0.5 percent growth from 2015 to 2016. Loaded cars between those

[50] http://tctrr.com/

years were down 5.5 percent; however, they are currently up 3 percent year to date in 2017.

Highways

The Port of Texas City has excellent highway connections including very good access to Interstate 45.

Pipeline

The Port of Texas City hosts a number of pipelines networks, which carry a range of bulk liquid and gas products including crude oil, naphtha, as well as diesel, fuel oil, kerosene and gasoline to and from terminals within the port complex (Figure 2-55).

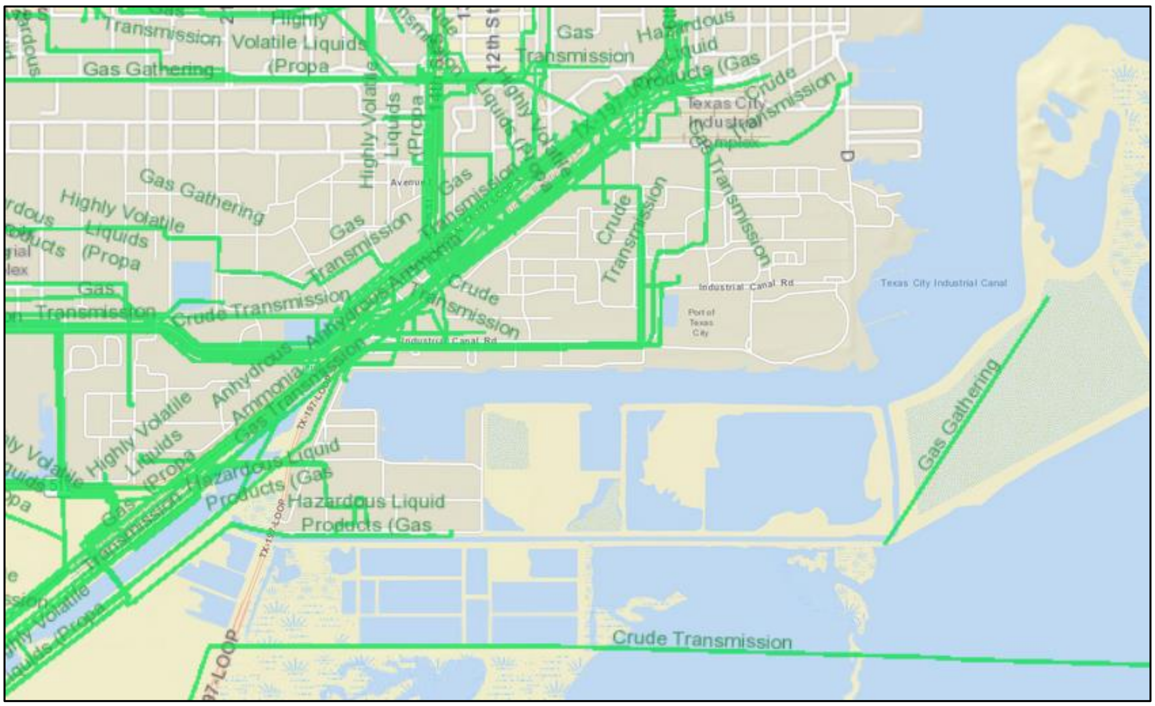


Figure 2-55. Pipelines at Port of Texas City

2.9.6 Growth and Development

There are several projects underway including an expansion of the Valero/Nustar facility capacity and export of thermal oxidizer. The Port needs more property for expansion, rail corridors and pipelines. There is extensive privately owned land surrounding the Port though there are several environmental issues which limit growth. In 2015, the Port/Texas City Railway Company supported the efforts of the City to remove any navigational impediments to a new development site at Shoal Point on Snake Island, on the southeast side of the Port. While supportive of expanded port growth and commerce, the Port expressed concerns that no agency should undertake planning that limits current access to existing facilities within the Port. The preference for a separate and designated route to Shoal Point would be the best possible scenario from the Port of Texas City’s perspective.

Oiltanking North America LLC has acquired approximately 220 acres of waterfront and industrial land on Shoal Point. This land will be used to house the company's Texas Independent Deepwater Expansion (TIDE) terminal.[51] The terminal will consist of three docks to service up to five Suezmax crude oil and petroleum tankers, onshore storage tanks, roads, and pipelines connecting to the adjacent Oiltanking facility located to the west of the project site.[52]

In the late 1990's and early 2000's the City worked with a private group to develop a Cargo Container Terminal within the Texas City Port at Shoal Point. This project is also known as the Texas City International Terminal (TCIT). The Terminal is proposed to have six berth areas roughly 1,000 feet each with state-of-the-art cranes, over 400 acres of container yard with potential for additional. The terminal is planned to be developed in three phases depending on speed of occupancy and demand.[53]

The project site is only 15 miles from the sea buoy located adjacent to the 45' deep Texas City Channel. With a 30-year lease from the City of Texas City and all construction permits from US Army Corps of Engineers, the TCIT project is ready to begin construction. However, no further information regarding any future developments or construction appears to be available.

Source: Texas City International Terminal

Figure 2-56. Rendering of Texas City International Terminal Complete Realization

[51] https://www.tanknewsinternational.com/oiltanking-acquires-land-in-texas-city-to-develop-texas-independent-deepwater-expansion-tide-terminal/

[52] https://www.swg.usace.army.mil/Media/Public-Notices/Article/1572771/swg-2016-01025-oiltanking-texas-independent-deepwater-expansion-tide-llc-texas/

[53] http://www.texas-city-tx.org/page/ed.shoal_point

2.10 Port Freeport Profile

2.10.1 Description

Port Freeport is a deep-water port located in Brazoria County, TX, about 40 nautical miles southwest of Galveston and about 65 miles south of downtown Houston. The port has direct access to the Gulf Intracoastal Waterway and Brazos River Diversion Channel (Figure 2-57).

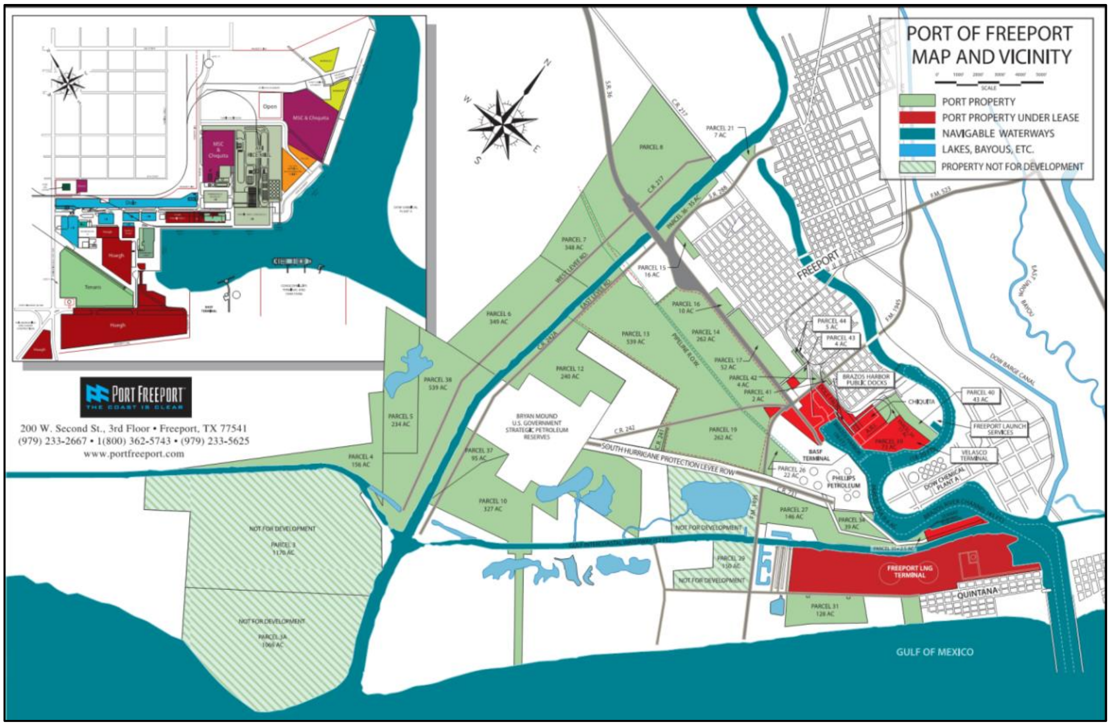


Figure 2-57. Port Freeport

2.10.2 Facilities

Surrounded by a Category 4 Hurricane Protection Levee, Port Freeport's land and operations includes about 540 acres of developed land and approximately 7,000 acres of undeveloped land. Port Freeport contains 18 berths accessed via a 45-foot deep channel via the Freeport Harbor Channel. The large tracts of undeveloped land are available to support future growth and development. Port Freeport also has the deepest berths on the Gulf Coast at 52 feet deep. Plans call for 2,400 feet of new berth to be added to the existing 1500 linear feet of berth.

The public terminal handles containers with calls from MSC and Ro-Ro cargo with Hoegh Autoliners. The terminal is equipped with two state of the art ZPMC container cranes that are capable of handling Panamax class container ships

2.10.3 Statistics

The port is ranked 28th in the U.S. and in 2018 handled nearly 24.5 million tons of cargo. The Port has over 800 vessel calls/year (including barge/tug calls) and had a TEU volume of 66,700 in 2018.

The annual economic impact for Port Freeport is $46.2 billion. The Port is responsible for 16,400 direct jobs, and 69,500 local indirect and induced jobs, and 41,100 jobs elsewhere in Texas.

Of all of the vessels that called on the port in 2016, 62 passed through the Panama Canal. The port's cargo is comprised of 85-90 percent liquid bulk.

The Foreign-Trade zone activities for 2015 are identified in Figure 2-58.

FTZ 149, FREEPORT
GRANTEE: PORT FREEPORT

All Activity:

MERCHANDISE RECEIVED	EXPORTS	EMPLOYEES
$5,000-10,000 mil	$100-250 mil	2,501-3,000

Warehouse/Distribution Activity:

NUMBER OF COMPANIES	MERCHANDISE RECEIVED	EXPORTS	TOTAL SHIPMENTS
5	$100-250 mil	$10-25 mil	$10-25 mil

Production Activity:

	COMPANY	MERCHANDISE RECEIVED	EXPORTS	TOTAL SHIPMENTS
149B	DSM Nutritional Products, Inc.	$5-10 mil	$5-10 mil	$5-10 mil
149C	Phillips 66 Company	$5,000-10,000 mil	$100-250 mil	$5,000-10,000 mil

Figure 2-58. FTZ #149 Activities

2.10.4 Commodities and Trade Flows

The oil and gas industry is a major client of Port Freeport. Other important commodities handled by the port are clothing, fresh fruits and vegetables, rice, paper goods, project cargo, plastic resins, aggregate, autos, and windmill components[54]. Tenants include Dole Fresh Fruit Company, Riviana, and Chiquita. In addition, there are also private terminal owners present at the port such as Dow Chemical Company and BASF.[55] The Dow Chemical Company's Freeport site is the largest integrated chemical facility in the Western Hemisphere. It employs 7,000 staff across 65 manufacturing units.

Top import commodities include aggregate, chemicals, clothing, crude oil, foods, LNG, paper goods, resins, wind turbines, automobiles, machines, steel pipe and project cargo. Port Freeport's top import countries are Brazil, Colombia, Costa Rica, Guatemala,

[54] 23 Port Freeport. (July 17, 2015). Welcome to Port Freeport. Presentation. Available at http://www.portfreeport.com/about_files/State%20of%20the%20Port%207.17.15.pdf.

[55] Port Freeport (February 2016). Port Freeport Economic Impact Analysis.

Honduras, India, Mexico, Korea and Japan. Top export commodities include automobiles, chemicals, clothing, foods, paper goods, resins, and rice. Port Freeport's top export countries are Brazil, Columbia, Costa Rica, Cuba, Dominican Republic, Honduras, Nigeria, and Saudi Arabia.[56]

Total tonnage at Port Freeport has been declining, largely as a result of domestic crude oil production replacing foreign imports, but 2017 marked a growth in tonnage. (Figure 2-59 and Figure 2-60).

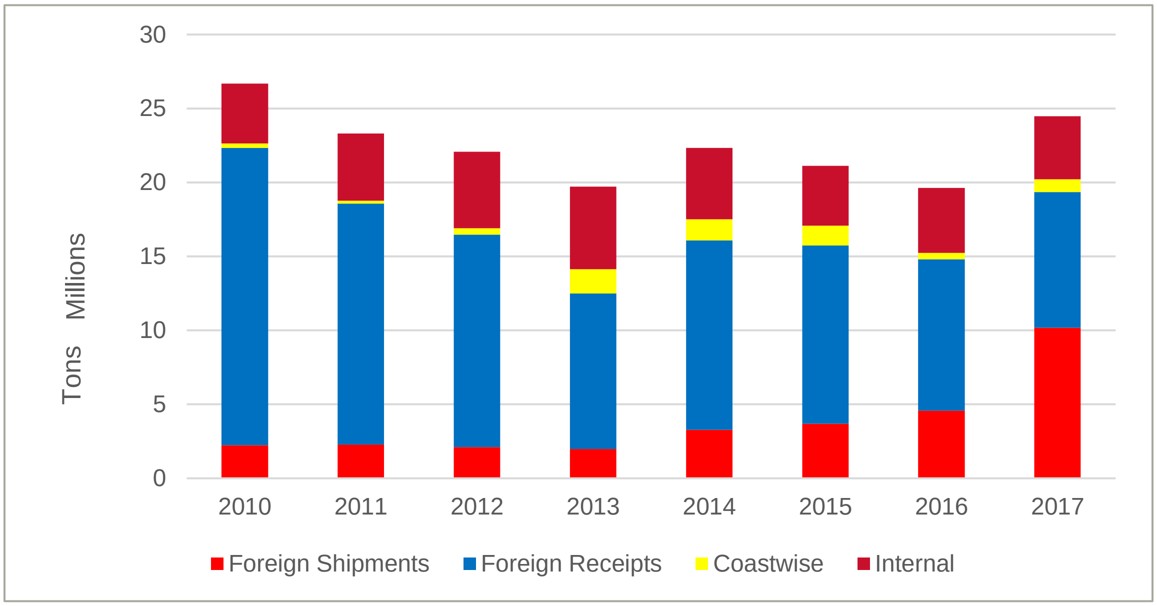


Figure 2-59. Port Freeport –Tonnage 2010-2015

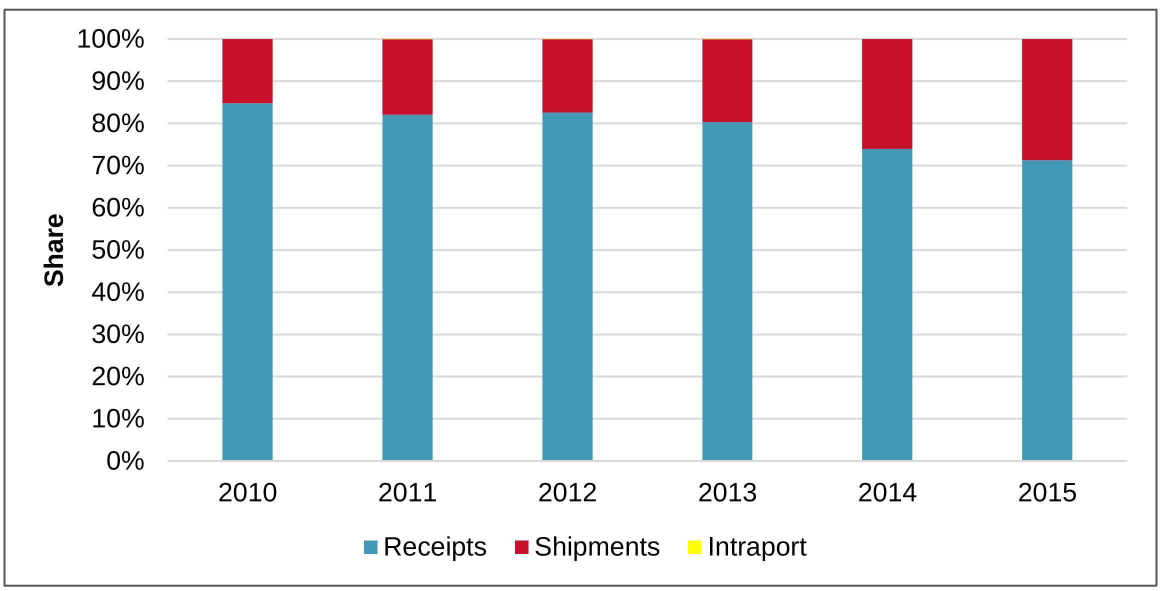


Figure 2-60. Port Freeport – Share of Tonnage

---

[56] Port Freeport (February 2016). Port Freeport Economic Impact Analysis.

2.10.5 Surface Transportation

Rail

The port is served by the Freeport subdivision of the Union Pacific Railroad. In August of 2017, a groundbreaking ceremony was performed to mark the commencement of construction associated with a 250-acre site that will be developed into a multimodal park with new warehousing facilities for plastic resins packaging, cross-docking activities and distribution centers. Additional areas of the site have been earmarked for new vehicle processing and storage. Union Pacific Railroad will offer manifest train service on the new rail infrastructure. The $21 million project consists of approximately 21,000 linear feet of new rail track that includes a 6,000-foot lead track spurring from the Union Pacific main line at Cherry Street, crosses SH 36, and then connects to three ladder tracks of approximately 5,000 feet each.

Highways

Freeport is served by SH 288, SH 36 with connections to I10, I45, and Beltway 8 (Figure 2-61).

Port Freeport sees the movement of 400,000 truckloads per year, and that number is expected to increase to 500,000 in 2 years. There is around 350-400 POV and trucks per day.

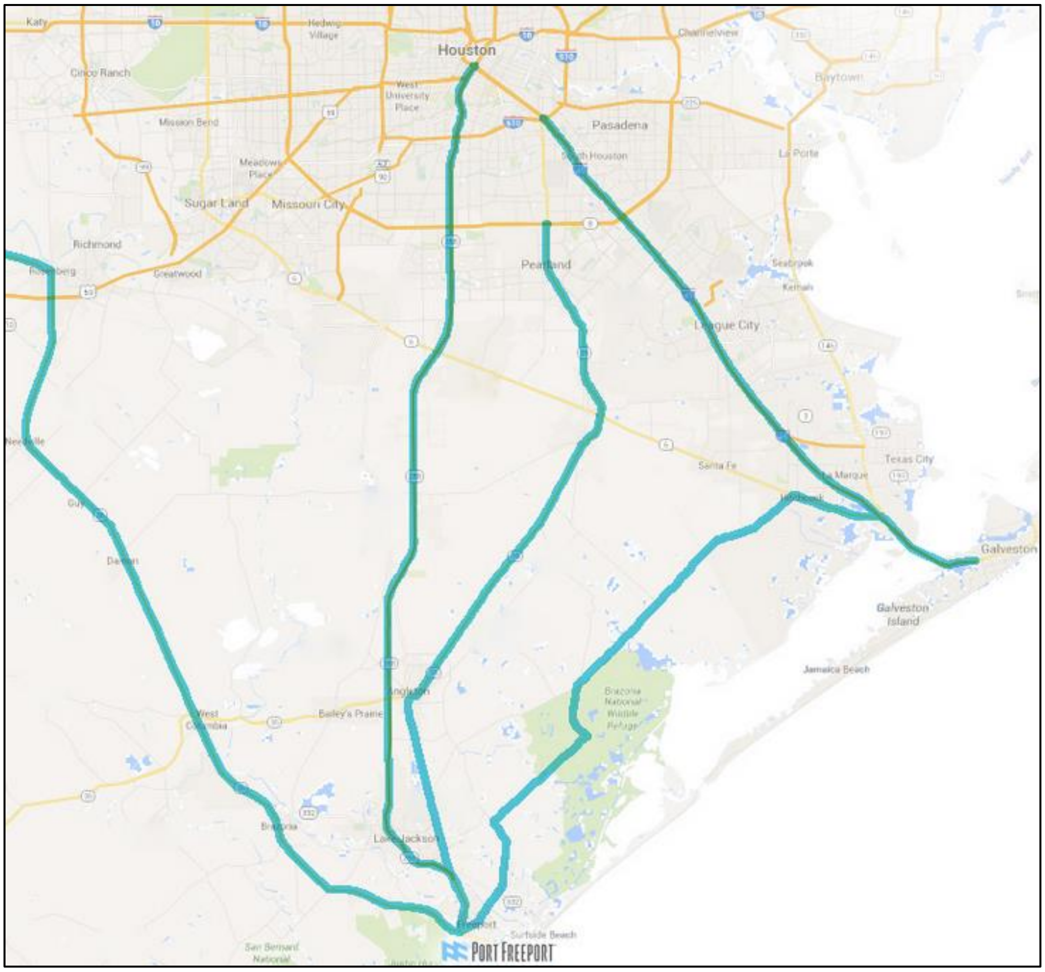
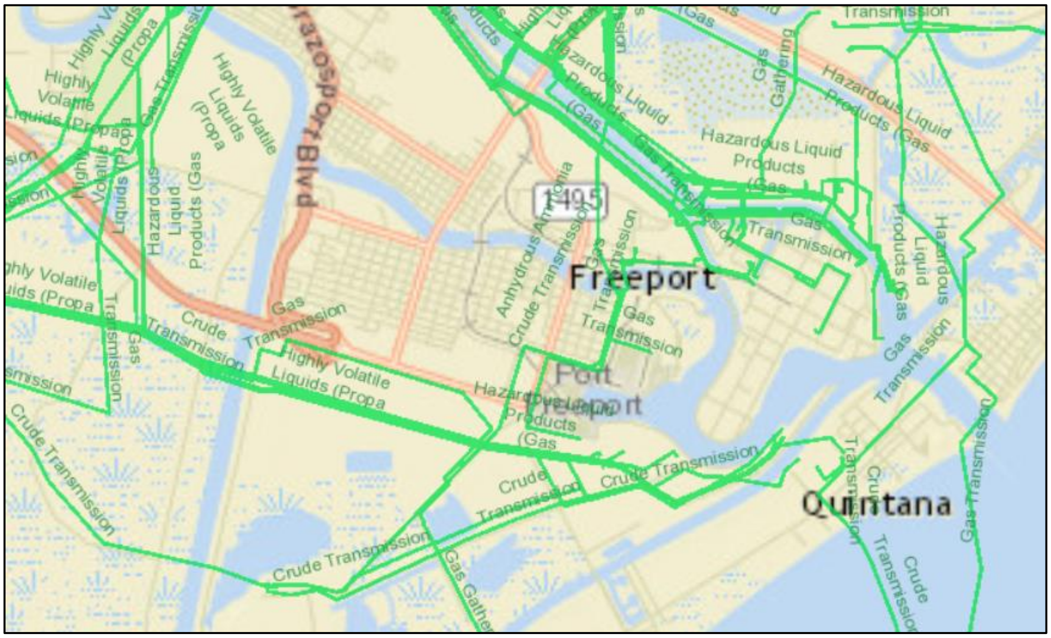


Figure 2-61. Highways serving Port of Freeport

The state approved funding for port projects within Legislative Rider 45 and Rider 48 which included for the Port Freeport, the construction of the railroad crossing on SH 36, just west of FM 1495 and SH 36 intersection. The Panama Canal expansion project, completed in 2016, supports larger vessels which are expected to discharge greater volumes at the port. To help with this issue, efforts have been underway to create a new route from the Port of Freeport via Texas State Highway 36. Phase One is scheduled to start in 2018 and involves widening a 55-mile stretch between Freeport and Rosenberg from two to four lanes.

Pipelines

A number of pipelines serve various terminals and facilities in the port and are operated by Phillips 66, Dow Chemicals, and Enterprise Products Partners L.P. Products transported by pipeline include natural gas liquids, crude oil and other industrial gases. A pipeline also links the port with the Bryan Mound Strategic Petroleum Reserve Site, located just to the west of Freeport (Figure 2-62).



Source. Texas Rail Road Commission

Figure 2-62. Pipelines in the Port of Freeport

2.10.6 Growth and Development

Port of Freeport and Private Terminal Projects

Overall, Port Freeport has determined that the State and H-GAC have done a good job of meeting the port’s expectations. Future planning needs to focus on future capacity needs as the port grows.[57]

Port Freeport is Brazoria County’s fastest growing port, growing at a rate of 15% per annum. As of 2016, $18.5 billion worth of oil and gas related projects were being constructed along Port Freeport’s Harbor Channel. There are over 500 acres that have been environmentally mitigated and are ready for development, and an additional 1,800 acres identified for industrial development. New infrastructure includes a new container terminal, a rail-accessible 100-acre OEM vehicle processing and storage facility and a break-bulk terminal. A private LNG processing and export facility is currently under construction in the Port.

A significant project includes expansion of the Velasco Container Terminal. This will allow the terminal to receive post-Panamax container vessels and will have 3 berths of 3,600 total feet. In addition, the terminal would host 9 post-Panamax Cranes and include a high-density terminal with on-dock rail and 1,500,000 TEU lift capacity. Phase 1 is currently taking place (as of 2017), and this is estimated to have an annual capacity of 800,000 TEUs.

[57] Ibid

Other tenants have also been spending money to enhance their facilities at Port Freeport. Phillips 66 has a $2.06 billion project to expand its terminal. BASF recently built a $90 million emulsion polymers manufacturing plant. Dow Chemical recently completed the construction of an ethane cracker plant. This facility is expected to produce 1.5 million metric tons of ethylene per year, which is derived from natural gas liquids and is used to form plastics.

Freeport Harbor Channel Improvement Project

Port Freeport has been authorized to deepen the port's channel to 55 feet with the passage of the Water Resources Reform and Development Act of 2014. This will make Port Freeport the deepest port on the Gulf of Mexico. Future enhancements will also include widening of the turning basin. Freeport LNG is funding a project to widen the entrance of the channel from 400 feet to 600 feet in order to accommodate larger ships and increase efficiency for ships traveling in and out of the channel.

The Freeport Harbor Channel Improvement Project (Figure 2-63is a $295 million federal cost-shared project that includes three major components:

- Channel deepening and limited widening will allow for a larger containership vessel class to penetrate further into the Port of Freeport and serve the Velasco Container Terminal;
- Bend easing will make it easier for modern ships to navigate through the Channel
- Creation of a turning notch at the Upper Turning Basin will enable easier turning of ships and turning of modern ships at Brazos Harbor

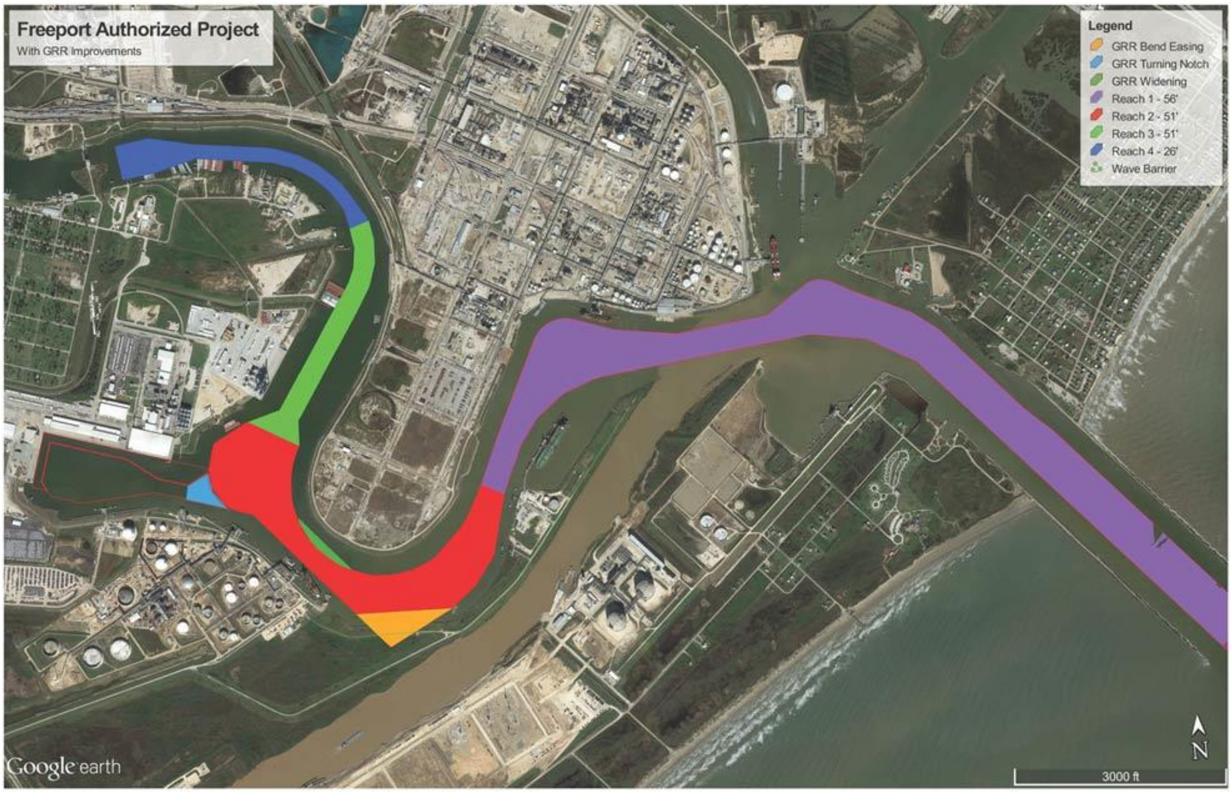
Federal investment for project construction is expected to total $165 million upon completion. Port Freeport's commitment to this project is $130 million, the amount of the bond package approved on the May 2018 ballot.[58]

The project can reap benefits by achieving savings in loading practices. With a deeper channel, a vessel can load more product and/or shift to a larger vessel class, also allowing for additional product per load. The heavier loading allows fewer vessels to transport the same amount of product, thereby reducing the number of round trips.

The second category of benefits for this project is time savings. These types of benefits are typically accrued by the reduction of transportation costs within a harbor. Reduced transportation costs may consist of a reduction in delays due to congestion and safety concerns, to name a few. Widening projects, including the turning basin and bend easing, may influence both loading practices and time savings. A wider channel may allow for a larger vessel class, or faster transit speeds.

Since the current channel is not designed to handle the larger vessels that are in service today, a deeper channel will enable Port Freeport to market the Port to a wider range of global vessels, expand capacity and customer base and potentially attract new liner services. This, in turn, is expected to facilitate additional economic opportunities.

[58] Port Freeport Freeport Harbor Channel Improvement Project Bond Package and Tax Rate Information http://portfreeportbondelection.com/project-information-2/



Source: Port Freeport Freeport Harbor Channel Improvement Project Bond Package and Tax Rate Information

Figure 2-63. Freeport Harbor Channel Improvement Project

2.11 Summary

While the region's ports are very different in size, layout and the markets they serve, they are vital for multitude of businesses that import and export goods through them. In 2015, the economic contributions of the Ports of Freeport, Galveston and Houston were estimated to support 555,400 Texas jobs and contribute over $76 billion to the Gross State Product. These jobs amount to nearly a third of all the 1.5 million Texan jobs that are supported by trade across all of Texas ports including seaports, airports and the U.S. Mexican border ports of entry.

The Texas ports handle a large and diverse mix of commodities, including consumer products, fresh produce, metal and pipe, cars and heavy cargoes including machinery and wind energy installations. However, the vast majority of trade though the region's ports is associated with fossil fuels and their related refined products. These petroleum and chemical products comprise over 85 percent of all trade flows in the region's ports, with 90 percent of domestic waterborne flows associated with these products and 74 percent of foreign trade flows. Increased domestic production of crude oil has reduced foreign crude oil imports coming through the region's ports. This includes Texas City, where foreign crude import was the basis for processing and handling of petroleum cargo, but most crude now comes in from domestic sources by pipeline and rail and in turn moves out in the same manner. However, since the growth in domestic crude oil production and the enacted legislation authorizing the export of U.S. crude oil without a license, exports through the Gulf Coast ports have grown rapidly and in 2018, the Gulf Coast became a net exporter of crude oil.

The region's growth in container trade, predominately focused on the Port of Houston's two container terminals, is a result of an increased consumer base in and around key Texas communities and the export of plastic resins produced by the region's chemical facilities. Direct sailings by container shipping lines to the Port of Houston from Asia and also Europe are contributing to this growth. The flow of international commodities into and out of the region is not just tied to Texas ports. Due to the extent of the national intermodal transportation network, Texas ports compete with ports throughout North America to attract and retain shippers whose goods are destined to or originate from Texas.

Increasing vessel size and the opening of the expanded Panama Canal locks in 2016, has also contributed to increasing numbers of larger vessels serving the region's ports. The need to accommodate larger containerships has evolved as a strategic focus for numerous U.S. ports including those in Texas, the Gulf and along the East coast. Accommodating these larger vessels have resulted in ports investing in infrastructure, such as deepening and widening harbor channels, raising bridges, expanding rail corridors and highway access, and increasing the amount of property dedicated to cargo handling at port terminals. These investments include the Houston Ship Channel and Freeport Channel improvements, terminal gate expansion that will double the number of truck lanes at the Barbours cut container and terminal and berth expansion and installing new post-Panamax cranes at the Valesco container terminal at the Port of Freeport.

However, the region's ports are limited in their ability to accommodate the largest bulk or container vessels now in service or projected over the next decade.

The region's ports rely on multimodal transportation options including rail, barge/short sea shipping, pipelines and truck to move goods to and from the ports. The extensive pipeline network linking the region's ports with refineries and chemical processing plants, means that much of the imported and exported petroleum, crude oil, chemicals and gases are transported by this mode, though rail and barge movement are also important modes for these commodities. Trucks however remain the dominant mode for container movement to and from the region's container terminals, dry bulk and RORO facilities.

3 Highway Network

3.1 Key Findings

- Interstate highways I-10, I-45, I-69 and I-610; and state highways SH 36, SH 225 and SH 146 provide crucial connections to the Houston regions ports. The following arterials also provide key last-mile connections to terminals and port related industries: Barbours Cut Boulevard, Port Drive, Industrial Road, Sheldon Road, Peninsula Road, Jacintoport Boulevard, Clinton Drive, Federal Road, Market Street, and Battleground Road.
- By 2035, trucks are anticipated to account for 54 percent of all goods movement by weight and 88 percent by value. These percentages were 50 and 82 respectively, in 2007.
- As per the American Transportation Research Institute (ATRI), seven out of the Top 100 Truck Bottleneck Locations in the nation are located in the H-GAC region. The interchanges of I-10, I-45 and I-69 form the top three out of those seven locations.
- According to the Economic Alliance Houston Port Region, 25,000-30,000 trucks served the Port of Houston per day in 2015.
- Among arterials, high truck volumes are concentrated on the eastside of Houston near the major port terminals on roads such as Barbours Cut Boulevard and Port Road, where approximately 4,000 and 8,000 trucks were counted in a day, respectively.
- Other arterials serving the industrial area on the north-east part of Houston such as SH 146 north of I-10, Battleground Road north of SH 225, FM 1405 south of Grand Parkway, Beaumont Highway west of John Ralston Road, McCarty Street north of Market Road and Federal Road north of Old Industrial Road experience approximately 2,000 to 3,000 trucks in a day.
- A comparison of 2017 and 2045 scenarios from H-GAC's travel demand model suggest that a significant increase in truck volumes is expected along I-610 on the east side of downtown, I-10E east of Sam Houston Tollway, and SH 225 between I-610 and Sam Houston Tollway. All three locations show a projected increase of 25% or more in truck volume by 2045.
- Currently, there are three major crossings across HSC: SH 146 (Fred Hartman Bridge), Sam Houston Tollway (Ship Channel Bridge) and I-610. Given the truck travel demand in this region, a fourth bridge to cross HSC was investigated as part of this study. The fourth bridge was assumed along Independence Parkway to travel between SH 225 and I-10 and further travel east along I-10 or north along US 90.
- Based on driver surveys conducted in October 2017 and data provided by American Truck Research Institute (ATRI), most of the truck trips to and from Port of Houston have origins and destinations predominantly within the Greater Houston Area including the Northeast Houston industrial area, specifically El Dorado/Oates Prairie, and refineries and chemical industrial complexes along the Houston Ship Channel, Baytown, and the north of Mont Belvieu.

- A number of projects have been identified by H-GAC, Texas Department of Transportation (DOT), Harris County and Port of Houston that are key to port related mobility and thus the economic development of the region: Improvements to SH 225; SH 146; Port Road; Barbours Cut Blvd; Red Bluff Rd; Fairmont Parkway; Clinton Drive; Industrial Road; Jacintoport Boulevard; Penn City Road; Sheldon Road and Appelt Drive are critical and they include improvements such as roadway expansions, providing direct connectors, signal retiming, and improved access.
- The expansion of I-45 from NASA 1 to FM 1764 in Texas City and SH 146 from Red Bluff Road to FM 517 are expected to help the truck movement to and from Ports of Galveston and Texas City.
- The proposed projects along SH 36 and SH 288 in the vicinity of Port Freeport along with grade separations at SH 332 and FM 523 and SH 36 and FM 1495 are expected to help the truck movement to and from Port of Freeport.
- Based on driver surveys conducted at study area port terminals in October 2017, it was noted that the majority of trucks arrive without a load when picking up or return without a load after a delivery.
- Among other challenges, freight industry is experiencing truck driver shortage and it is expected to get worse resulting in higher transportation costs and longer delivery lead times, thus impacting the economic growth.

3.2 Introduction

This chapter focuses specifically on describing the existing road and traffic conditions in the region, port related trucking operations, and how the road network supports goods movement to and from ports in the Houston region and beyond. It also outlines the role of heavy and oversized haul truck routes serving the region's ports and associated regulations. Many of the region's ports handle these types of loads from both domestic and international sources. Heavy haul and oversize routes are vitally important in facilitating the installation and construction of petrochemical structures in the state; the movement of power generation, including wind turbine equipment; and, increasingly the export of plastic resins that are shipped in heavy weight containers.

The Houston area and the surrounding Gulf Coast region continues to experience some of the largest economic growth occurring in the United States today. Higher than average population growth coupled with increasing economic activity and port development across the region has led to an overall increase in transportation demand, as well as a need for expanded transportation options among freight shippers and manufacturers in the area. Road transportation has played an important role in meeting the freight transportation needs of the Houston region and continues to do so.

However, the use of road transportation for freight movement varies by commodity. Other modes such as rail, pipeline and barge movement compete with trucks to move products to and from the ports. For bulk fuel and chemical movements, rail, pipeline and barges are heavily used, with trucks being used for small volumes and local distribution. Conversely for container movement to and from the ports, trucking is by far the dominant mode. The movement of steel pipe from the ports to the Texan oil fields is also predominately by truck.

3.3 Roadway Hierarchy

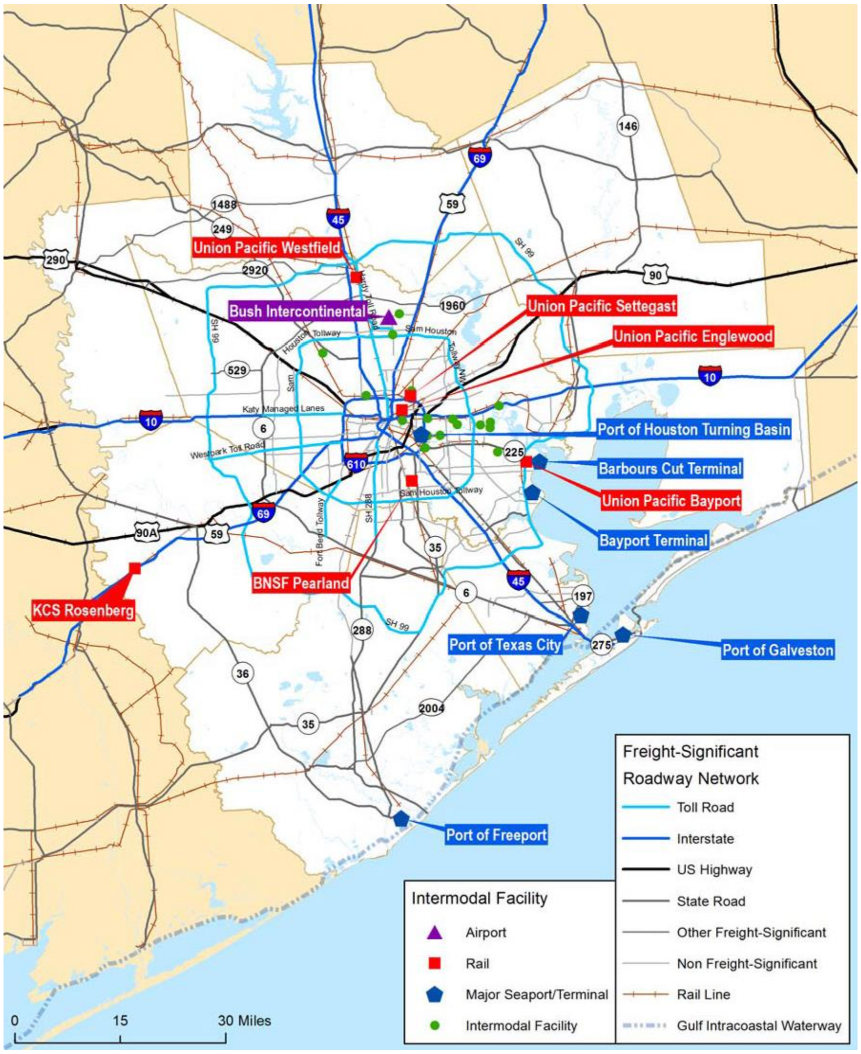
The region's road system consists of a network that ranges from transcontinental interstate highways to local roads providing "last mile" access to industrial facilities and port terminals. All of these different roads play a vital role in serving the ports' mobility needs.

Roadways relevant for the efficient movement of freight have been identified at federal, state, and regional levels. Together they form networks that are essential to keep the port and its terminals running day and night. The National Highway Freight Network contains the region's Interstate Highways, US 59 and US 290.[59] The Texas Highway Freight Network (THFN) is comprised of a Primary Freight Network and a Secondary Freight Network/Emerging Freight Corridors.[60] It contains the region's Interstate Highways, the US and State Highways and many local arterials, such as Farm-to-Market Roads. H-GAC's Freight Significant Corridors[61] is a network similar to the THFN, but is a localized network that has been tailored by private sector stakeholders, including trucking and rail company representatives, industrial developers, and shippers and manufacturers and is shown in Figure 3-1. Approximately 95 percent of the roads mentioned in this document are at least part of one of the networks mentioned above.

[59] FHWA: https://ops.fhwa.dot.gov/Freight/infrastructure/nfn/index.htm

[60] TxDOT & ArcGIS

[61] H-GAC Regional Goods Movement Plan, June 2013



Source: H-GAC Regional Goods Movement Plan, June 2013

Figure 3-1. Freight-Significant Corridors

The Interstate Highway System plays a critical role in dispersing goods to and collecting freight from locations throughout the wider region and beyond the state of Texas. Interstates 10, 45, and 69 are vital hinterland connections linking the region's ports to distant customers. These connections link the port with consumer bases outside of the Greater Houston Area, and also bring in agrarian produce from farms, or manufactured goods from factories in other urban cores. In addition to long distance connectivity, the interstate highways also provide an important link between the ports and local origins and destinations. I-610 serves both local port traffic and long-distance traffic from the ports of Houston and Galveston to avoid Houston's congested city core.

The Port of Freeport heavily depends on SH 36 and SH 288. SH 146 is an important corridor for the Port of Texas City, the terminals to the east of Houston, and Baytown. SH 225 is crucial for access for all terminals on the south side of the Houston Ship Channel (HSC) and the industries set up along HSC. Beltway SH 8 (Sam Houston Tollway) also provides an important crossing of the HSC.

As noted by Harris County Precinct 2 and Port of Houston representatives, the following arterials carry large volumes of port-related traffic: Barbours Cut Boulevard, Port Drive, Industrial Road, Sheldon Road, Peninsula Road, Jacintoport Boulevard, Clinton Drive, Federal Road, Market Street, SH 146 and Battleground Road.

Local roads are used for last mile access to terminals. Many of the port terminals to the north and south of the HSC rely on two-lane local roads for access, while other port terminals such as Galveston, Texas City and the Houston container terminals are served by four-lane highways.

3.4 Port-Related Traffic Types

There are typically five different traffic flows in relation to the ports and associated terminals which the supporting road system has to accommodate, as described in Table 3-1.

The last three traffic flows detailed in the table, are accommodated on local and regional road networks where trucks are used for local and regional distribution purposes, serving to transport goods between warehouses, distribution centers, local customers, and port terminals. The national road network, including Interstates 10 and 45, serve both the aforementioned local purposes and continental goods movement from origins and to destinations outside of Texas. The first two traffic categories are more common on these roads.

Table 3-1. Five Types of Port-Related Traffic

Traffic Description	Common Vehicles	Notes
Import and export of goods that are transported by ocean-going vessel and discharged or loaded at a terminal	Tractor-trailer trucks	Common Commodities • 20-foot and 40-foot intermodal shipping containers on chassis • breakbulk or project cargo loads on flatbed trailers • autos on car transporters • grain in specialized hopper trailers
Movement of goods out of terminals that are not directly imported by ships, but are derivatives from imported goods or other manufacturing or industrial processes that occur within the terminal	Tractor-trailer trucks	Common Commodities • tractor-trailer tank trucks that enter the port area to collect refined products at refineries and other petrochemical plants. These refineries and industrial complexes are typically located adjacent to the water, due to their dependence on imports and exports from ocean going vessels and domestic barges.
Movement of goods and waste in support of the presence of personnel and primary processes at the terminal, such as operation and loading of ships, and maintenance on ships and cranes	Single-unit trucks, such as box trucks and delivery vans	Common Commodities • janitorial supplies, express parcels, office supplies, and food • ship supplies, - food and spare parts • trucks that collect waste • fuel supply for cargo handling equipment
Movement of building materials, heavy machinery, and personnel to work on terminals, quays, warehouses, or industrial structures	Wide range of construction trucks and private vehicles	This is an irregular flow of traffic going to locations for limited periods of time but can cause peak demand on roads leading to active construction sites.
Employees who work in the port	Bus or private vehicle	Many port activities require 24-hour staff presence, causing commuter traffic outside of conventional rush hour periods

3.5 Highway and Truck Trends and Challenges

3.5.1 Modal Share of Trucks

Trucks currently are the dominant mode for freight movement in the H-GAC region and will continue to be in the foreseeable future. By 2035, trucks are anticipated to account for 54 percent of all goods movement by weight and 88 percent by value (see Table 3-2).[62]

[62] Houston-Galveston Area Council, Regional Goods Movement, June 2013

Table 3-2. Modal Share of Trucks in H-GAC Region's Goods Movement by Weight and by Value in 2007 and 2035

Modal split	Weight		Value	
	Tons in millions	Percentage	USD in trillions	Percentage
2007	465	50	1.3	82
2035	781	54	3.0	88

Source: Houston-Galveston Area Council, Regional Goods Movement, June 2013

3.5.2 Driver Shortage

Although truck driver is the most common profession in 29 states, there are not enough truck drivers to meet the existing demand.[63] The truck driver shortage is expected to increase, resulting in higher transportation costs and longer delivery lead times. Expected effects on the ports' mobility are:

- Goods will remain longer in the port before being picked up.
  - Terminals will require larger holding areas for goods awaiting pick-up.
  - Ports will have to consider investing in or collaborating in alternate (potentially driverless) hinterland modalities.
- Higher transportation costs will impact economic growth.
  - Port-based companies will lose market-share due to higher prices for their goods or will experience smaller profit margins due to higher costs.

3.5.3 Highway Congestion

Highway congestion occurs when traffic demand is higher than the capacity a roadway can accommodate. Trucks contribute to congestion but also suffer from it. Congestion is a relevant topic for the ports, as the capacity and flow of their hinterland connections determine the ports' competitiveness with other ports in the same region.

The American Transportation Research Institute (ATRI) annually releases a Top 100 Truck Bottleneck List.[64] In 2018, seven out of the top 100 bottlenecks are located in the H-GAC region. ATRI's analysis includes various factors, including truck volume and average speed.

[63] American Trucking Association

[64] http://atri-online.org/2018/01/25/2018-top-truck-bottleneck-list/

Table 3-3. Top ATRI Bottleneck Locations Present in the H-GAC Area

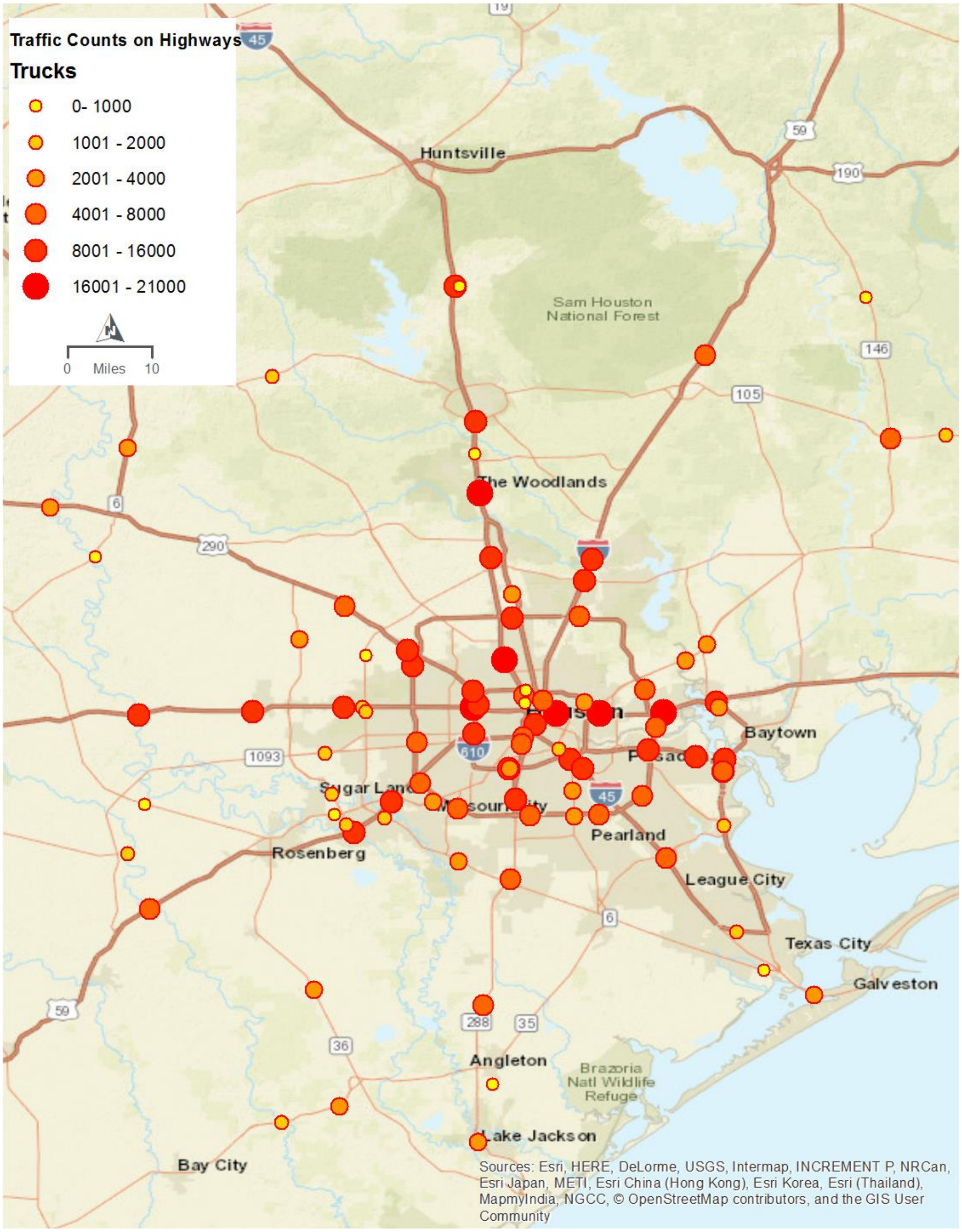
ATRI Congestion Ranking	Location Description	Peak Average Speed (mph)	Peak Average Speed Percent Change 2017-2018
18	Houston, TX: I-10 at I-45	32.0	2.60
19	Houston, TX: I-45 at US 59	26.7	3.99
23	Houston, TX: I-10 at US 59	31.2	1.17
41	Houston, TX: I-45 at I-610 (North)	34.8	-0.56
48	Houston, TX: I-10 at I-610 (West)	36.7	-1.00
58	Houston, TX: I-610 at US 290	31.6	-1.98
93	Houston, TX: I-610 at US 59 (West)	33.2	9.64

Source: American Transportation Research Institute (ATRI)

Daily truck traffic volumes on major highways in the H-GAC area are shown in Figure 1-2. The first tier of the most heavily used highways are along I-45, north of downtown Houston, I-10, and I-69 (US 59). The second tier are along I-45, south of downtown Houston, SH 290, SH 288, I-610, and the Sam Houston Tollway. These results are also consistent with ATRI's top truck bottleneck locations (Table 3-3), of which, the top three in the H-GAC area are located at the intersections of I-10, I-45, and I-69. High truck congestion along the two major loops, I-610 and the Sam Houston Tollway of the study area shows that these highways are vital connections between all major highways.

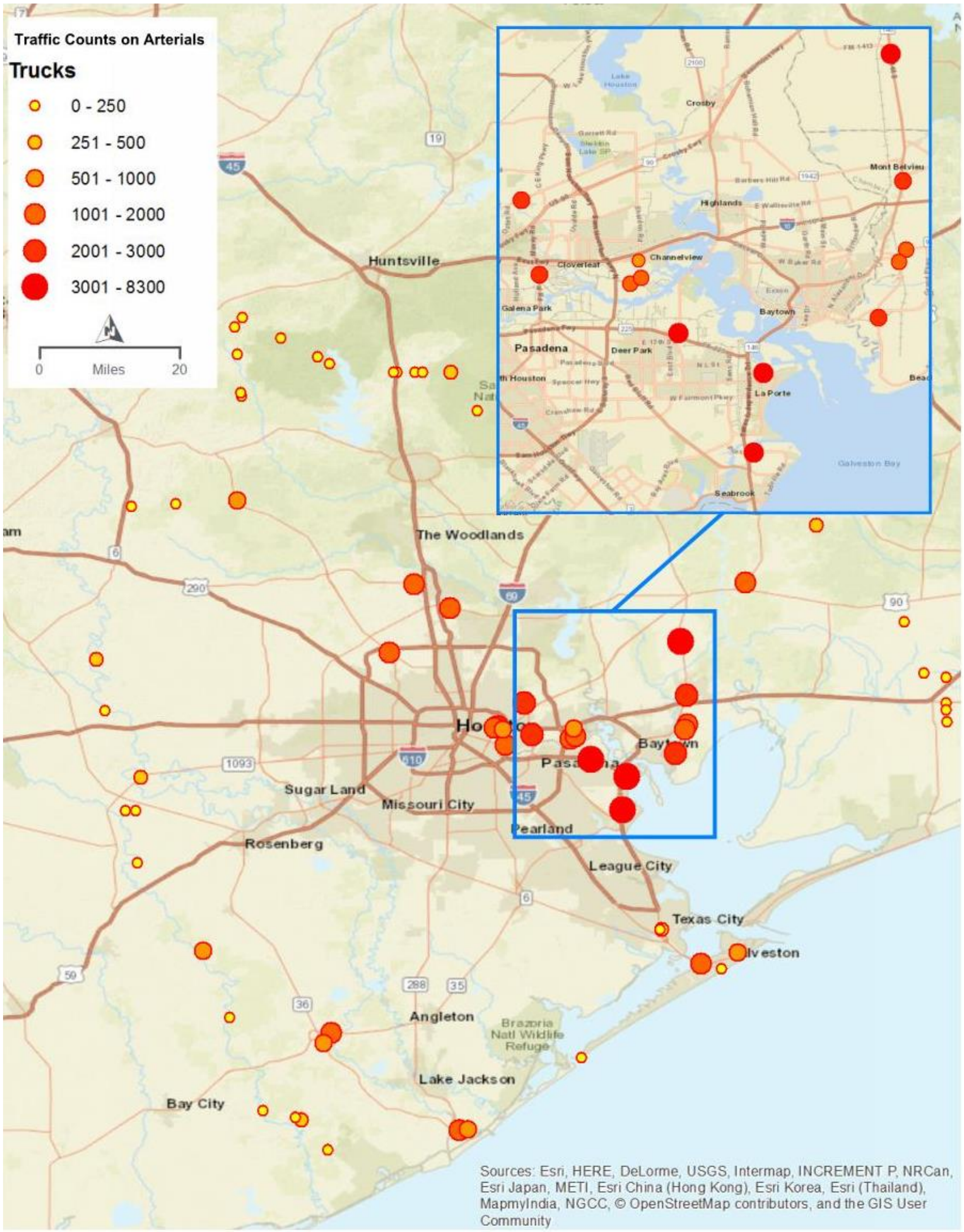
However, these challenges are not limited to major highways, significant truck volumes congestion are also experienced along arterials that connect highways to the ports. The daily truck traffic counts along arterials in the H-GAC area are shown in Source: H-GAC Travel Demand Model

Figure 3-3. As expected, high truck volumes are also concentrated on the eastside of Houston near the major port terminals on roads such as Barbours Cut Boulevard and Port Road, where approximately 4,000 and 8,000 trucks were counted in a day, respectively. Similarly, other arterials serving the industrial area on the north-east part of Houston such as SH 146 north of I-10, Battleground Road north of SH 225, FM 1405 south of Grand Parkway, Beaumont Highway west of John Ralston Road, McCarty St north of Market Road and Federal Road north of Old Industrial Road experience approximately 2,000 to 3,000 trucks in a day. Truck traffic heading north and west out of the region originating from the Port of Houston and terminals along the Houston Ship Channel, unfortunately has to travel along some of the most congested corridors in the region. The same also applies to the Port of Galveston and north bound traffic from the Port of Freeport.



Source: H-GAC

Figure 3-2. Truck Volumes on Major Highways

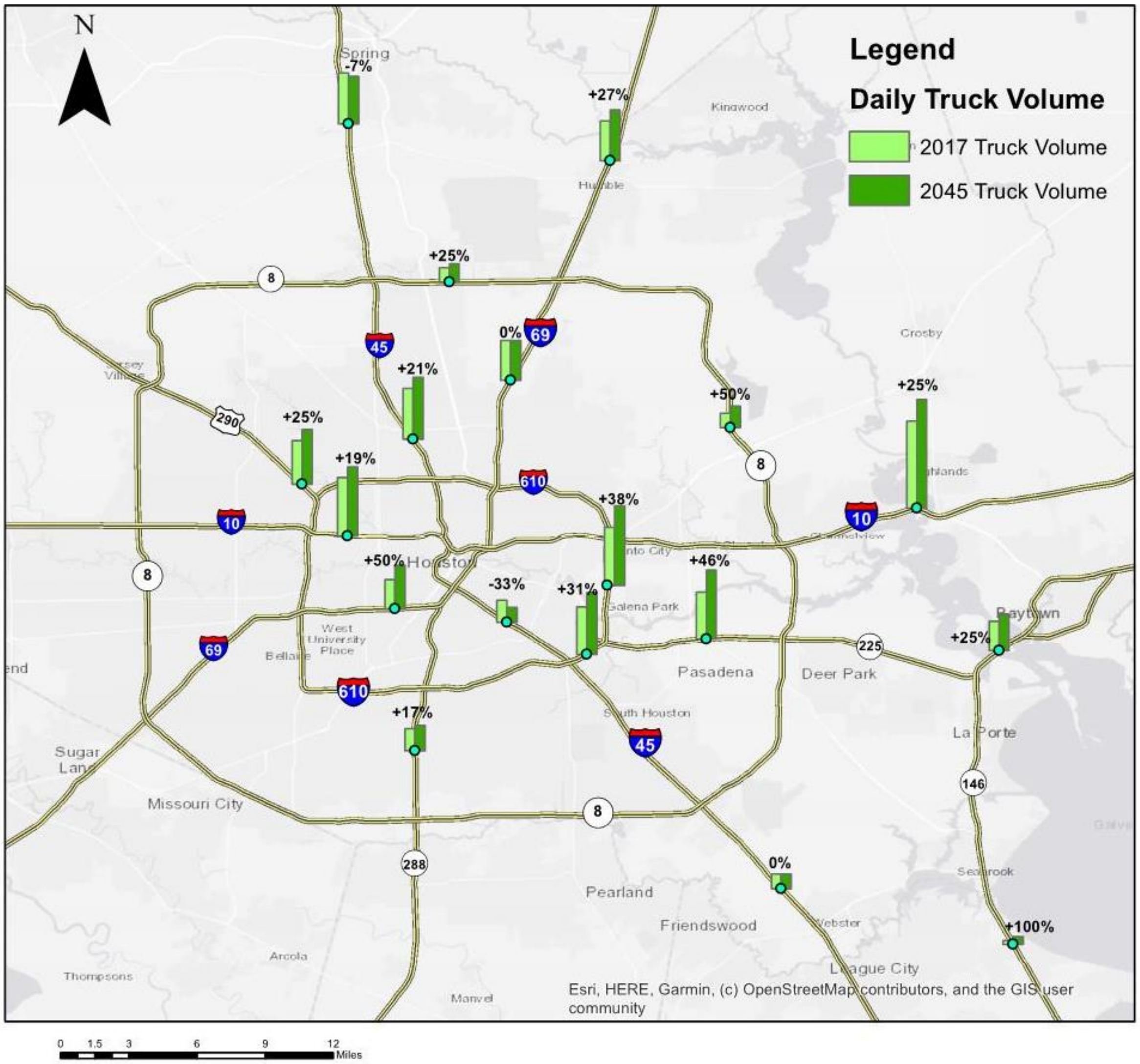


Source: H-GAC Travel Demand Model

Figure 3-3. Truck Volumes on Arterials

Source: H-GAC Travel Demand Model

Figure 3-4 shows the percent change in truck traffic volume from 2017 to 2045 as estimated from the H-GAC's travel demand model on key highways in the region. It is worth noting that though all highways are expected to experience an increase in truck volumes in 2045, the I-45 locations north of Sam Houston Tollway and within the I-610 loop are expected to experience a drop in truck volumes. This could be due to the expected completion of Grand Parkway on the north-east part of the City and other major projects within the region, which divert traffic to other highways. A significant growth in truck traffic is expected along some of the already congested roadways such as the loop I-610 on the east side of downtown, I-10 east of Sam Houston Tollway, and SH 225 between I-610 and Sam Houston Tollway. All three locations show a projected increase of 25% or more in truck volume by 2045.



Source: H-GAC Travel Demand Model

Figure 3-4. Truck Volume Comparison between 2017 and 2045

3.5.4 Ship Channel Crossings

The anticipated increase in truck volumes in the north-east part of Houston is consistent with the presence of numerous terminals and industries along the Houston Ship Channel (HSC) (See section 2.1). The location of warehouses and distribution centers associated with large retailers such as Walmart and Ikea along with resin packaging plants within the Cedar Port Industrial Park and Baytown area also demonstrate a significant truck travel demand in this region.

This truck travel demand is demonstrated by other data sources such as truck driver surveys conducted by HDR (section 2.4) and ATRI's Origin-Destination (OD) data (section 2.5).

Currently, there are three major crossings across HSC: SH 146 (Fred Hartman Bridge), Sam Houston Tollway (Ship Channel Bridge) and I-610. The Ship Channel Bridge is the only toll bridge and is currently undergoing replacement with two separate bridges, one for each direction of traffic. The southbound bridge is expected to open to traffic in Fall 2021 and the northbound bridge is expected to open in Fall 2024.[65]

Given the truck travel demand in this region, a fourth bridge to cross HSC was investigated as part of this study. The cross-section of the new bridge was assumed to be the same as existing Fred Hartman Bridge, with four lanes proposed in each direction.

Independence Parkway is located approximately half-way between SH 146 and Sam Houston Tollway and connects SH 225 on the south with I-10 on the north through a ferry service called Lynchburg Ferry. The proposed bridge is assumed to replace the ferry service to provide a fourth option for the trucks to travel between SH 225 and I-10 and further travel east along I-10 or north along US 90.

---

[65] https://www.shipchannelbridge.org/overview.html

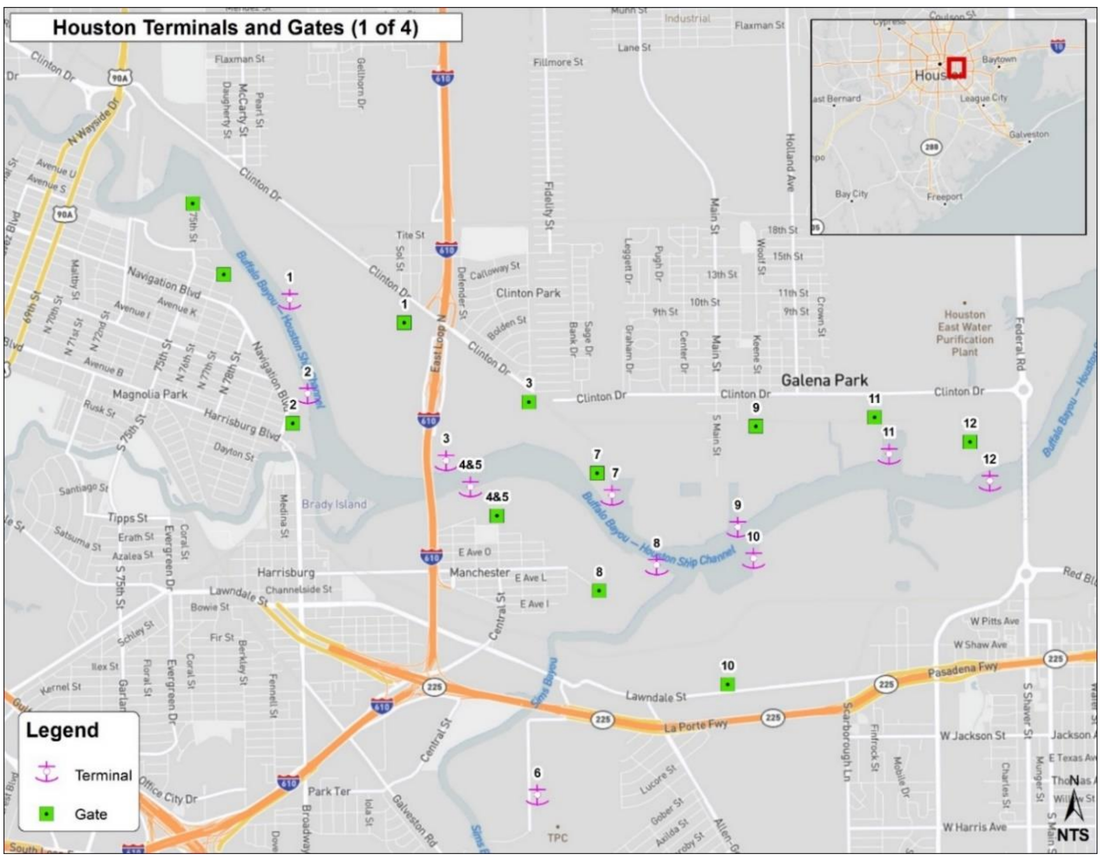
3.6 Port of Houston - Highway Network and Trucking Operations

3.6.1 Location of Terminal Gates

The many terminals lined along the HSC mostly have their own access gates onto local roads and occasionally direct access to a highway (see Source: HDR Inc.

Figure 3-5 through Source: HDR Inc.

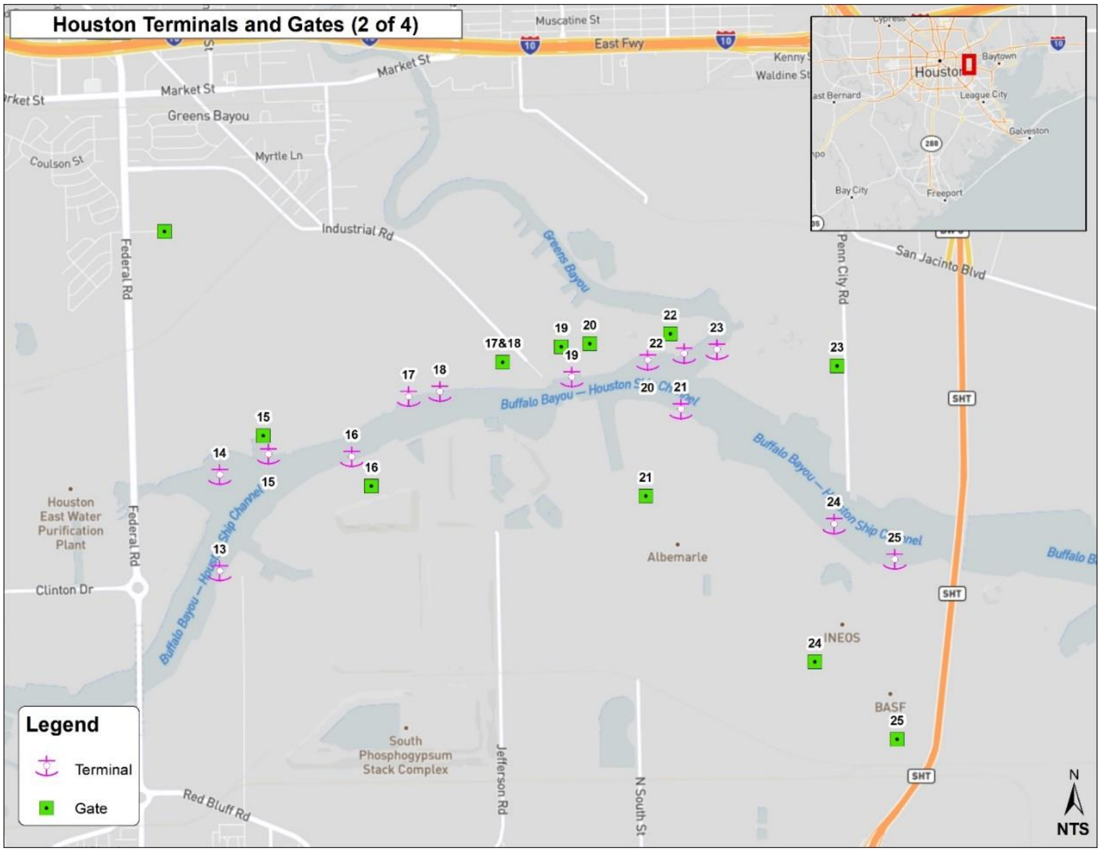
Figure 3-8) with one exception. The Port of Houston Authority's (PHA) Southside Wharves southwest of the Turning Basin have two entry points for trucks. The Southside wharves can be accessed through gates at the northernmost end of 75th Street and the easternmost end of Avenue P. The Northside wharves are part of PHA City Docks/Turning Basin and can be accessed through the Main Truck Gate off of I-610.



1	PHA City Docks	7	Houston Cement (West)
2	New Terminal	8	Manchester Terminal Company
3	Texas Terminals	9	PHA Woodhouse
4	Contanda	10	Lyondell
5	Old Manchester	11	Kinder Morgan
6	TPC	12	Houston Cement (East)

Source: HDR Inc.

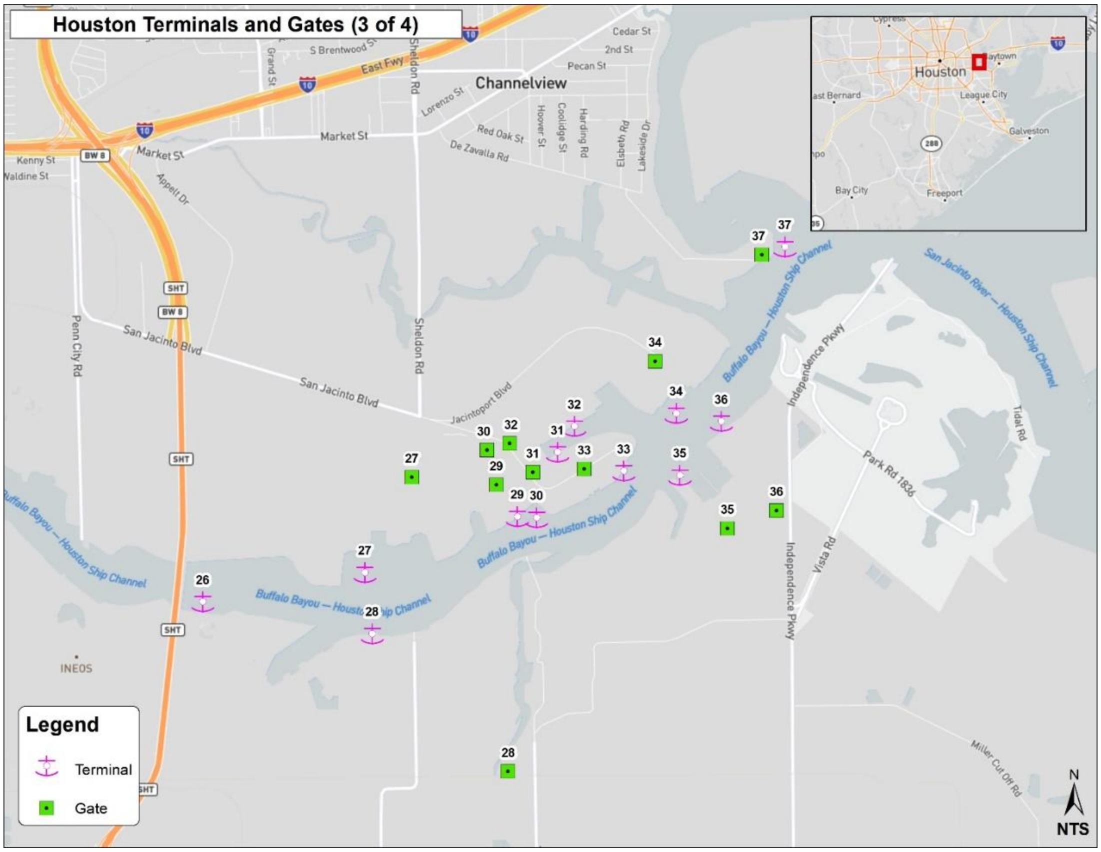
Figure 3-5. Houston Terminals and Gates (1/4)



13	Kinder Morgan	20	Vulcan
14	Targa	21	Enterprise Products
15	Magellan	22	South Central Cement
16	Rentech	23	PHA Bulk Plant
17	Watco GreensPort Industrial	24	Georgia Gulf
18	Watco/Kinder Morgan GreensPort	25	Houston Ammonia Terminal
19	Industrial Terminals		

Source: HDR Inc.

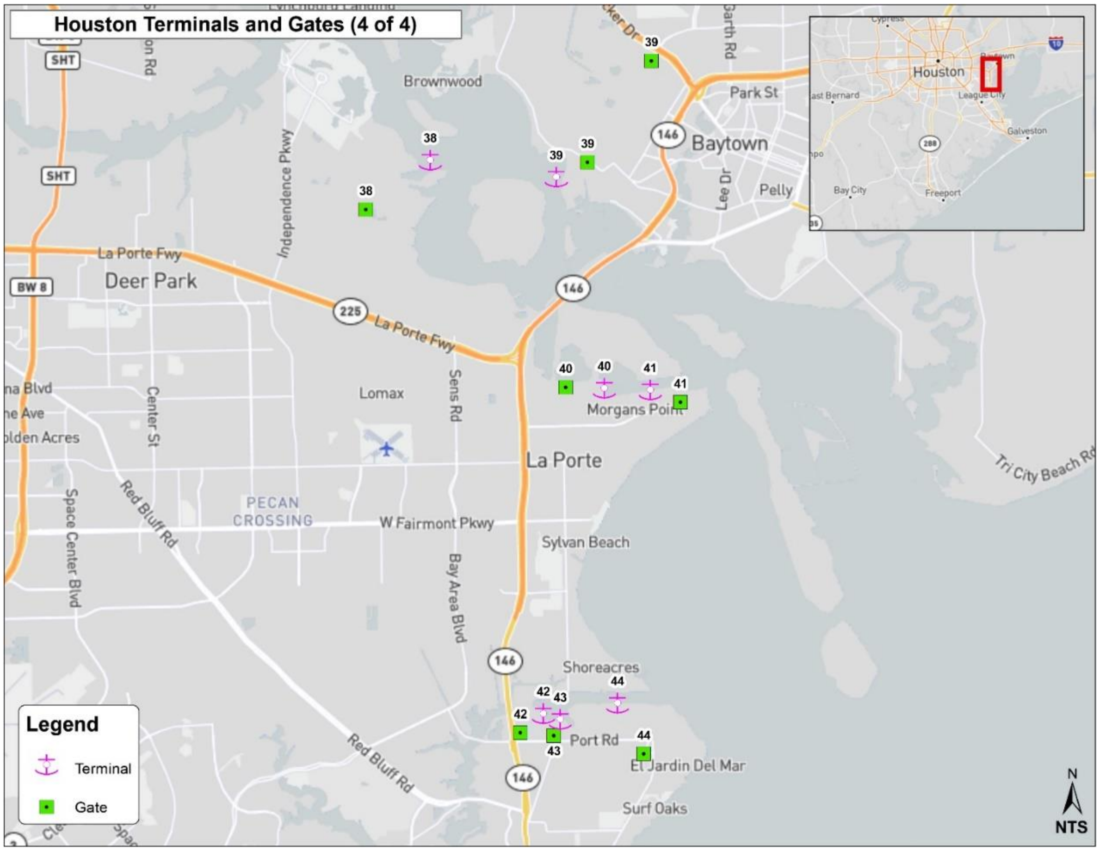
Figure 3-6. Houston Terminals and Gates (2/4)



26	Kinder Morgan	32	PHA Jacintoport Terminal
27	Stolthaven	33	PHA CARE Terminal
28	Shell	34	Houston Fuel Oil
29	Mosaic	35	Intercontinental Terminals Company
30	Cargill	36	Vopak
31	Contanda Steel	37	CEMEX

Source: HDR Inc.

Figure 3-7. Houston Terminals and Gates (3/4)

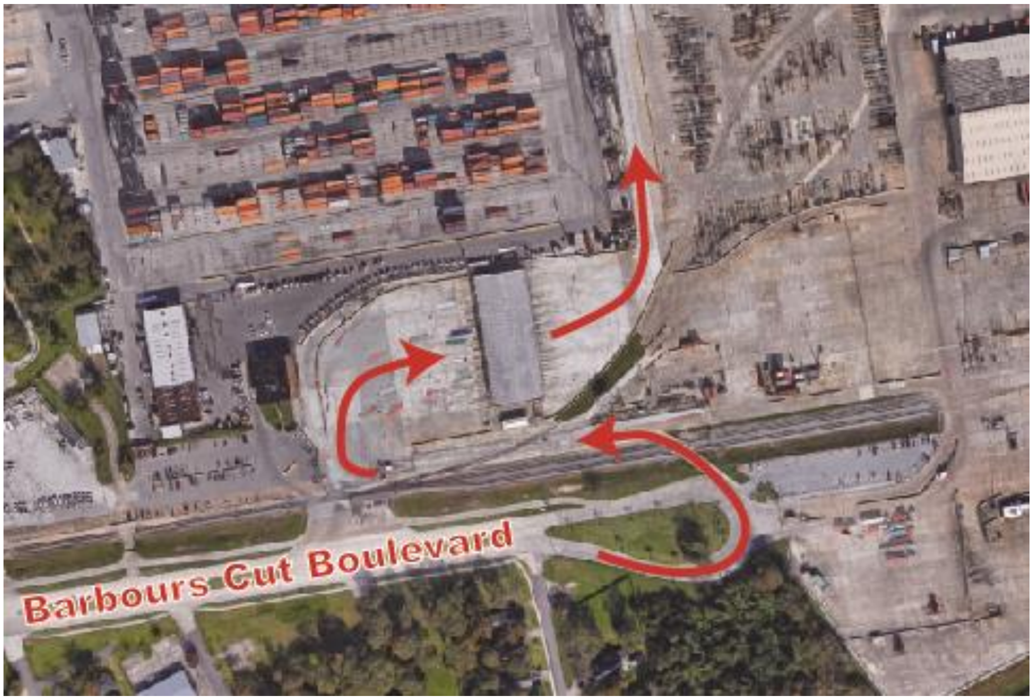


38	Bostco	42	LBC
39	Exxon	43	Odfjell
40	Enterprise Products / Morgans Point	44	PHA Bayport
41	PHA Barbours Cut		

Source: HDR Inc.

Figure 3-8. Houston Terminals and Gates (4/4)

The Barbours Cut and Bayport container terminals’ entrance gates have been designed to handle large volumes of trucks entering the respective terminals. For example, entry routes have also been designed to prevent entering trucks from making left turns. The layout also allows for trucks to go through the entry procedure and queue without blocking traffic on the highway.



Source: Google Data SIO, NOAA, U.S. Navy, NGA, Gebco

Figure 3-9. Barbours Cut Container Terminal Truck Entrance

Source: Google Data SIO, NOAA, U.S. Navy, NGA, Gebco

Figure 3-10. Bayport Container Terminal Truck Entrance

3.6.2 Highway Network Serving the Port of Houston

The Port of Houston's terminals and industrial complexes are generally accessible by I-10, I-610, and SH 8. For regional and continental connectivity, the Port of Houston depends on I-10, I-45, I-69, and SH 59. SH225 serves the terminals and industrial complexes on the south side of the HSC. SH 146 provides an essential north-south link between I-10 and the Port of Texas City, in between connecting important eastern Port of Houston sites. Barbours Cut Container Terminal is served by SH 146 and SH 225, whereas Bayport Container Terminal is served by SH 146.

Clinton Drive, Federal Road, Industrial Road, Sheldon Road, and Jacintoport Boulevard are not categorized as highways, but major thoroughfares connecting the terminals and industrial complexes on the north side of the HSC to the state and interstate highways. I-610 and SH 8 are vital north-south connectors providing access across HSC.

Besides access to the two largest container terminals of the Port of Houston, SH 146 also serves Baytown and links to I-10 East. SH 99 provides an alternative connection between Baytown and I-10 East accessing the newly developed industrial area east of Baytown, including Cedar Port Industrial Park. SH 330 links Baytown to I-10 West and will serve the planned Port 10 Logistics Center.

In 2010, there were about 10,000 trucks per day serving the port. By 2015, according to the Economic Alliance Houston Port Region, that number had grown to 25,000-30,000 trucks per day using the same roads. With increasing trade and tonnage passing through the port, especially with commodities that move predominantly by road such as containers, the number of trucks could significantly keep increasing.

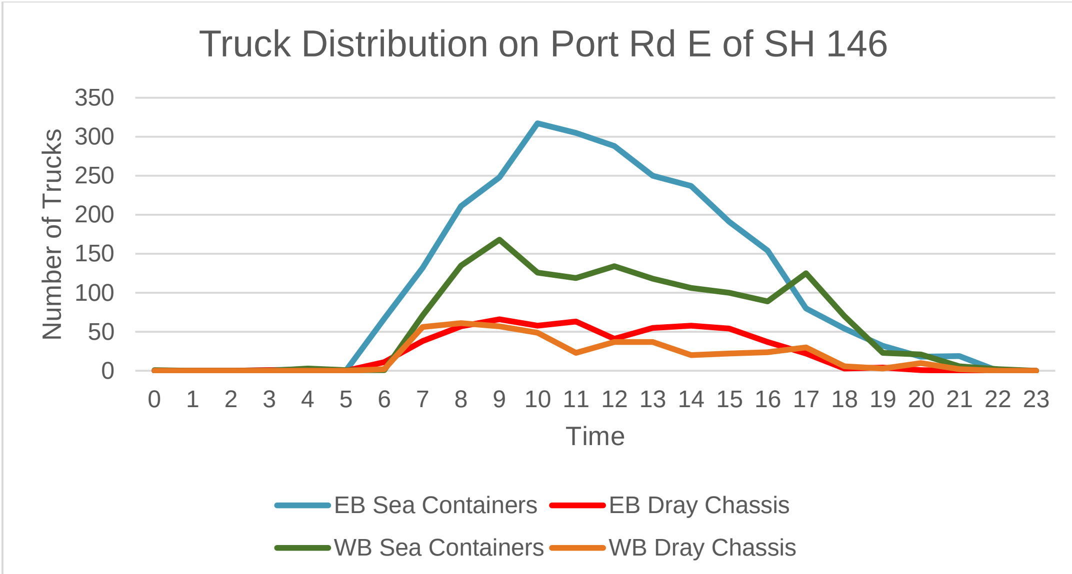
There is competition for road space between commuter and freight journeys in the port area. This has led to traffic congestion during peak commuter periods that coincide with port traffic. Even though Houston is a diversified port handling mostly petroleum-based tonnage which is transported by other modes including pipeline, rail and barge, a great deal of the port related truck traffic is related to containerized cargo. While Houston's container terminals typically have a 25-minute average truck turnaround, overall journey time for trucks serving the container terminals can be much longer due to traffic and highway congestion.

3.6.3 Truck Volumes

Port of Houston Container Terminals

Sea containers were observed in both relative and absolute high numbers at locations close to Houston's main container handling locations, Bayport and Barbours Cut container terminals. The following numbers reflect a 24-hour period from midnight through midnight.

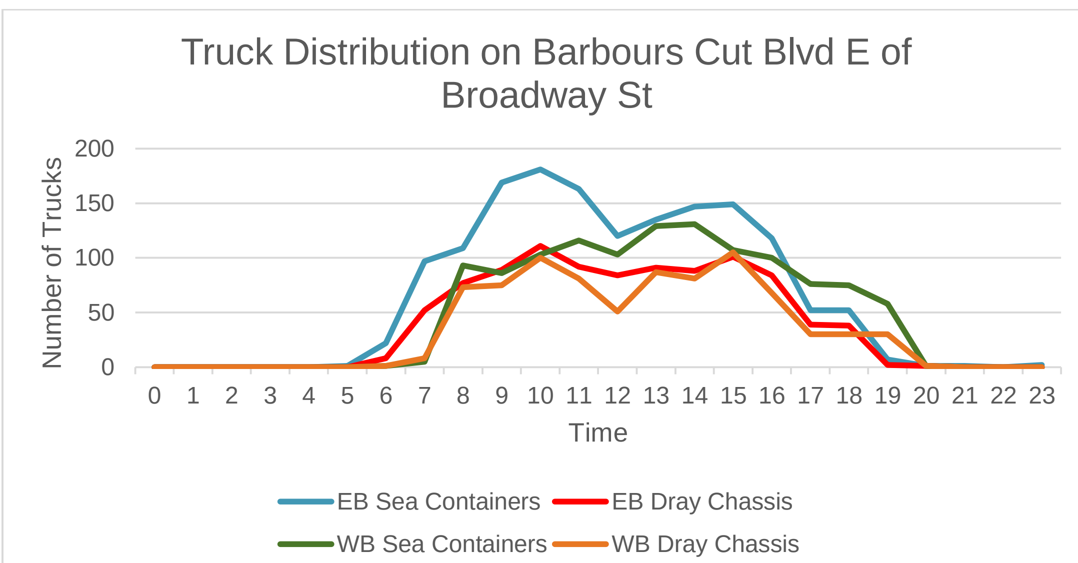
On Port Road, east of SH 146, 47 percent of westbound and 77 percent of eastbound truck traffic carries 20-foot and 40-foot sea containers. This represents respectively 1,419 and 2,606 trucks. Including dray chassis, 61 percent of westbound and 94 percent of eastbound truck traffic was sea container related, or respectively 1,858 and 3,175 trucks.



Source: Ports Area Mobility Study Traffic Counts

Figure 3-11. 24-hour Truck Distribution on Port Rd E of SH 146

On Barbours Cut Boulevard, east of Broadway Street, 1,150 out of 2,356 (49 percent) westbound trucks and 1,599 out of 2,899 (55 percent) eastbound trucks were observed to transport sea containers. Including dray chassis, these numbers were 1,971 out of 2,356 (84 percent) westbound and 2,556 out of 2,899 (88 percent) eastbound.



Source: Ports Area Mobility Study Traffic Counts

Figure 3-12. 24-hour Truck Distribution on Barbours Cut Blvd E of Broadway St

On Fred Hartman Bridge (SH 146), 890 out of 3,471 (26 percent) of northbound trucks and 907 out of 3,309 (27 percent) of southbound trucks were observed to transport sea containers. Including dray chassis, 1,105 out of 3,471 (32 percent) and 1,187 out of 3,309 (36 percent) were sea container related truck traffic in northbound and southbound directions, respectively.

On SH 225 east of Strang Road, 2,072 out of 5,648 (37 percent) of westbound trucks and 2,382 out of 5,360 (44 percent) of eastbound trucks were observed to transport sea containers. Including dray chassis, 2,623 out of 5,648 (46 percent) and 2,927 out of 5,360 (55 percent) are sea container related truck traffic in westbound and eastbound directions, respectively.

North of the Houston Ship Channel

Near Jacintoport and CARE multipurpose terminals on Jacintoport Boulevard, 169 out of 907 (19 percent) of all westbound truck traffic transported sea containers, 203 out of 907 (22 percent) including dray chassis. On Sheldon Road, north of Jacintoport Boulevard, only 60 out of 593 (10 percent) of northbound truck traffic transported sea containers, but including dray chassis, 146 (25 percent) trucks were sea container related.

South of the Houston Ship Channel

The only count location on the south shore of HSC was on Battleground Road North of SH 225. Observations at this location counted 1,162 trucks northbound and 1,089 trucks southbound, with high volumes of tank trucks. Their presence can be explained by the petrochemical terminals and plants along Independence Parkway. The tank trucks were 39 percent (458) of northbound truck traffic and 40 percent (439) of southbound truck traffic.

Box tractor-trailers represented 31 percent in the northbound direction and 32 percent in the southbound direction.

Other Count Locations

On SH 288, south of West Orem Drive, all truck types, with the exception of intermodal containers, were frequently observed. Total trucks counts were 1,685 northbound and 1,831 southbound.

Box tractor-trailers were most common with 33 percent of all truck traffic in the northbound direction and 32 percent in the southbound direction. Tank trucks in either direction accounted for 24 percent (northbound) and 22 percent (southbound) of all truck traffic.

Flatbed trucks represented 21 percent of northbound truck traffic at 347 trucks and 27 percent of southbound truck traffic at 486 trucks.

At 369 out of 1,685 trucks observed, 22 percent of northbound truck traffic was observed to transport sea containers or empty dray chassis. At 18 percent the southbound count of containers and dray chassis was low compared to other locations.

3.6.4 Truck Observations and Interview Findings

A series of interviews with truck drivers and observations of trucks entering and leaving port terminals was undertaken to collect further information regarding truck type, Federal Highway Administration (FHWA) class, model year, commodity, origin or destination, employer, and whether the load was oversize or overweight.

Barbours Cut Container Terminal

The following observations are based on 188 surveys, performed on October 30, 2017. Approximately 90 percent of trucks going through to and from Barbours Cut were class 9 tractor-trailers. Occasionally a class 5 or 10 truck was observed. Approximately 65 percent of the trucks surveyed carried a 20- or 40-foot sea container, and 20 percent transported an empty dray chassis. The distribution of import collection versus export deliveries was approximately 30/70. The majority of trucks arrived without a load when picking up or returned without a load after a delivery.

Import Collection

A wide variety of commodities are collected, most destinations are within the Greater Houston area. Some examples are:

- Towels to Houston, TX
- Hazardous materials to Houston, TX
- Shoes to Houston, TX
- Flooring material to Houston, TX
- Brakes to Pasadena, TX
- Bicarbonate liquid to Channelview, TX

Approximately 25 percent of the picks-ups have destinations further away:

- Tempered glass to Brownsville, TX
- Granite to Dallas, TX
- Chairs to Colorado

Export Deliveries

Goods delivered to Barbours Cut from the Greater Houston area represent a wide range of commodities, but approximately a third is plastics and plastic-related goods. Some examples are:

- Resin from Porter, TX
- Plastic from Houston, TX
- Plastic from Pasadena, TX
- Plastic from Freeport, TX
- Plastic from Baytown, TX
- Sulfur from Texas City, TX
- Boxes from Houston, TX
- Flooring material from Houston, TX
- Car covers from Houston, TX
- Compressor parts from Pasadena, TX
- Bicarbonate liquid from Freeport, TX

From further away the following commodities were observed:

- Sheets from San Antonio, TX
- Clothes from Austin, TX
- Clothes from Indiana
- Automotive parts from Atlanta, GA

- Piping from Springfield, MO

Bayport Container Terminal

The following observations are based on 216 surveys, performed on October 31, 2017. Approximately 95 percent of trucks going to and from Bayport Container Terminal were class 9 tractor-trailers. Occasionally a class 8 or 10 trucks were observed. More than 80 percent of trucks transported a 20 or 40-foot sea container. The distribution of import collection versus export deliveries was approximately 55/45. The majority of trucks arrived without a load when picking up or returned without a load after a delivery.

Import Collection

Approximately 95 percent of the collections have a destination within the Greater Houston area. The commodities transported are very diverse:

- Sporting goods to Katy, TX
- Coils to Houston, TX
- Signs to Freeport, TX
- Plastics to Baytown, TX
- Home Depot merchandise to Baytown, TX
- Walmart merchandise to Baytown, TX

Export Deliveries

Approximately 90 percent of the loads being delivered, are collected within the Greater Houston area. The most common commodities are metals and scrap metals, plastics, and biodiesel. Some more unique transports observed, are:

- Army truck from La Porte, TX
- Lubricants from Pasadena, TX
- Cotton from Kemah, TX
- Machinery from Missouri City, TX

One of the few commodities observed from more distant origins was motor oil from Louisiana.

Houston Gatehouse San Jacinto, Jacintoport

The following observations are based on 269 surveys, performed on October 25, 2017. The majority of trucks going through Gatehouse San Jacinto were class 5 single tractor cabs or class 9 trucks with either an empty dray chassis or carrying a container. Forty foot and 20-foot sea containers, and dray chassis made up approximately 50 percent of all trucks observed. The distribution of import collection versus export deliveries was approximately 25/75.

Import Collection

No loads or destinations have been specified.

Export Deliveries

Trucks carry a variety of loads from a variety of origins:

- Copper from within Jacinto Port
- Resin from within Jacinto Port
- Beer from within Jacinto Port
- Beer from Freeport, TX
- Lime from Oklahoma

3.6.5 Truck Origins and Destinations

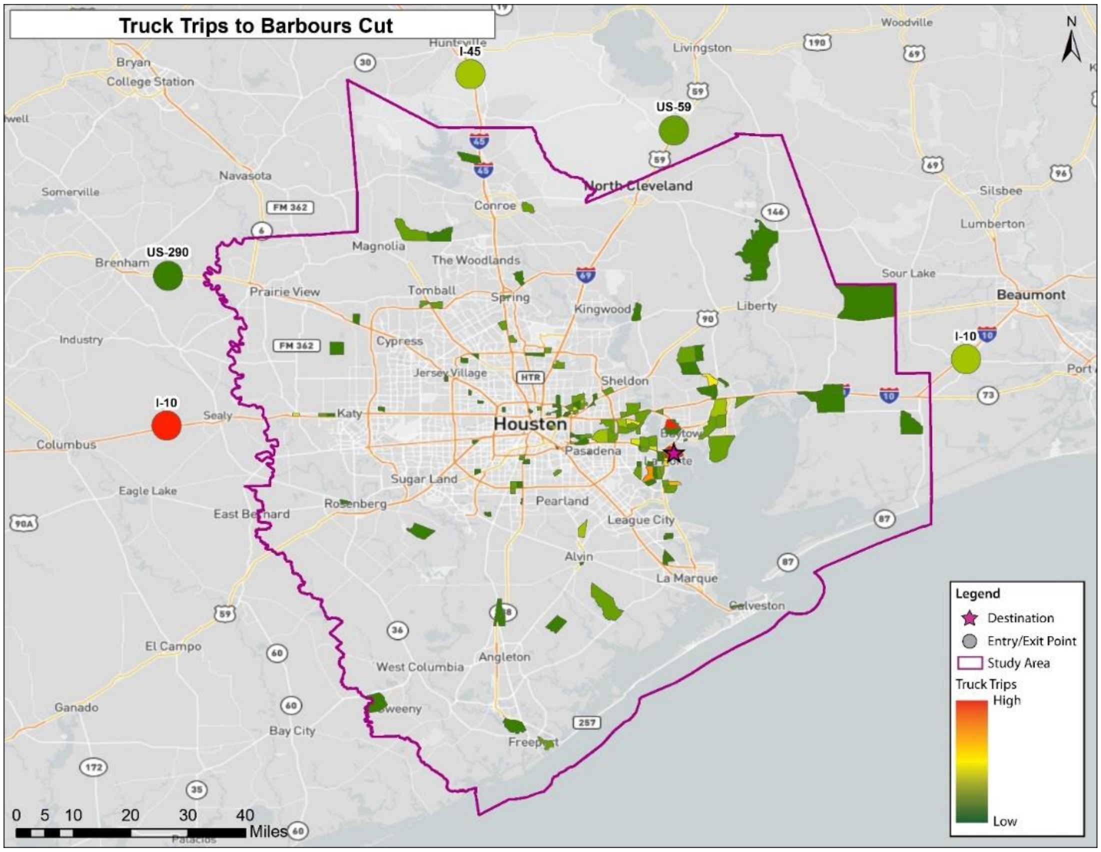
Truck GPS probe data (provided by ATRI) offers insight into the origins and destinations of trucks travelling to and from various geographical areas, which include terminals associated with the Port of Houston. These areas are based on geographic units known as traffic analysis zones (TAZs).

Barbours Cut

The Barbours Cut TAZ (#2660) contains the Port of Houston's Barbours Cut Container Terminal, the Enterprise Products/Morgans Point bulk liquids terminal and Gulf Winds - a Port warehousing and distribution complex. Truck trips to and from this TAZ are generally focused on locations within the Houston region, namely the Bayport Container Terminal, the Northeast Houston industrial area, specifically El Dorado/Oates Prairie, and refineries and chemical industrial complexes along the Houston Ship Channel, Baytown, and the north of Mont Belvieu. Truck trips also originate in, or are destined for, locations outside of the Houston region. I-10 is the important gateway for origins and destinations in the west, while I-45 is the predominant route to and from the north.

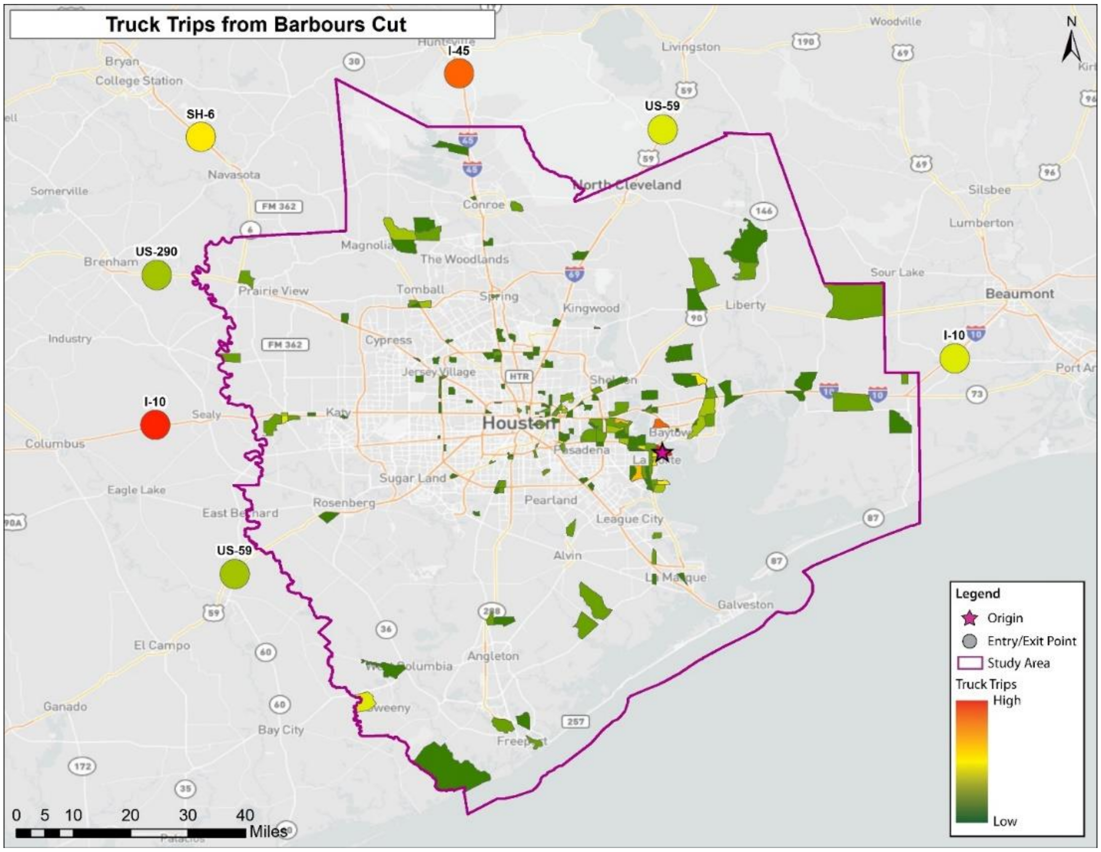
Source: Google Data SIO, NOAA, U.S. Navy, NGA, Gebco

Figure 3-13. Aerial Image of TAZ 2660



Source: HDR Inc., ATRI

Figure 3-14. Origins of Truck Trips to Barbours Cut



Source: HDR Inc., ATRI

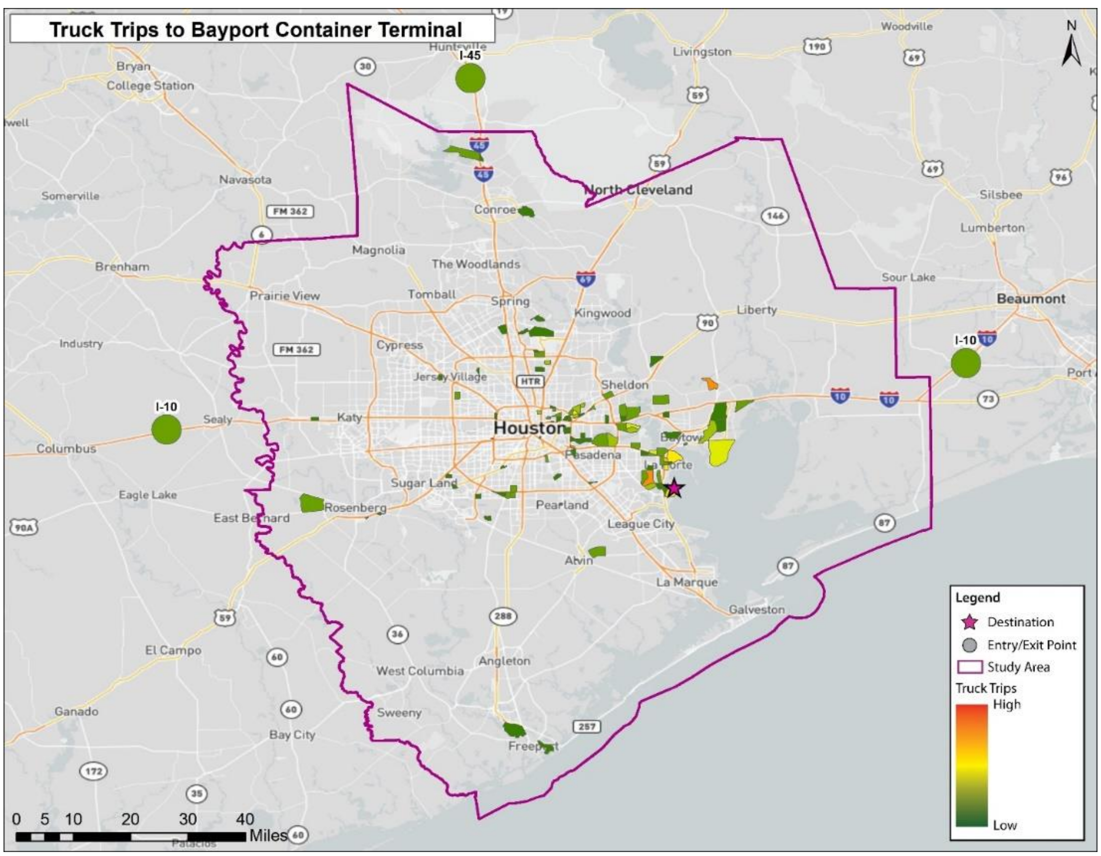
Figure 3-15. Destinations of Truck Trips from Barbours Cut

Bayport Container Terminal

Truck trips to and from Bayport Container Terminal TAZ (#2693) have origins and destinations predominantly within the Houston region including the Barbours Cut Container Terminal area, Cedar Point Industrial Park, and the industrial complexes north of Mont Belvieu. I-10 west, I-45 north, and US-59 are the favored routes for destinations outside of the region. Truck trips rarely originate outside the Greater Houston area.

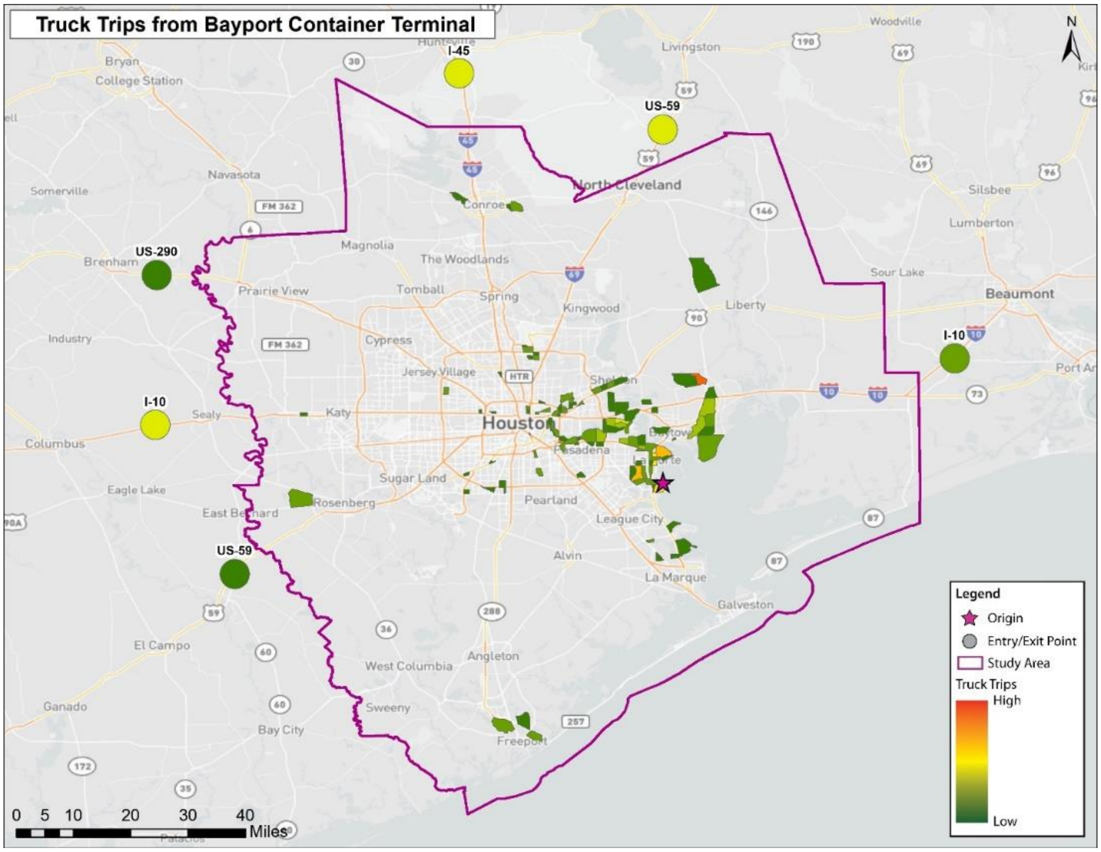
Source: Google Data SIO, NOAA, U.S. Navy, NGA, Gebco

Figure 3-16. Aerial Image of TAZ 2693



Source: HDR Inc., ATRI

Figure 3-17. Origins of Truck Trips to Bayport Container Terminal



Source: HDR Inc., ATRI

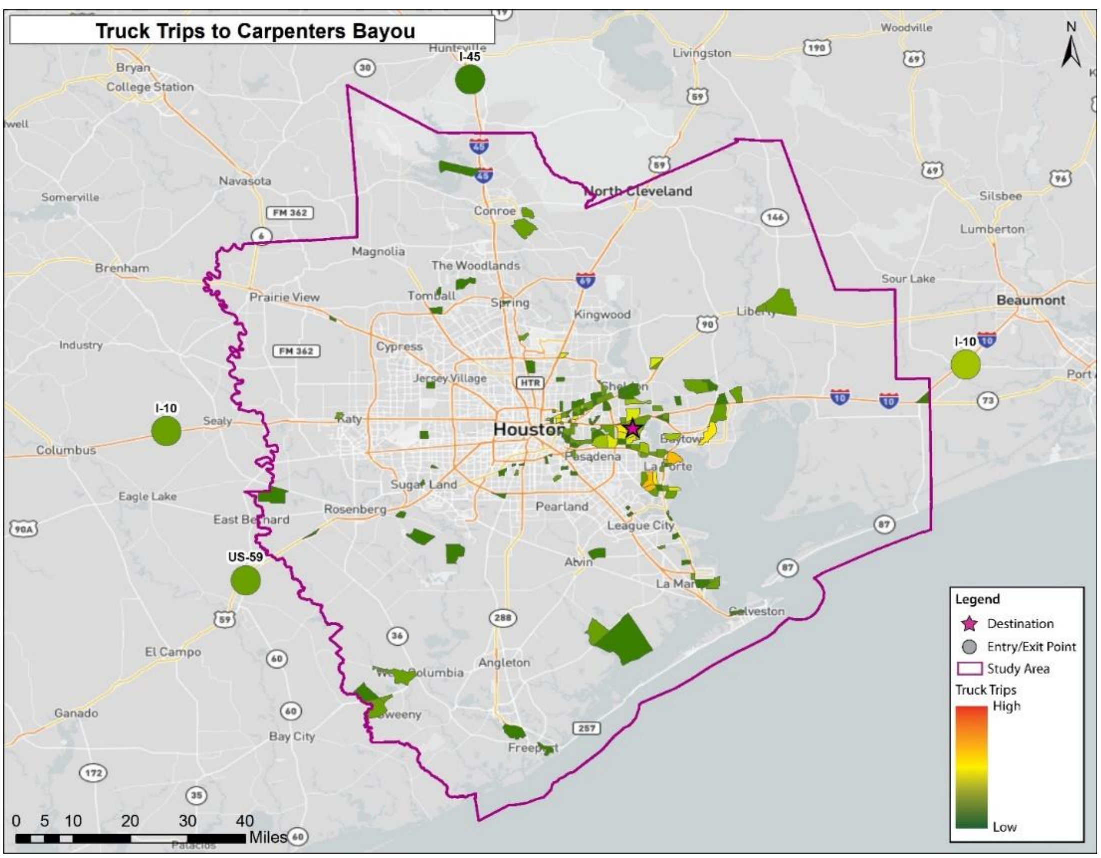
Figure 3-18. Destinations of Truck Trips from Bayport Container Terminal

Carpenters Bayou

The Carpenters Bayou TAZ (#2490) area is defined by the HSC, the Carpenters Bayou, Sheldon Road, De Zavalla Road, and the Old River. It contains the CEMEX cement terminal and plant and companies providing container services and tubular services, such as inspection, repair, cleaning, and storage. Truck trips to the Carpenters Bayou TAZ generally originate in the immediate surroundings, Barbours Cut, Bayport industrial area, and the western Chambers County. Truck trips from the Carpenters Bayou area typically have destinations in the direct vicinity, Barbours Cut, Bayport industrial area, and outside of the region via I-10 west, I-10 east, and US-59.

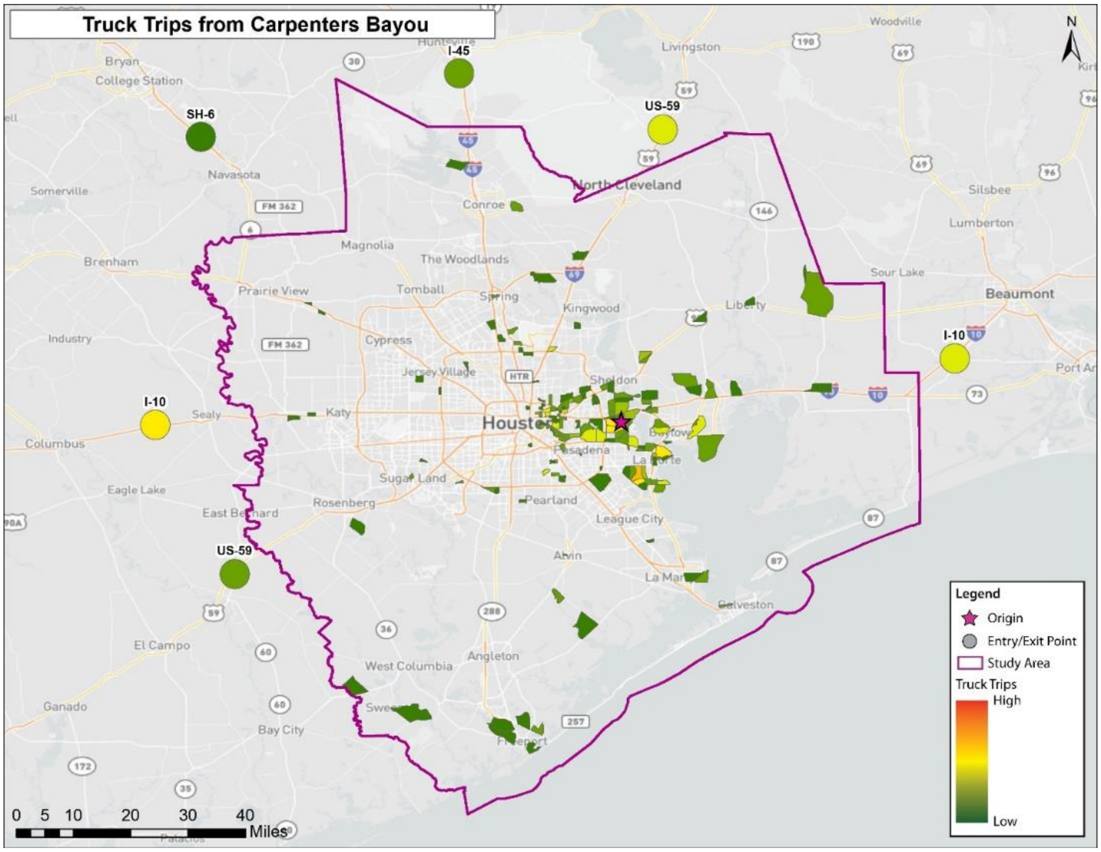
Source: Google Data SIO, NOAA, U.S. Navy, NGA, Gebco

Figure 3-19. Aerial Image of TAZ 2490



Source: HDR Inc., ATRI

Figure 3-20. Origins of Truck Trips to Carpenters Bayou



Source: HDR Inc., ATRI

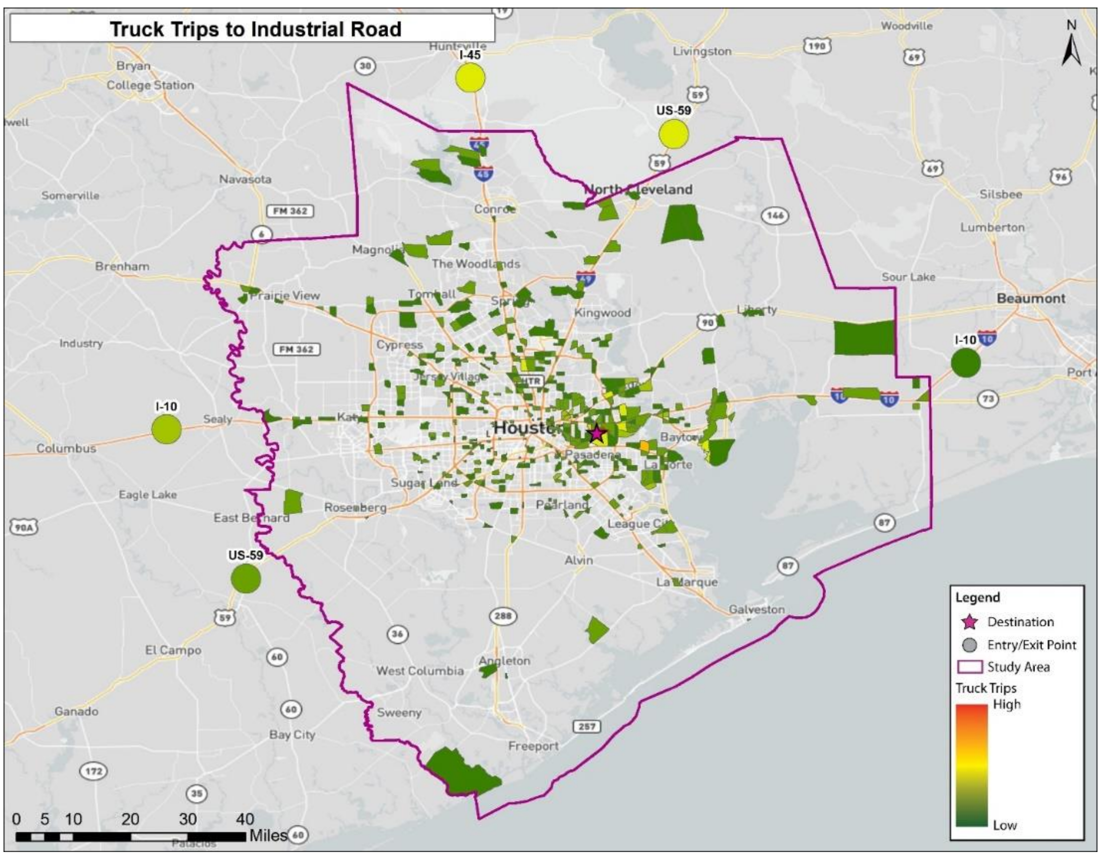
Figure 3-21. Destinations of Truck Trips from Carpenters Bayou

Industrial Road

The Industrial Road TAZs (#1257 and #1258) are bordered by the Greens Bayou, Buffalo Bayou, Federal Road, PTRA's North District railroad, and Industrial Road. The area contains many different terminals: Magellan's and Targa's petrochemical bulk liquid terminal, Watco GreensPort Industrial's and Watco/Kinder Morgan GreensPort's breakbulk terminals, Industrial Terminals' container and breakbulk terminal, and Vulcan's and South Central Cement's bulk terminals. Truck trips to the Industrial Road area mainly originate in the northern La Porte area between Independence Parkway and Miller Cut Off Road. They also originate in the area's direct vicinity and arrive from further away via I-45 and US-59 from the north. Destinations from the Industrial Road area are similar to its origins, plus destinations outside of the region via I-10 west. Unlike the trip analysis associated with the Barbours Cut and Bayport container terminals, the Industrial Road TAZ identifies a wider more disaggregated origin and destination of truck trips.

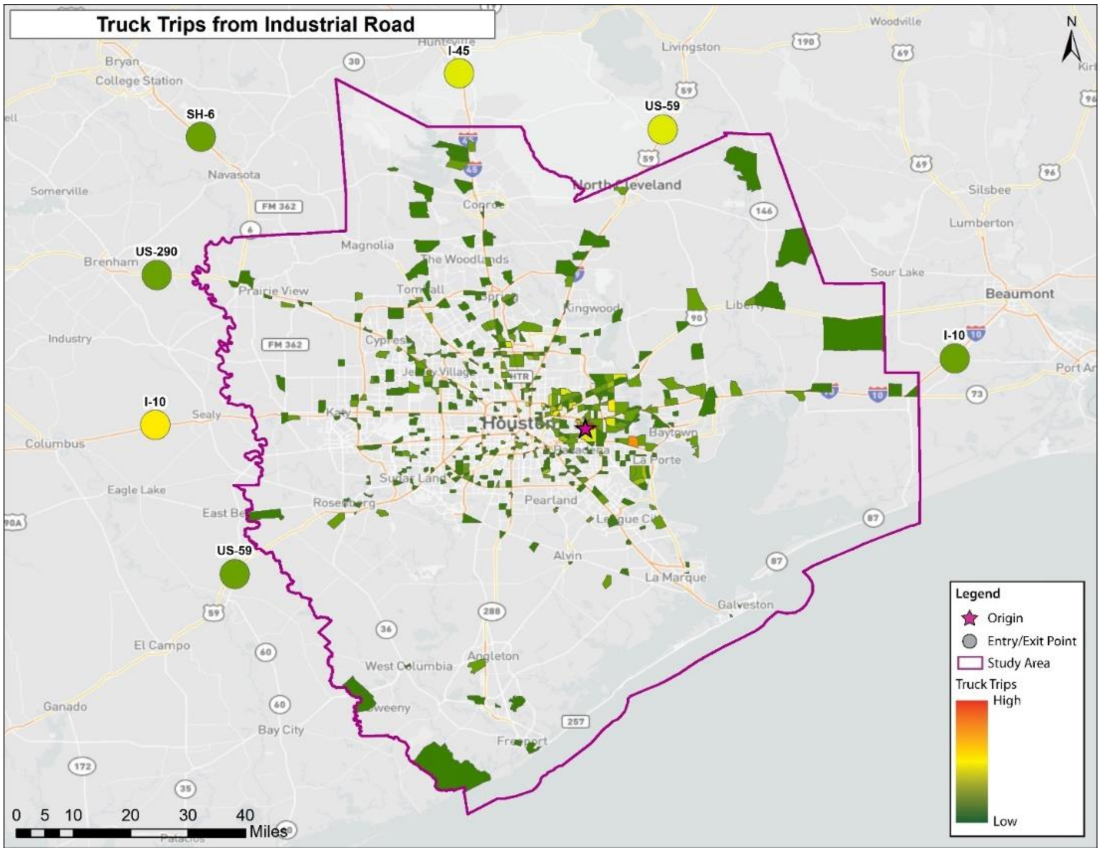
Source: Google Data SIO, NOAA, U.S. Navy, NGA, Gebco

Figure 3-22. Aerial Image of TAZs 1257 and 1258



Source: HDR Inc., ATRI

Figure 3-23. Origins of Truck Trips to Industrial Road



Source: HDR Inc., ATRI

Figure 3-24. Destinations of Truck Trips from Industrial Road

Jacintoport Boulevard & CARE Terminal

The Jacintoport Boulevard & CARE Terminal TAZs (#2487 and #2489) are bordered by the HSC, Carpenters Bayou, Sheldon Road, Jacintoport Boulevard, and the Sam Houston Beltway. The area contains the PHA Jacintoport and CARE multipurpose terminals handling containers and break-bulk products, the bulk liquid terminals for Houston Fuel Oil and Stolthaven, the bulk terminals for Cargill and Mosaic, and the breakbulk terminal for Contanda Steel.

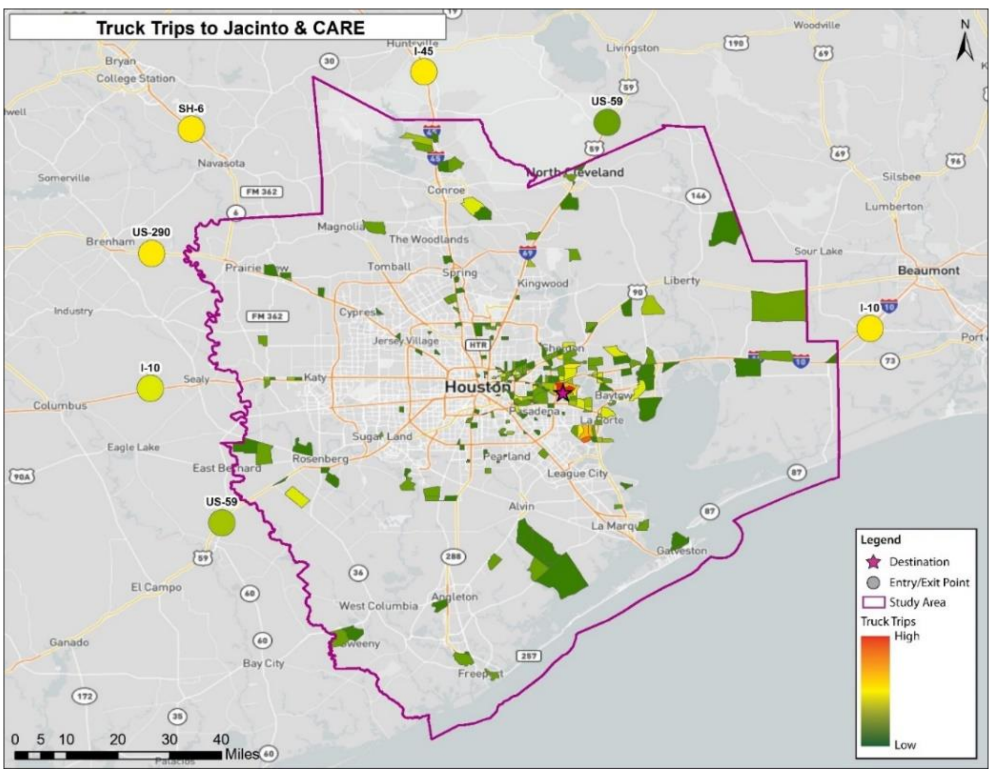
Source: Port of Houston online photo and video gallery

Figure 3-25. PHA CARE Terminal and Contanda Steel in the Foreground, Cargill in the Background

Truck trips to the area mainly originate in the direct vicinity and the Bayport industrial area. The most important inbound gateways are I-10 from the east, I-45 from the north, and SH-6 and US-290 from the west. Truck trips from the area typically stay in the immediate environment, or go to northeast Houston, and the Bayport industrial area. The most important gateways leaving the region are I-10 west, I-45 north and I-10 east. The Jacintoport Boulevard & CARE Terminal area is based on TAZs 2487 and 2489.

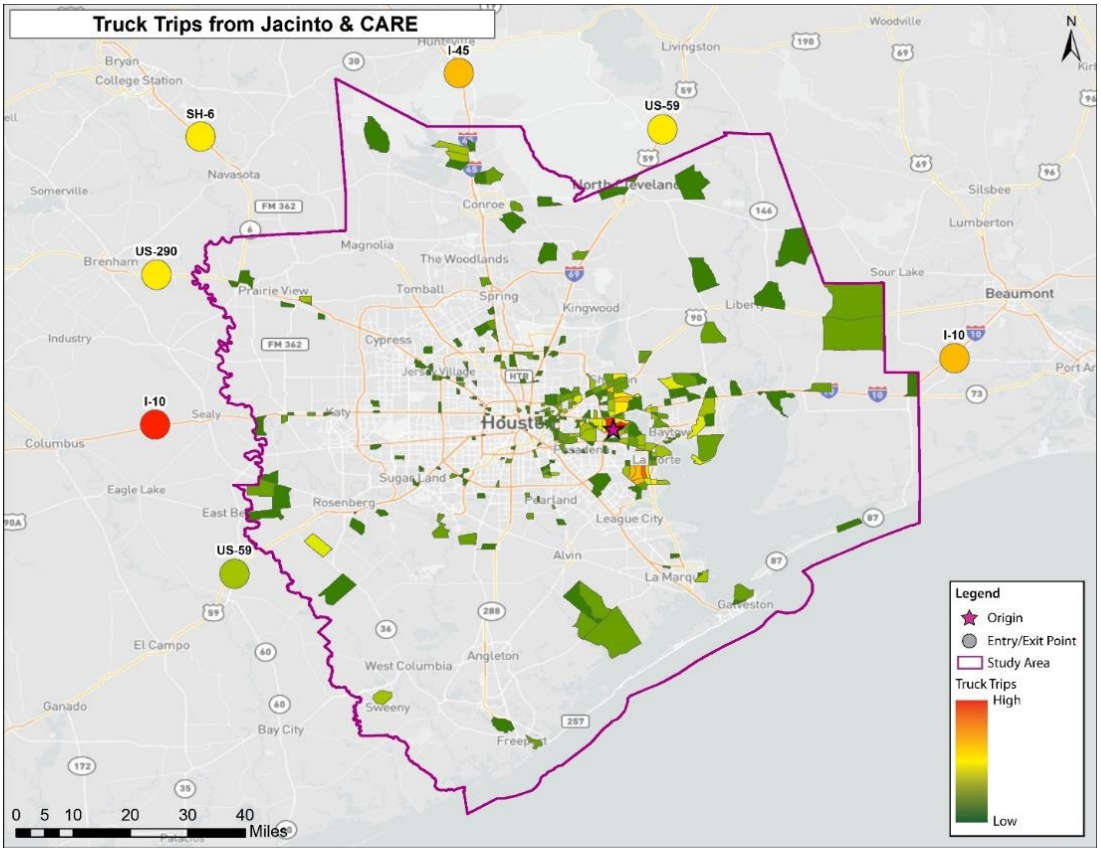
Source: Google Data SIO, NOAA, U.S. Navy, NGA, Gebco

Figure 3-26. Aerial Image of TAZs 2487 and 2489



Source: HDR Inc., ATRI

Figure 3-27. Origins of Truck Trips to Jacintoport Boulevard & CARE Terminal

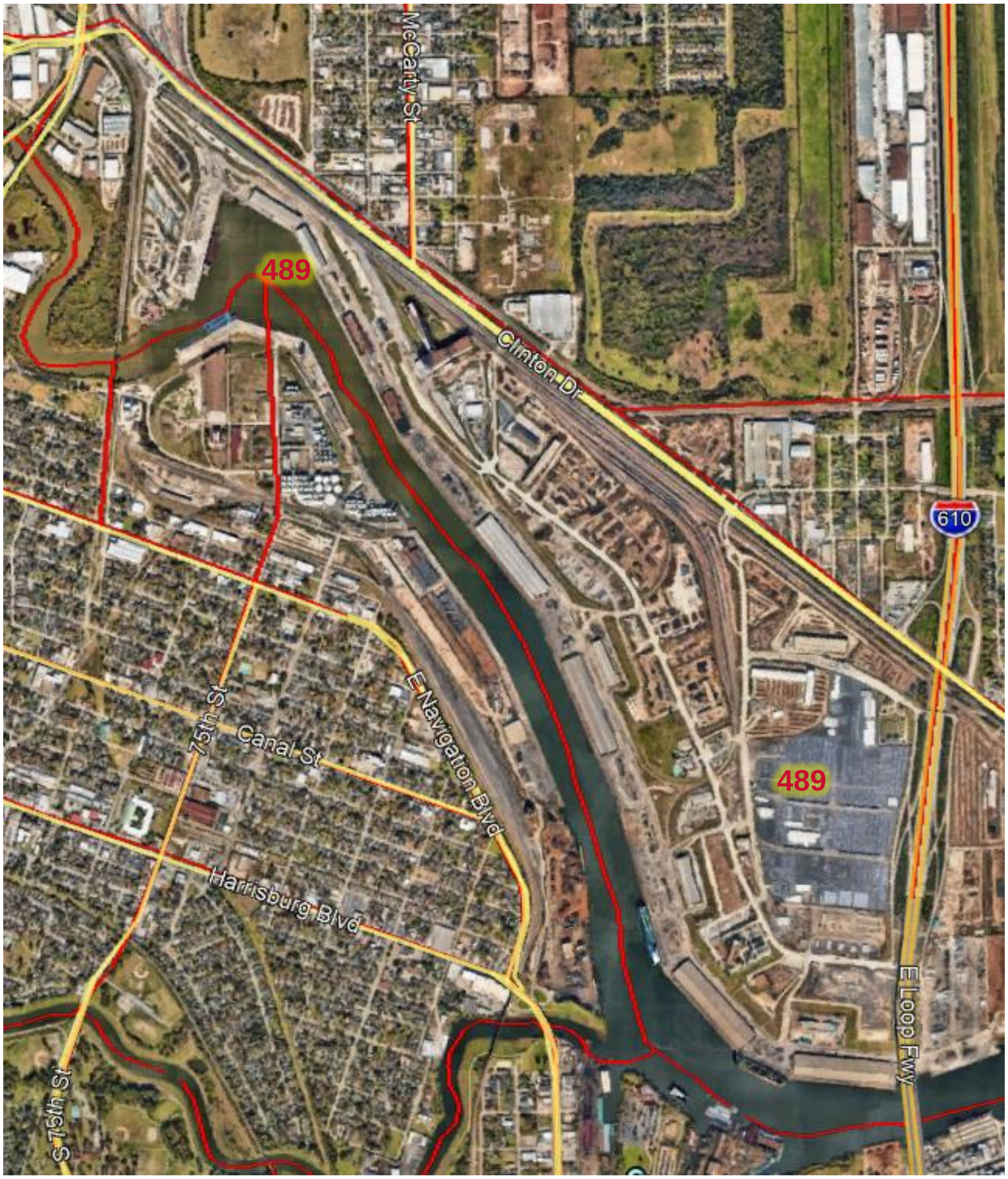


Source: HDR Inc., ATRI

Figure 3-28. Destinations of Truck Trips from Jacintoport Boulevard & CARE Terminal

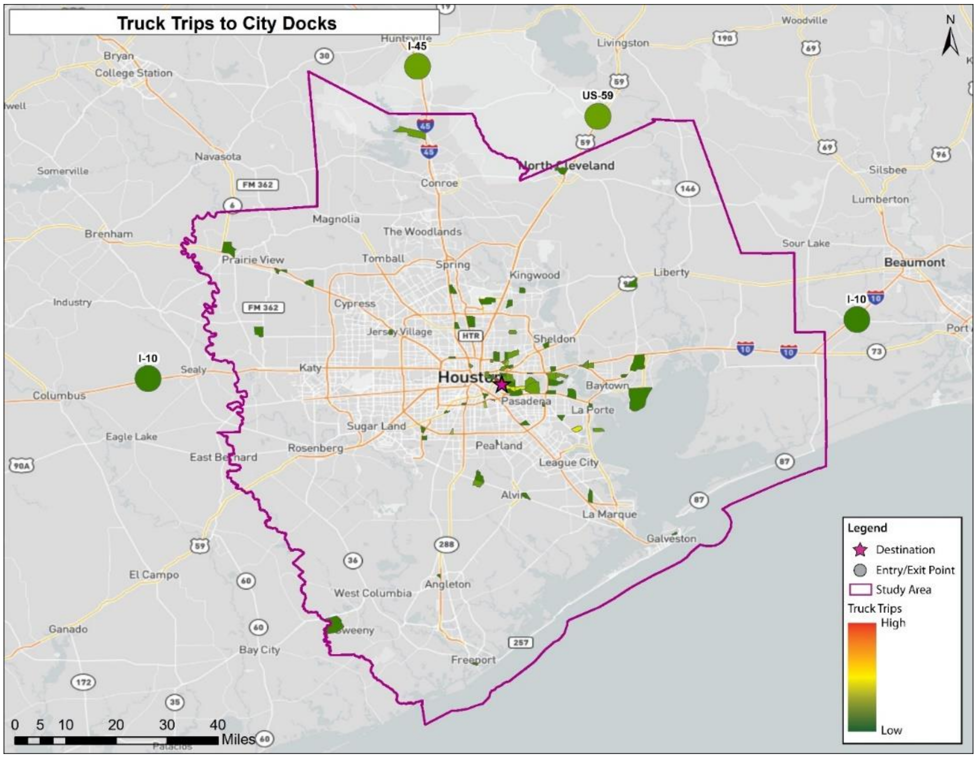
City Docks

The City Docks TAZ (#489) consists of the northern PHA City Docks wharves and warehouses between HSC, Clinton Drive, Wayside Drive, and I-610. The majority of truck trips to and from the area stay within the direct vicinity.



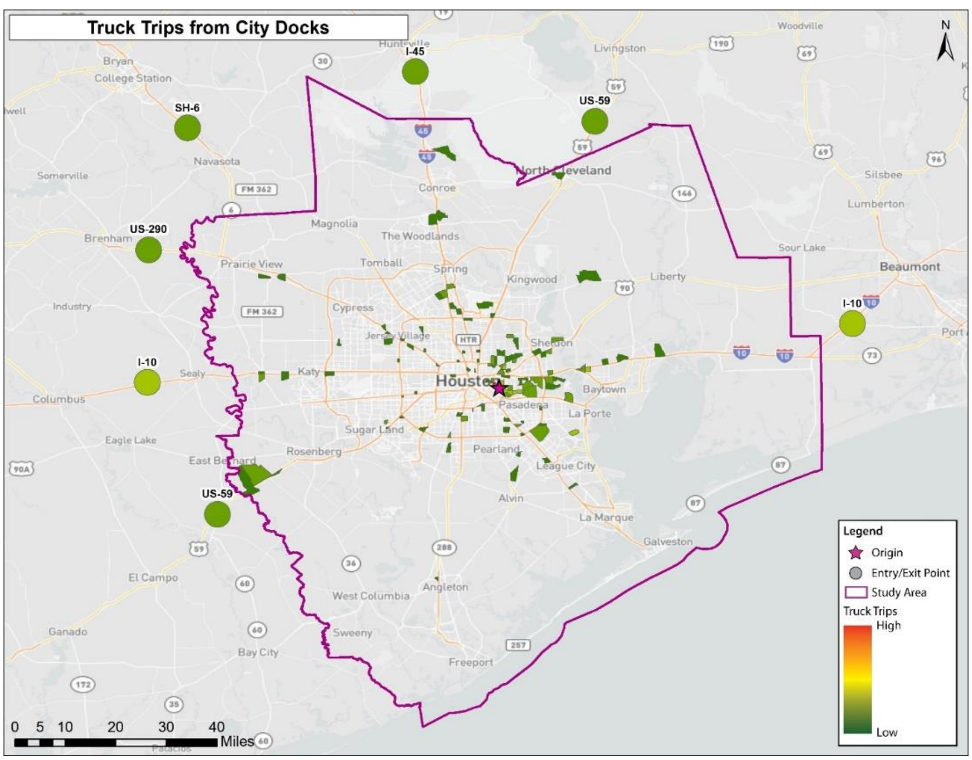
Source: Google Data SIO, NOAA, U.S. Navy, NGA, Gebco

Figure 3-29. Aerial Image of TAZ 489



Source: HDR Inc., ATRI

Figure 3-30. Origins of Truck Trips to City Docks



Source: HDR Inc., ATRI

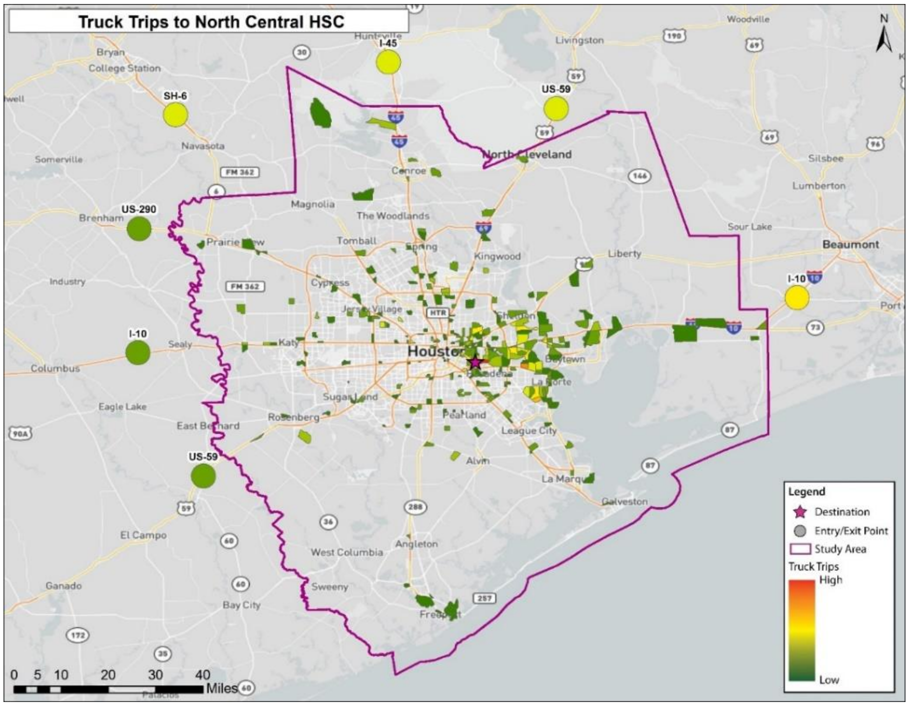
Figure 3-31. Destinations of Truck Trips from City Docks

North Central Houston Ship Channel

The North Central Houston Ship Channel TAZs (#1210 and #1215) are defined by the HSC, I-610, Clinton Drive and the Washburn Tunnel. The area contains the Industrial Park East that is part of PHA City Docks, Texas Terminals, Houston Cement, PHA Woodhouse Terminal, and Kinder Morgan's bulk liquids terminal. Truck trips from the North Central Houston Ship Channel area tend to go to local destinations in the eastern part of Houston: Bayport, Baytown, Galena Park, Houston Farms, and Northeast Houston. Destinations outside of the region are served mainly via I-10 east, I-45 north, US-59 north, and I-10 west. Truck trips to the North Central Houston Ship Channel originate from the same local areas, and generally enter via I-10 from the east.

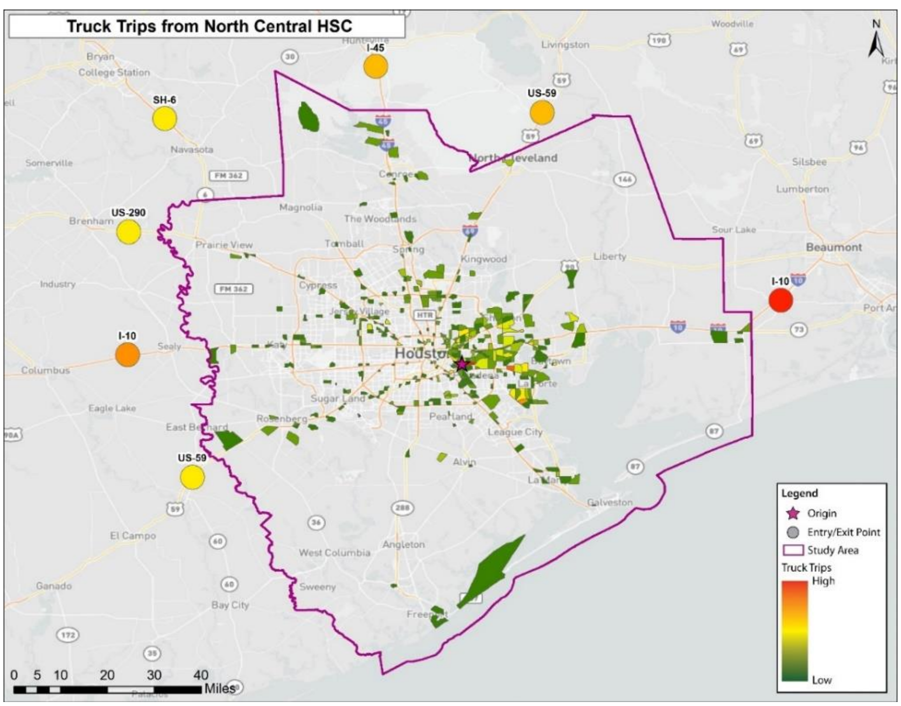
Source: Google Data SIO, NOAA, U.S. Navy, NGA, Gebco

Figure 3-32. Aerial Image of TAZs 1210 and 1215



Source: HDR Inc., ATRI

Figure 3-33. Origins of Truck Trips to North Central HSC

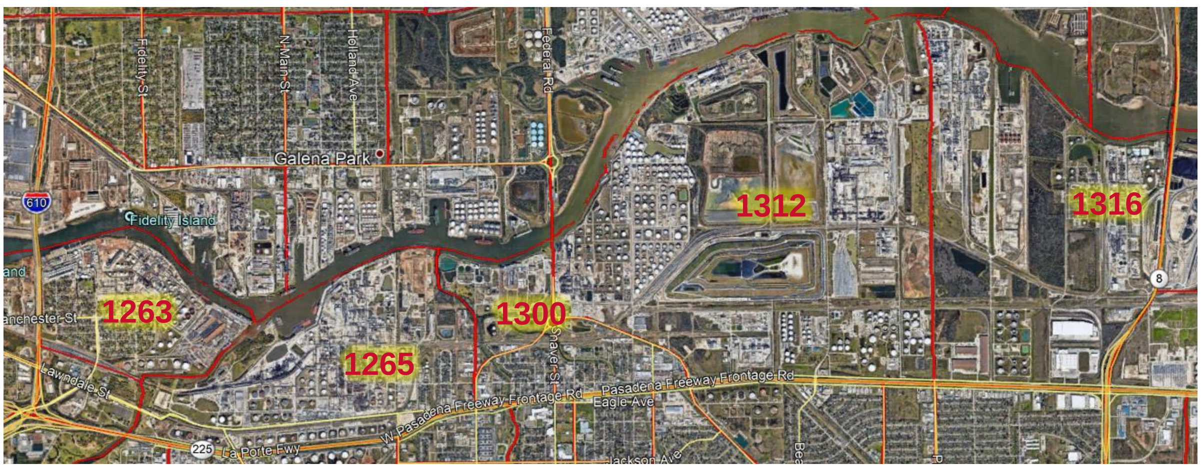


Source: HDR Inc., ATRI

Figure 3-34. Destinations of Truck Trips from North Central HSC

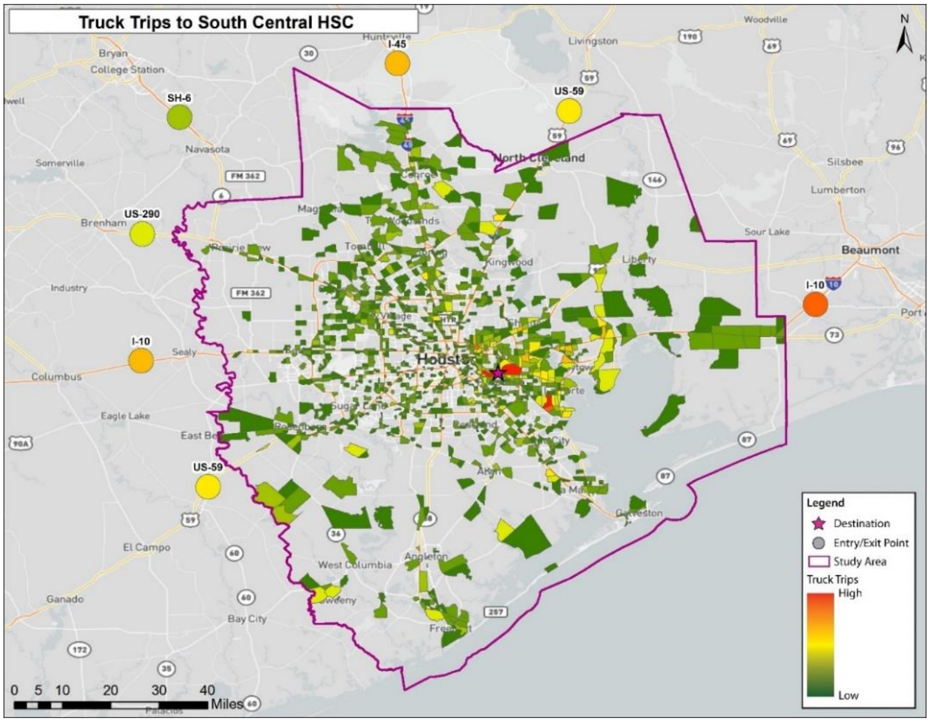
South Central Houston Ship Channel

The South Central Houston Ship Channel TAZs (#1263, #1265, #1300, #1312, and #1316) is defined by I-610, the HSC, Sam Houston Beltway, Pasadena Freeway, Red Bluff Road, South Richey Street, PTRA's Manchester Yard, and the Sims Bayou. It contains bulk liquid terminals for Contanda, Old Manchester, Lyondell, Kinder Morgan, Enterprise Products, Georgia Gulf, and Houston Ammonia Terminal, the Manchester Terminal Company's break-bulk terminal, and the Rentech fertilizer terminal and plant. Truck trips to the South Central Houston Ship Channel area generally originate in the direct vicinity, Northeast Houston, Channelview, Sheldon, Coady, Bayport and west Mont Belvieu. The most important gateways to this area are I-10 both from the east and the west, and I-45 from the north. Truck trips from the South Central Houston Ship Channel area go to the same location as the origins. Additional destinations are in northern La Porte and the area containing the Cedar Bluff and Channelview Village industrial areas. Leaving the region, most truck trips use I-10 east, US-59 north, I-45 north, and I-10 west.



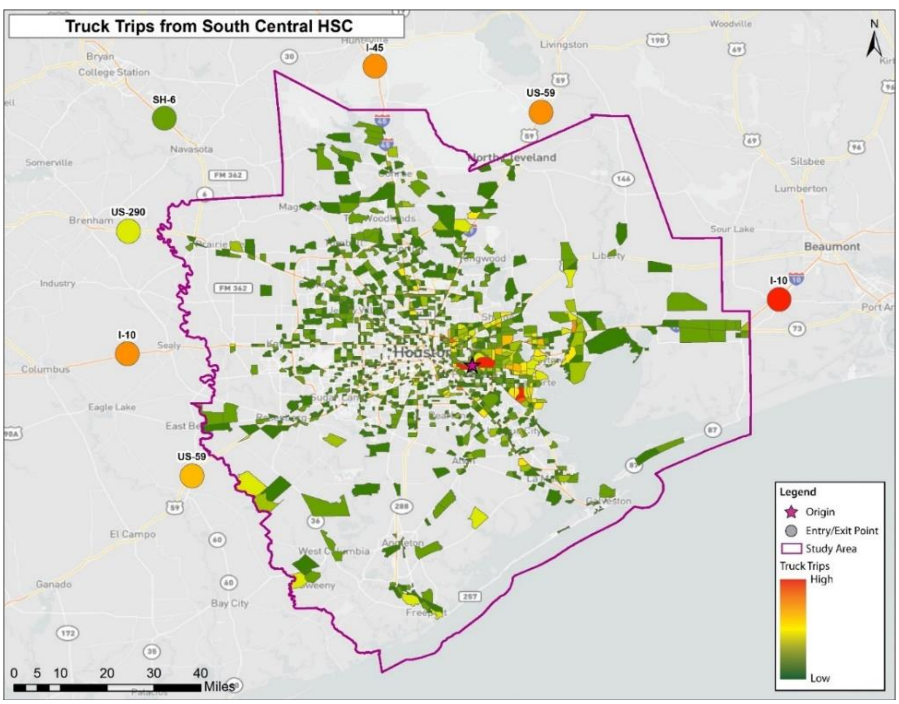
Source: Google Data SIO, NOAA, U.S. Navy, NGA, Gebco

Figure 3-35. Aerial Image of TAZs 1263, 1265, 1300, 1312, and 1316



Source: HDR Inc., ATRI

Figure 3-36. Origins of Truck Trips to South Central HSC

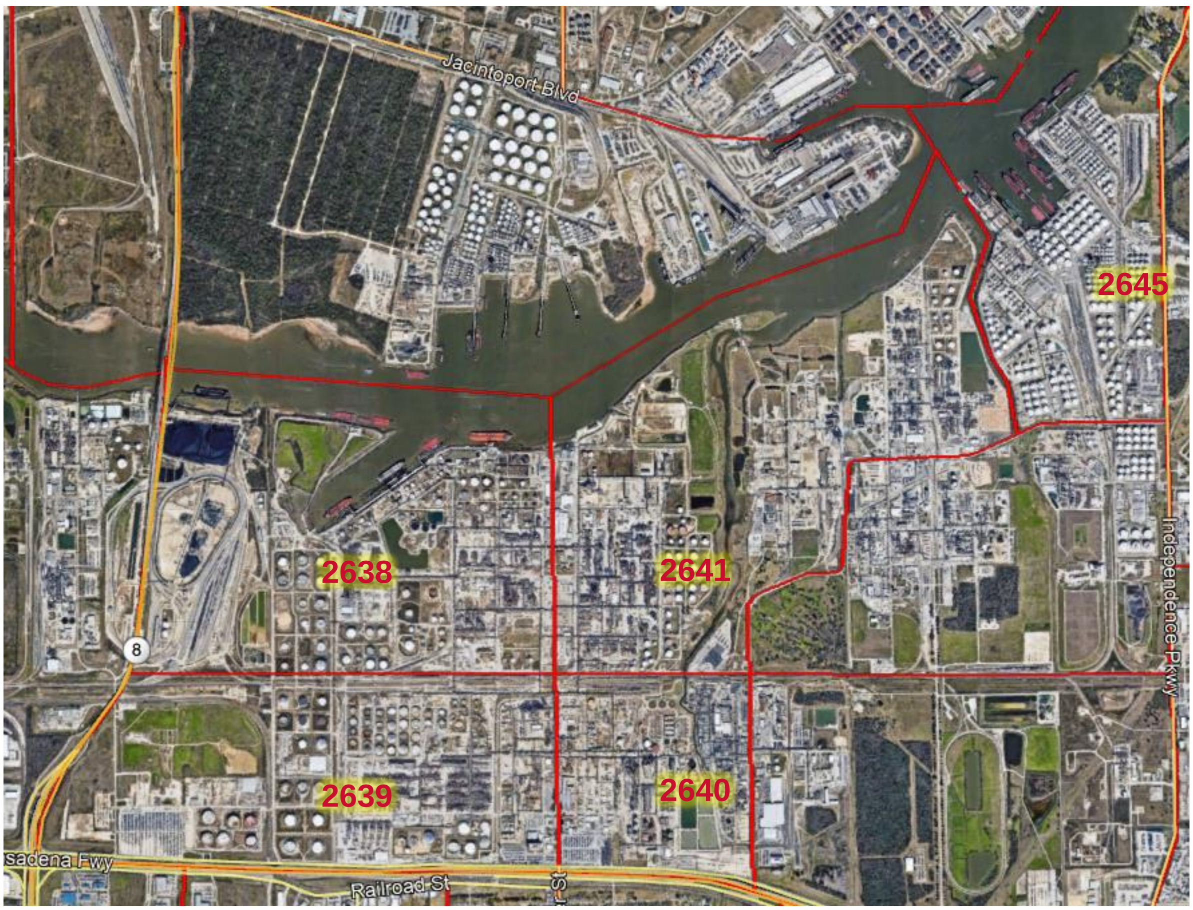


Source: HDR Inc., ATRI

Figure 3-37. Destinations of Truck Trips from South Central HSC

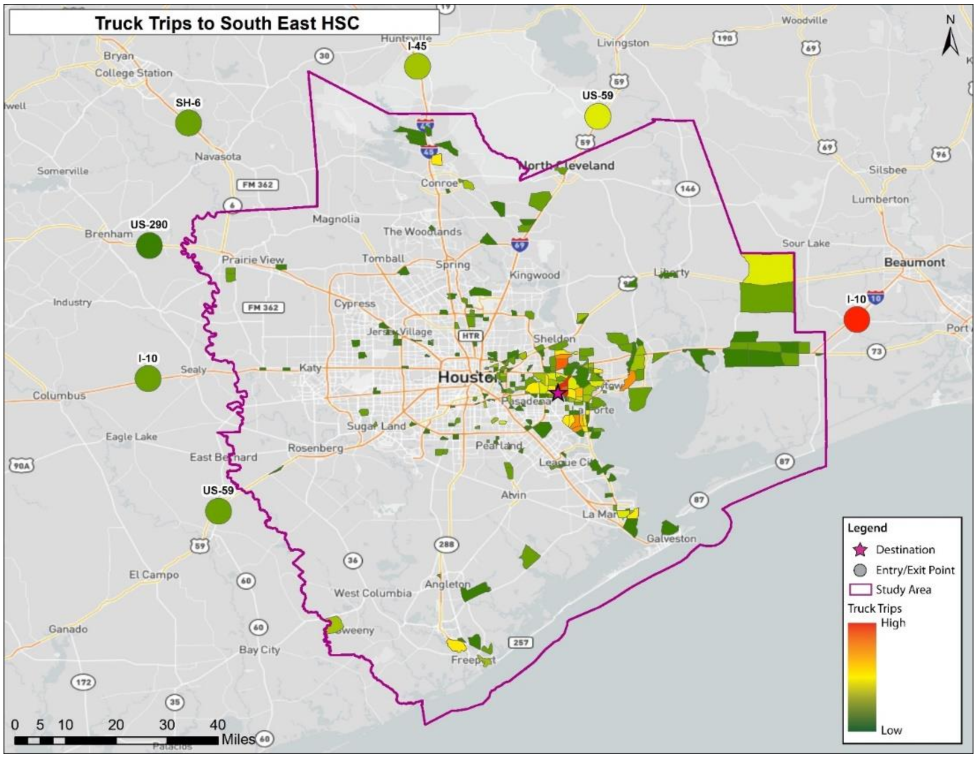
South East Houston Ship Channel

The South East Houston Ship Channel TAZs (#2638, #2639, #2640, #2641, and #2645) are defined by the HSC, Sam Houston Parkway, Pasadena Freeway, Tidal Road, and Independence Parkway. It contains the Kinder Morgan bulk terminal, petrochemical bulk liquid terminals for Vopak, Intercontinental Terminals Company, and Shell. Truck trips to the South East Houston Ship Channel area originate in Bayport, west Chambers County, north La Porte, and the area containing the Cedar Bluff and Channelview Village industrial areas. Truck trips from outside the region generally enter from the east via I-10. Truck trips from the area have destinations similar to the local origins. In addition, truck trips leaving the region use I-10 east and I-45 north.



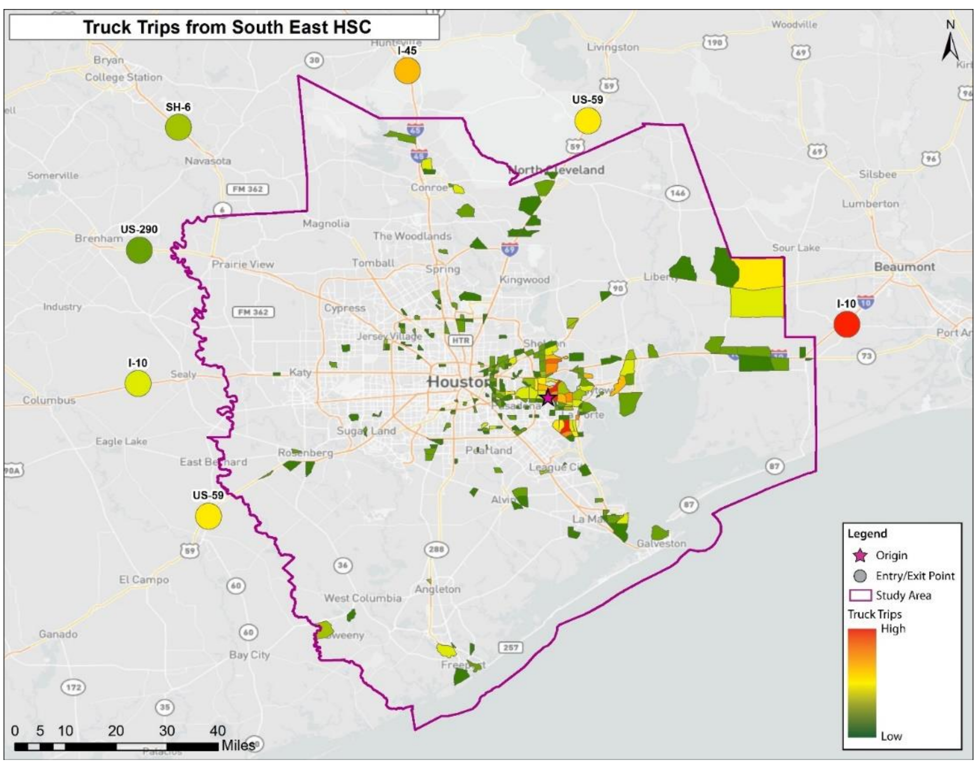
Source: Google Data SIO, NOAA, U.S. Navy, NGA, Gebco

Figure 3-38. Aerial Image of TAZs 2638, 2639, 2640, 2641, and 2645



Source: HDR Inc., ATRI

Figure 3-39. Origins of Truck Trips to South East HSC

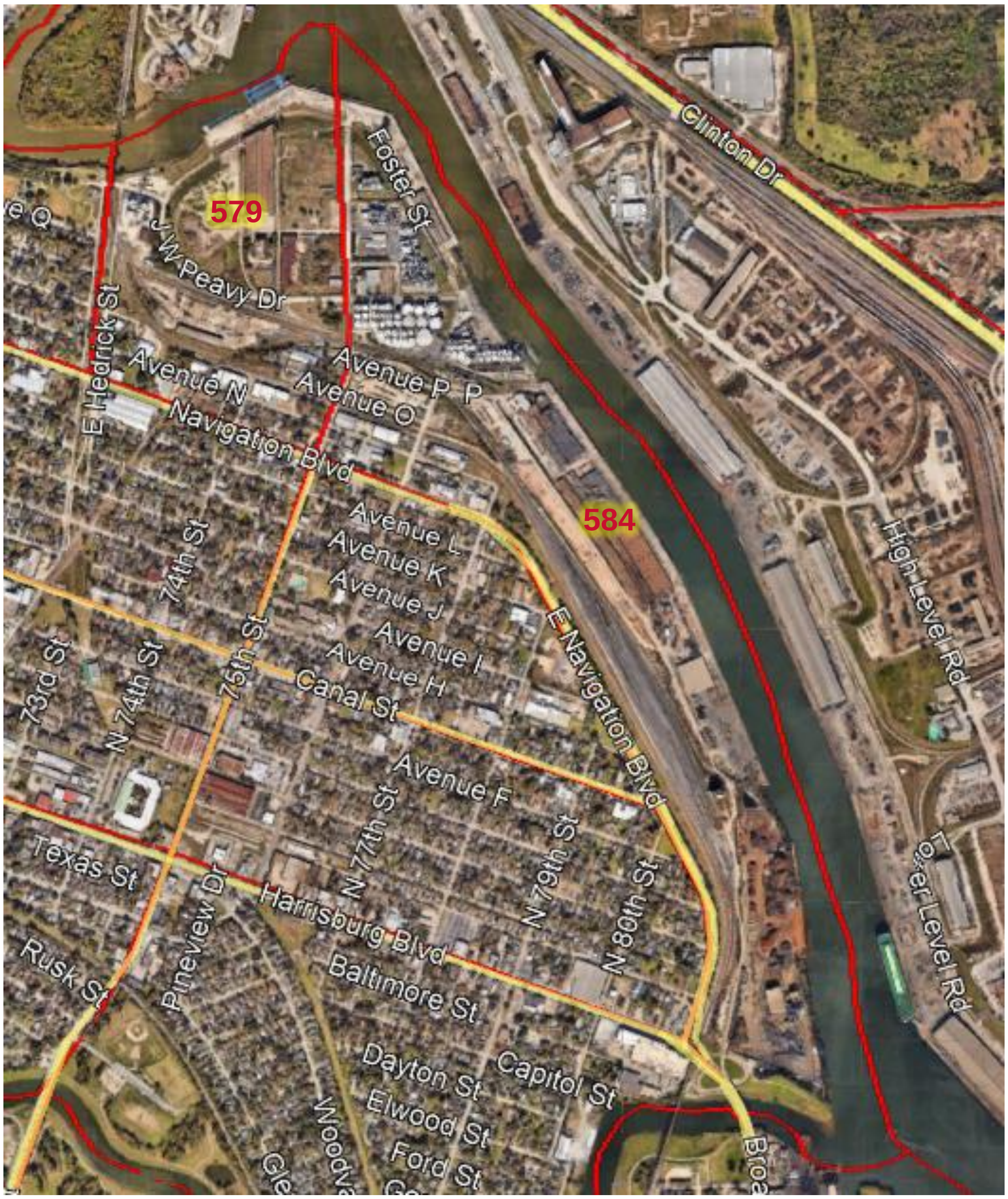


Source: HDR Inc., ATRI

Figure 3-40. Destinations of Truck Trips from South East HSC

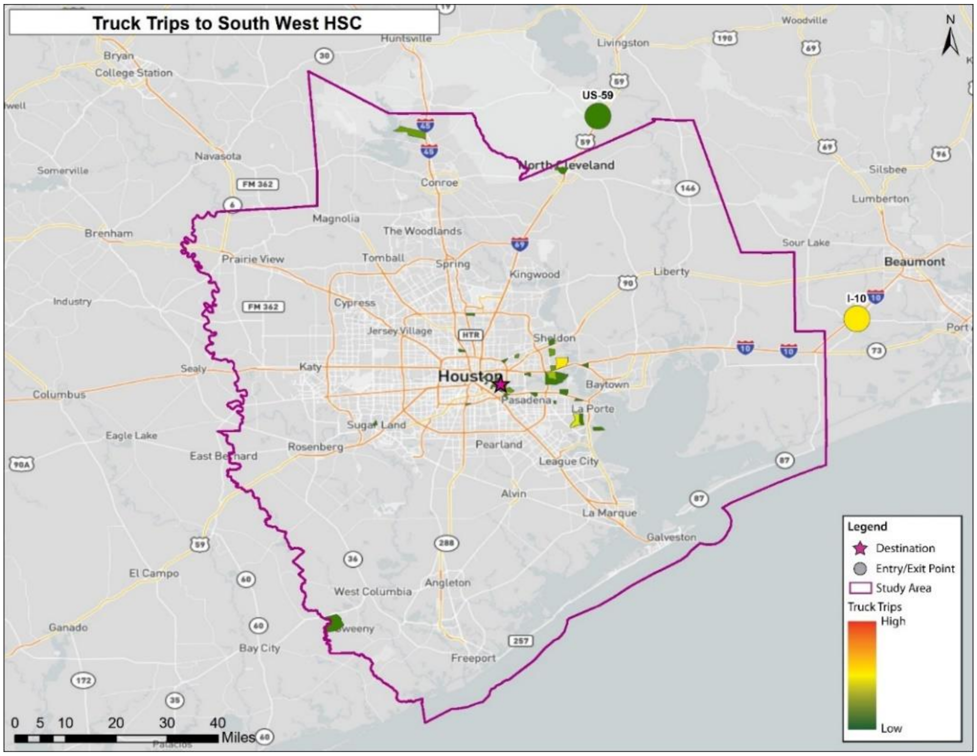
South West Houston Ship Channel

The South West Houston Ship Channel TAZs (#579 and #584) are defined by the HSC, Navigation Boulevard, Harrisburg and Sunset Rail Trails, and the Brays Bayou. It contains New Terminal's bulk terminal, and the PHA City Docks' Southside wharves. Truck trips to the South West Houston Ship Channel area commonly originate in Bayport, the area containing the Cedar Bluff and Channelview Village industrial areas, and to the east of region, entering via I-10. Truck trips from the area mainly leave the region via I-10 east.



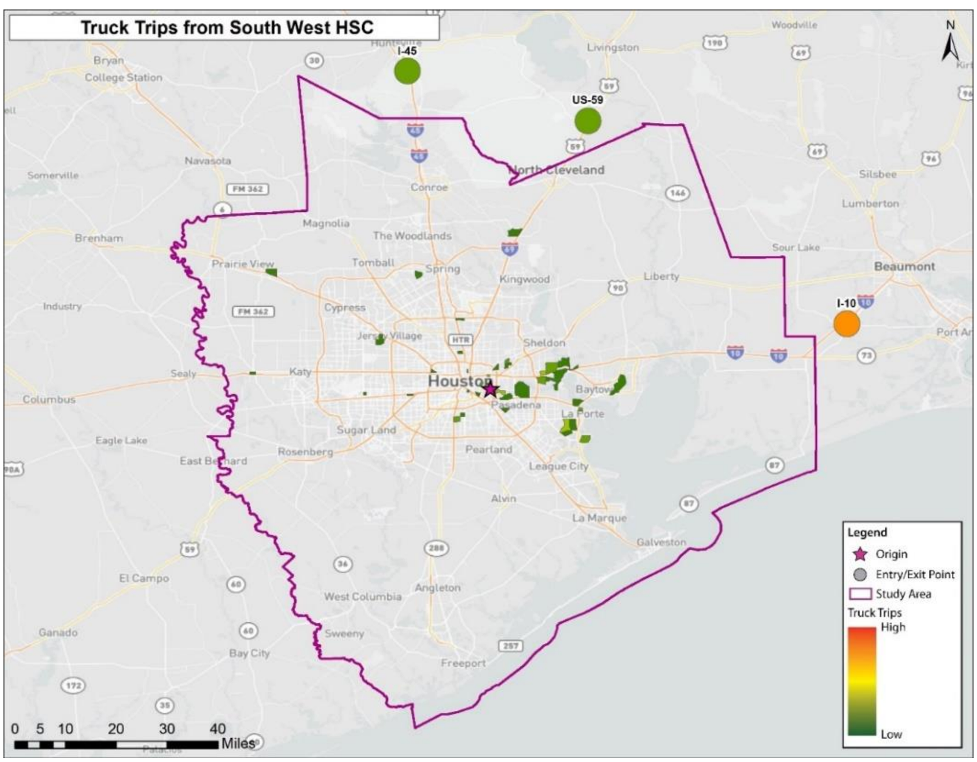
Source: Google Data SIO, NOAA, U.S. Navy, NGA, Gebco

Figure 3-41. Aerial Image of TAZ 579 and 584



Source: HDR Inc., ATRI

Figure 3-42. Origins of Truck Trips to South West HSC



Source: HDR Inc., ATRI

Figure 3-43. Destinations of Truck Trips from South West HSC

Summary of Truck Origins and Destinations

Table 3-4 and Table 3-5 summarize the origin and destination of truck trips captured by the ATRI data. Interestingly, there is a difference in the percentages between origins and destinations of the truck trips, and where the port area is a truck trip destination, there are more trips from outside the region. However, despite that difference, the main take away from this analysis is that the vast majority of truck trips related to the Port of Houston and immediate surrounding areas, have an origin and destination within the H-GAC region.

Table 3-4. ATRI Truck Trip Port TAZ Origin Summary

Area	TAZs	Percentage of Truck Trips Within H-GAC Region	Percentage of Truck Trips Outside of H-GAC Region
Barbours Cut	2660	93%	7%
Bayport	2693	99.7%	0.3%
Carpenters Bayou	2490	99.6%	0.4%
Industrial Road	1257, 1258	99%	1%
Jacinto Boulevard & CARE Terminal	2487, 2489	98%	2%
City Docks	489	99%	1%
North Central Houston Ship Channel	1210, 1215	98%	2%
South Central Houston Ship Channel	1263, 1265, 1300, 1312, 1316	98%	2%
South East Houston Ship Channel	2638, 2639, 2640, 2641, 2645	99%	1%
South West Houston Ship Channel	579, 584	97%	3%
All Port of Houston Areas		98%	2%

Table 3-5. ATRI Truck Trip Port TAZ Destination Summary

Area	TAZs	Percentage of Truck Trips Within H-GAC Region	Percentage of Truck Trips Outside of H-GAC Region
Barbours Cut	2660	74%	26%
Bayport	2693	94%	6%
Carpenters Bayou	2490	92%	8%
Industrial Road	1257, 1258	96%	4%
Jacinto Boulevard & CARE Terminal	2487, 2489	85%	15%
City Docks	489	94%	6%
North Central Houston Ship Channel	1210, 1215	85%	15%
South Central Houston Ship Channel	1263, 1265, 1300, 1312, 1316	94%	6%
South East Houston Ship Channel	2638, 2639, 2640, 2641, 2645	91%	9%
South West Houston Ship Channel	579, 584	59%	41%
All Port of Houston Areas		89%	11%

3.7 Planned Highway Infrastructure Projects

Long-range transportation planning usually takes place at multiple governmental levels. Within Metropolitan Planning Organizations and at State level, parties cooperate to address shared regional challenges. The projects listed below have been identified by H-GAC, Texas Department of Transportation (DOT), and/or PHA as being important to port related mobility. The projects were identified in mobility plans, freight plans, transportation plans and Transportation Improvement Programs (TIP). Also, the state has recently approved funding for port projects - Legislative Rider 45 and Rider 48 - which included multiple smaller projects.

3.7.1 I-69 By-Pass/Grand Parkway

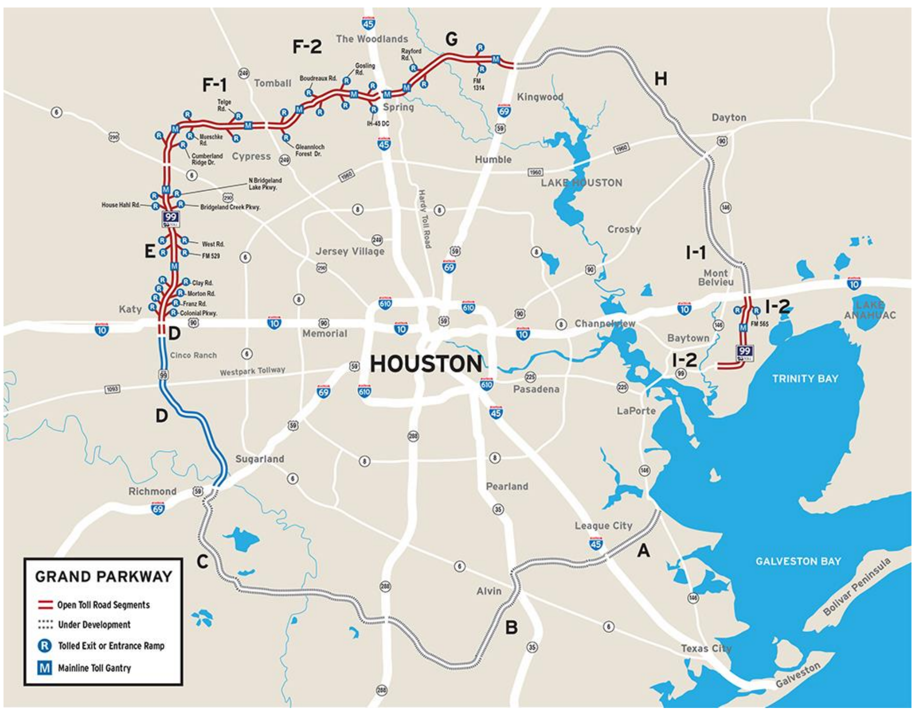
Texas DOT is developing the Grand Parkway, a proposed 180-mile circumferential highway traversing seven counties in the Greater Houston area. Approximately one-third of this new loop has been completed, specifically, the north-western portion. The northeastern part will be most beneficial to the Port of Houston, providing a link from the Fred Hartman Bridge (Route 146), through Baytown and Chambers County's Cedar Port Industrial Park north to connect to I-69. The north east section, comprising of SH 99 from Fred Hartman Bridge to I-10, known as segment I-2 has been open to traffic since March 2008[66] and is a toll road.[67] Five-axle trucks with an electronic toll tag pay $7.80 to travel the full segment. The upgrade to a controlled access toll road is expected to be

[66] https://www.TxDOT.gov/inside-TxDOT/projects/studies/houston/sh99-grand-parkway/overview/segment-i2.html
[67] https://www.txtag.org/en/about/tollroad_grndpky_sh99.shtml

completed by 2022.[68] The remainder of the northeast loop, known as segments H and I-1, are expected to be completed by 2022.[69] This will also be a controlled access toll road. Because truck traffic tends to avoid toll roads, the actual use of the Grand Parkway by port-related traffic to connect to I-69 has to be examined after completion of sections H, I-1, and I-2.

The southern segments of Grand Parkway including Segment B from I-45 South to SH 288, Segment C from SH 288 to US 59 South and unfinished portions of Segment D from US 59 South to I-10 on the west are part of the ten year Unified Transportation Plan (UTP) for the region.

The completion of these segments along with unfunded Segment A from I-45 South to SH 146 is expected to provide a bypass around the congested corridors in Houston urban core. This bypass will serve trucks traveling from Port Houston terminals and other ports in the area to travel west including Austin and San Antonio as well as to the South towards Laredo and Mexico.



Source: TxTag

Figure 3-44. Grand Parkway and Its Current Toll Segments

68 https://www.TxDOT.gov/inside-TxDOT/projects/studies/houston/sh99-grand-parkway/overview/segment-i2.html, Port of Houston Prioritized Project List

69 https://www.TxDOT.gov/inside-TxDOT/projects/studies/houston/sh99-grand-parkway/overview/segment-h-i1.html, Port of Houston Prioritized Project List

3.7.2 Bayport and Barbours Cut Container Terminals and Baytown

Besides the Grand Parkway project, the Baytown area will also benefit from improved northbound connectivity through a planned direct connector from SH 330 to I-10[70] and a new entrance ramp to I-10 east[71]. The direct connector project has been assigned 'medium priority' by PHA and TxDOT. There is no completion date assigned for the entrance ramp.

SH 146 is not formally part of the Grand Parkway project but does provide the missing eastern link in the loop. SH 146 investments[72] include expansion up to six lanes, creating a limited access highway, which will facilitate access from I-10 east, Baytown, and the eastern part of the Port of Houston down to the I-45 Galveston Causeway into the Port of Galveston. The project is essential to improved accessibility to both Barbours Cut and Bayport container terminals.

Bayport Container Terminal will also benefit from the planned expansion from four to six lanes of Port Road, its only local access road, by 2020.[73] Direct connectors and widened frontage roads will improve the connectivity between the terminal and SH 146 by 2020.[74] A widened Red Bluff Road by 2019[75] and widened Southern Access Road by 2025[76] will improve accessibility between the terminal and business parks west of it.

Both Barbours Cut and Bayport container terminals will gain improved accessibility from improvements planned for Fairmont Parkway. The Parkway is set to be widened[77] and benefit from geometric improvements and signal optimization at 14 intersections between Sam Houston Tollway and 7th Street[78], just east of SH 146. Both projects' completion dates are still to be determined.

Barbours Cut Container Terminal will benefit from the planned expansion to six lanes of Barbours Cut Road, its only local access road, and the construction of direct connectors from Barbours Cut Road to SH 146 and SH 225.[79] Both projects have no estimated completion date yet, however they have been scheduled as high priority by TxDOT and PHA.

---

[70] Texas Freight Mobility Plan 2017

[71] Texas Freight Mobility Plan 2017, Port of Houston Prioritized Project List

[72] H-GAC TIP, H-GAC Regional Transportation Plan 2040, Texas Freight Mobility Plan 2017, Port of Houston Prioritized Project List

[73] H-GAC Regional Transportation Plan 2040

[74] H-GAC Regional Transportation Plan 2040, H-GAC TIP

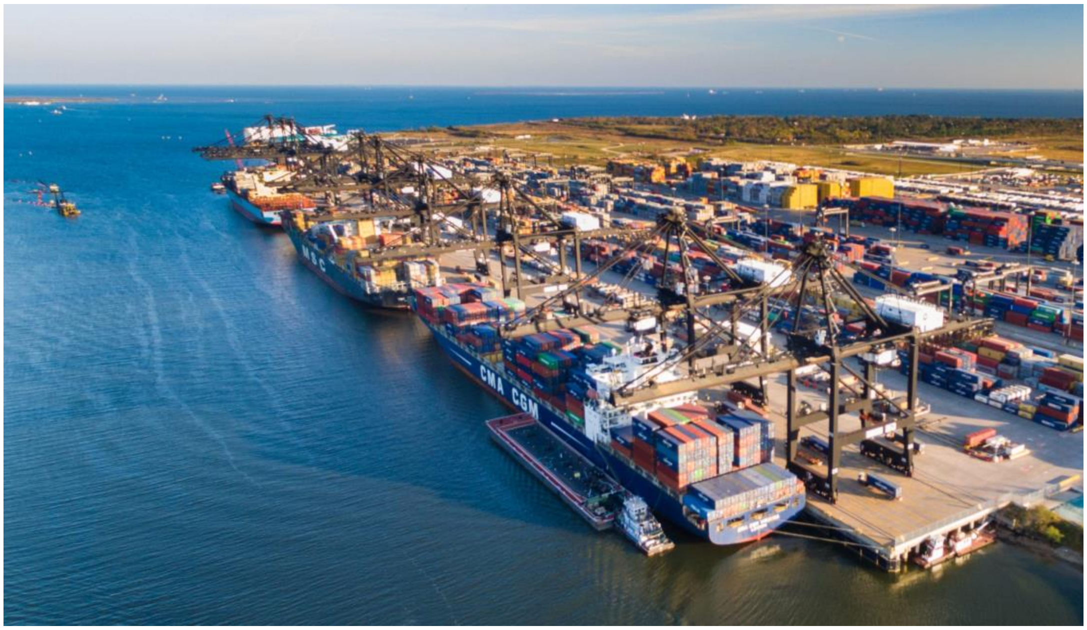
[75] H-GAC TIP, H-GAC Regional Transportation Plan 2040

[76] H-GAC Regional Transportation Plan 2040

[77] Texas Freight Mobility Plan 2017, Port of Houston Prioritized Project List

[78] H-GAC Regional Transportation Plan 2040, Texas Freight Mobility Plan 2017, Port of Houston Prioritized Project List

[79] Texas Freight Mobility Plan 2017, Port of Houston Prioritized Project List



Source: Port of Houston online photo and video gallery

Figure 3-45. Bayport Container Terminal

3.7.3 South of Houston Ship Channel

Independence Parkway serves the Port of Houston south of the HSC. A project to replace the roadway with a 5-lane typical section between SH 225 and Lynchburg Ferry will increase the accessibility of the mainly petrochemical industry and petrochemical terminals along that road.[80] H-GAC anticipates completion of this project in the long term.

Direct connectors between Sam Houston Parkway and SH 225 are planned to improve the flow of traffic between these highways, allowing traffic to bypass the frontage roads and traffic lights.[81] A completion date is still to be determined by TxDOT.

3.7.4 North of Houston Ship Channel

A project to replace Clinton Drive with a 5-lane typical section between Federal Road and I-610 aims to improve the accessibility of Galena Park.[82] No completion date is yet to be identified.

A project to replace Industrial Road with a 5-lane typical section east of Federal Road aims to improve the accessibility of Brown Shipbuilding Industrial Park and Greensport.[83] This project has been planned by H-GAC and PHA for the long term without a completion date identified.

[80] H-GAC Regional Goods Movement Plan, June 2013

[81] Texas Freight Mobility Plan 2017

[82] H-GAC Regional Goods Movement Plan, June 2013

[83] H-GAC Regional Goods Movement Plan, June 2013, Port of Houston Prioritized Project List

The following projects serve to improve the accessibility of the area between Greens Bayou and Sam Houston Tollway south of I-10:

- Jacintoport Boulevard connection to Penn City Road (high priority)[84]
- Jacintoport Boulevard widening to four lanes (low priority)[85]
- Penn City Road roadway replacement with 5-lane typical section from I-10 to 3100 Block (long term)[86]
- Haden Road extension to Penn City Road connector (low priority)[87]

The construction of direct connectors between Sam Houston Parkway and Jacintoport Boulevard[88] would drastically improve the connectivity of the entire Jacintoport Area to and from the south. A completion date has not been set and the project's urgency is defined as low priority by TxDOT and PHA.

The following projects serve to improve the accessibility of the area between Sam Houston Tollway and the Old River, south of I-10. There are plans to widen Sheldon Road between Jacintoport Road and I-10 to four lanes[89]. TxDOT and PHA assigned the project with a 'medium priority'. As part of the long term plans, H-GAC proposes to replace this section with a 5-lane typical section.[90] The other project aiming to increase north-south connectivity is the widening of Appelt Drive over its full length, to be completed at a still to be determined date by TxDOT and PHA.[91] In order to improve the east-west connectivity between the terminals and the Sam Houston Tollway, replacement of Jacintoport Boulevard with a 4-lane typical section has been included in long term plans by TxDOT.[92]

[84] Texas Freight Mobility Plan 2017

[85] Texas Freight Mobility Plan 2017

[86] H-GAC Regional Goods Movement Plan, June 2013, Port of Houston Prioritized Project List

[87] Texas Freight Mobility Plan 2017

[88] Texas Freight Mobility Plan 2017, Port of Houston Prioritized Project List

[89] Texas Freight Mobility Plan 2017, Port of Houston Prioritized Project List

[90] H-GAC Regional Goods Movement Plan, June 2013

[91] Texas Freight Mobility Plan 2017, Port of Houston Prioritized Project List

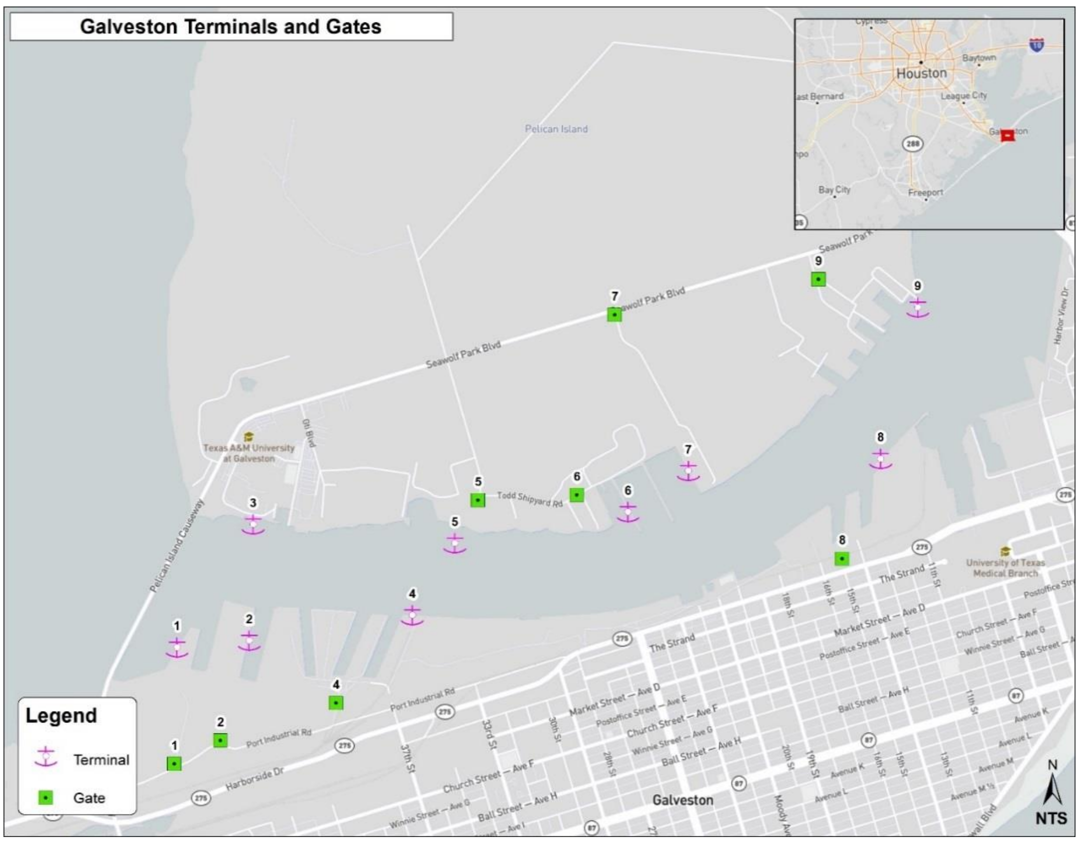
[92] Texas Freight Mobility Plan 2017

3.8 Port of Galveston- Highway Network and Trucking Operations

3.8.1 Location of Terminal Gates

The Port of Galveston comprises the north side of Galveston Island as well as the south shore of Pelican Island. All facilities on Pelican Island are accessed through Pelican Island Causeway and Seawolf Parkway. Martin Midstream and Halliburton's gates are located on Seawolf Parkway. Galveston Terminal Company and Gulf Copper shipyard's gates are located on a local road, Todd Road.

On the north shore of Galveston Island, the Port of Galveston's public wharves are accessible through two gates. The gate to the eastern wharves is located on SH 275 at the intersection with 14th Street. The gate to the western wharves is located on Port Industrial Road, just west of the intersection with 37th Street. Further west on Port Industrial Road are the gates for Gulf Sulphur and Texas International Terminals.



1	Texas International	4	Public Wharves (West)	7	Halliburton
2	Gulf Sulphur	5	Galveston Terminal Company	8	Public Wharves (East)
3	Texas A&M	6	Gulf Copper	9	Martin Midstream

Source: HDR Inc.

Figure 3-46. Galveston Terminals and Gates

3.8.2 Highway Network Serving the Port of Galveston

Interstate 45 is the predominant roadway connection to the Port of Galveston. SH 275 (Harborside Drive) is located along the south side of Galveston Channel provides access to most of the waterside, although the majority of terminal gates are located on Port Industrial Road, a parallel road closer to the quays.

Pelican Island Causeway is the only road connection to Pelican Island where the terminals are located north of the Galveston Channel. To fully support any substantial port development on Pelican Island, the Pelican Island Bridge would need to be replaced with a 4-lane bridge and railroad corridor.

There is consistent flooding on the main waterfront route off I-45 along Harborside Drive as well as congestion near cruise terminals ships are undergoing turnarounds. A separate study is currently underway to address these issues.

3.8.3 Truck Volumes

In 2014, the Port of Galveston handled 135,000 vehicles, both public and private truck traffic volume.[93]

Sea Containers

Practically no sea containers were observed during the traffic counts undertaken as part of this study on SH 275, near I-45, and near 17th Street. While containers are offloaded from incoming produce vessels, the containers are unloaded at the Del Monte's produce warehouse located within the port and as such do not traverse roads outside of the port.

Flatbed Trucks

On SH 275 just north of I-45, flatbed trucks constituted 77 out of 401 (19 percent) northbound and 69 out of 284 (24 percent) southbound. On SH 275 (Harborside Drive) east of 17th Street, no significant number of flatbed trucks was observed.

Box Tractor-Trailers

The only significant truck type observed on SH 275 east of 17th Street was box tractor-trailer. Eighty-seven out of 136 (64 percent) eastbound trucks were box tractor-trailers. In the westbound direction, 95 out of 140 (68 percent) trucks were box tractor-trailers.

On SH 275 north of I-45, box tractor-trailers represented 106 out of 401 (26 percent) of northbound and 93 out of 284 (33 percent) of southbound truck traffic.

Tank Trucks

On SH 275 just north of I-45, 133 (33 percent) northbound and 99 (35 percent) southbound tank trucks were noted. On SH 275 (Harborside Drive) east of 17th Street, no significant number of tank trucks was observed.

---

[93] Texas DOT

3.8.4 Truck Observations and Interview Findings

A series of interviews with truck drivers and observations of trucks entering and leaving port terminals was undertaken to collect further information regarding truck type, Federal Highway Administration (FHWA) class, model year, commodity, origin or destination, employer, and whether the load was oversize or overweight.

Galveston East Gate

The following observations are based on 63 surveys, performed on October 24, 2017. Approximately 95 percent of trucks going through Dole Gate were class 9 tractor-trailers. Occasional class 8 or 10 trucks were also observed. The distribution of import collection versus export deliveries is approximately 70/30. The majority of trucks arrive without a load when picking up, or return without a load after a delivery.

Import Collection

The majority of trucks, approximately 60 percent, were box tractor-trailers that transport fruit to various destinations:

- Galveston, TX
- Houston, TX
- Port Arthur, TX
- Grand Prairie, TX
- Dallas, TX
- San Antonio, TX
- Amarillo, TX
- Nebraska
- Wisconsin
- Phoenix, AZ

The remainder of trucks were mainly flatbeds carrying heavy equipment like excavators and agricultural equipment, such as tractors. These loads were bound for League City, TX, and Louisiana in equal numbers.

Export Deliveries

A wide range of products are delivered through the East Gate:

- Bags from Houston, TX
- A large generator from Houston, TX
- Plastic from Pasadena, TX
- Wire from Dayton, TX
- Containers from New Mexico
- Roofing from Wisconsin

All trucks enter Galveston over the I-45 Causeway.

Galveston West Gate

The following observations are based on 51 surveys, performed on October 24, 2017. The majority of trucks going through West Gate were class 5 and class 9 flatbeds. The distribution of import collection versus export deliveries is approximately 50/50. The majority of trucks arrive without a load when picking up or return without a load after a delivery.

Import Collection

The majority of trucks were observed transporting wind turbine blades to Sterling City, TX on class 9 flatbed tractor-trailers. Crane parts for Houston, occasional cars, tractor cabs and pipes were also observed.

Export Deliveries

Approximately 90 percent of trucks were car carriers transporting cars. An occasional flatbed carrying a tractor cab, or an excavator was also observed. Cars are mainly transported in from Texas and nearby states:

- Rosharon, TX
- Houston, TX
- Austin, TX
- New Orleans, LA
- Oklahoma City, OK
- Tulsa, OK
- Kansas City, MO
- Alabama
- Georgia
- Sacramento, CA

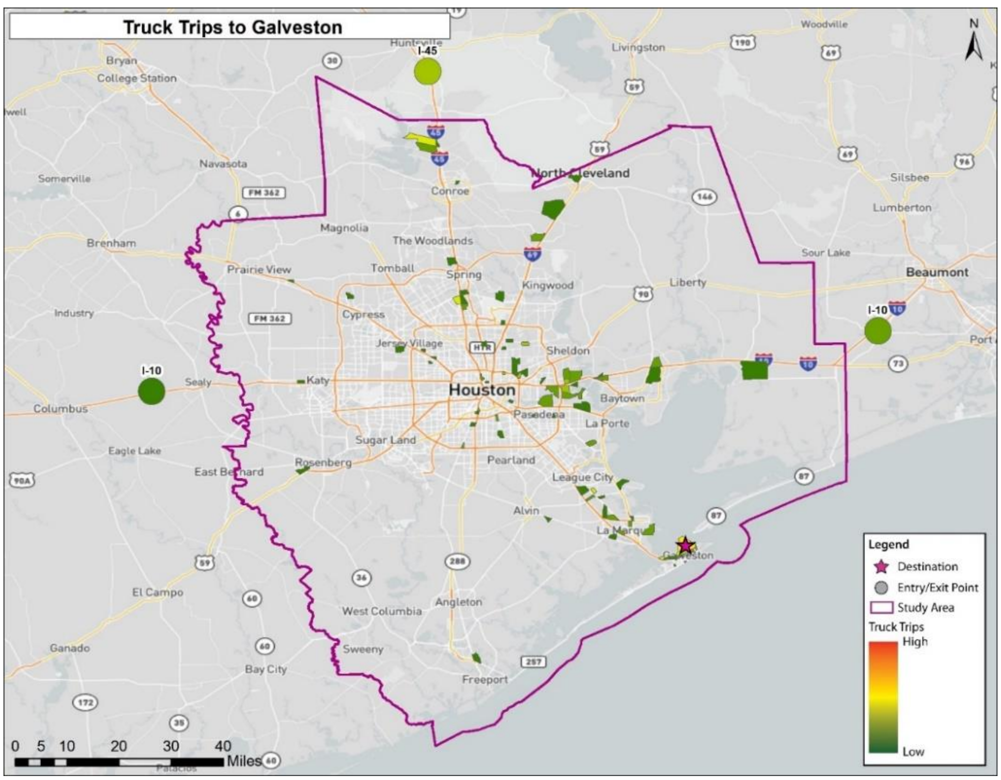
3.8.5 Truck Origins and Destinations

The truck data from ATRI provides insight into the origins and destinations from the Port of Galveston TAZs (#4980, #4984, and #4990), including the public wharves, Texas International Terminals, Gulf Sulfur, Galveston Terminal Company, Gulf Copper, Halliburton, and Martin Midstream.

Truck trips from the Port of Galveston focus on local destinations in the direct vicinity on Galveston Island, South Central HSC, and long-distance destinations, mainly via I-10 east. Truck trips to the Port of Galveston generally originate near Cypress Station and Willis. From outside the region truck trips mainly use I-45 from the north and I-10 from the east.

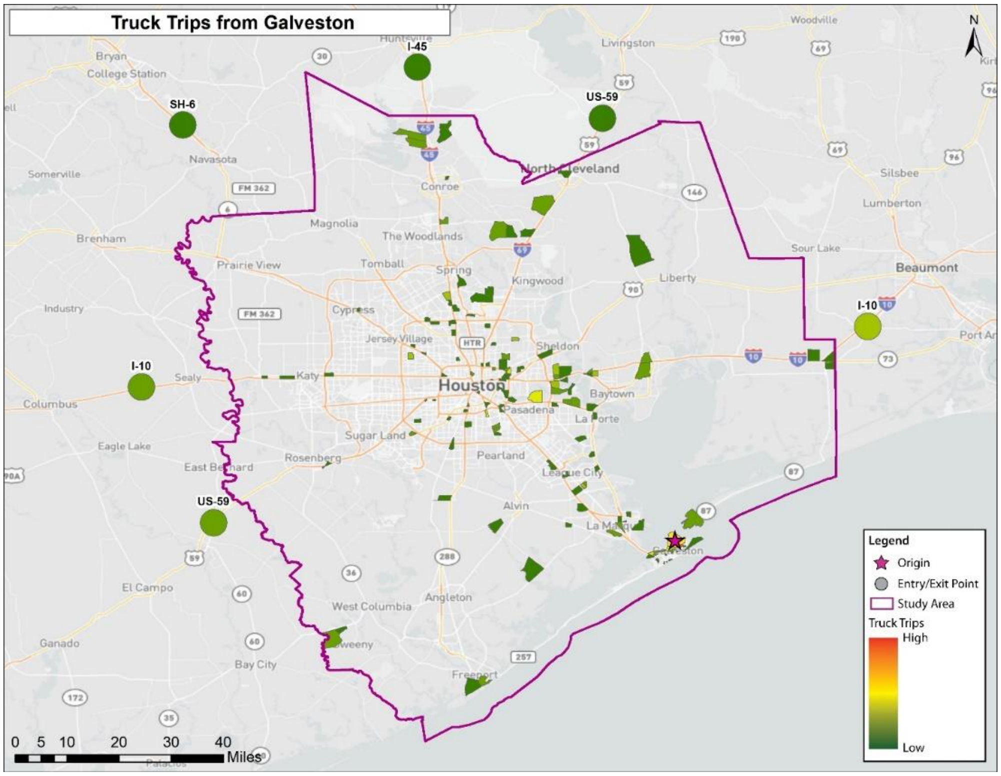
Source: Google Data SIO, NOAA, U.S. Navy, NGA, Gebco

Figure 3-47. Aerial Image of TAZs 4980, 4984, and 4990



Source: HDR Inc., ATRI

Figure 3-48. Origins of Truck Trips to Galveston



Source: HDR Inc., ATRI

Figure 3-49. Destinations of Truck Trips from Galveston

The ATRI data identifies that truck trips originating in the Port of Galveston's TAZs, 99.9 percent of those trips had a destination within the H-GAC area. Where the Port's TAZs are a truck destination, 96.4 percent of truck trips begin their trip with the H-GAC region.

3.9 Planned Infrastructure Projects

More than an estimated billion dollars will be spent on transportation infrastructure improvement in Galveston County over the next decade.[94] There will be major improvements to the two main arteries running through the county: I-45 (Gulf Freeway) and SH146. These corridors serve the ports of both Galveston and Texas City.

The I-45 project[95] will expand I-45 from six lanes to eight lanes between NASA 1 in southern Harris County and FM 1764 in Texas City, including a 1.5-mile stretch of ten lanes with three-lane frontage roads on either side of the Harris-Galveston County Line.

SH 146 investments[96] include expansion up to six lanes and conversion to a limited access highway, which will facilitate access from I-10 East, Baytown, and the eastern part of the Port of Houston down to the I-45 Galveston Causeway into the Port of Galveston.

---

[94] http://www.developgalvestoncounty.com/road-improvements

[95] H-GAC TIP, H-GAC Regional Transportation Plan 2040, Texas Freight Mobility Plan 2017

[96] H-GAC TIP, H-GAC Regional Transportation Plan 2040, Texas Freight Mobility Plan 2017, Port of Houston Prioritized Project List

Locally, a four-lane 61st Street extension has been planned from Broadway to Harborside Drive on a still to be determined timeline[97] by TxDOT and H-GAC. In order to improve traffic flow to and from the port's eastern public wharves, traffic light synchronization has been planned by TxDOT for the downtown area on Harborside Drive. However, this project has undefined timeline.[98]

The state funding for port projects contained within Legislative Rider 45 and Rider 48 identified improvements to Old Port Industrial Road, 33rd Street, and the intersection of 28th Street and Harborside Drive to improve traffic flow.

---

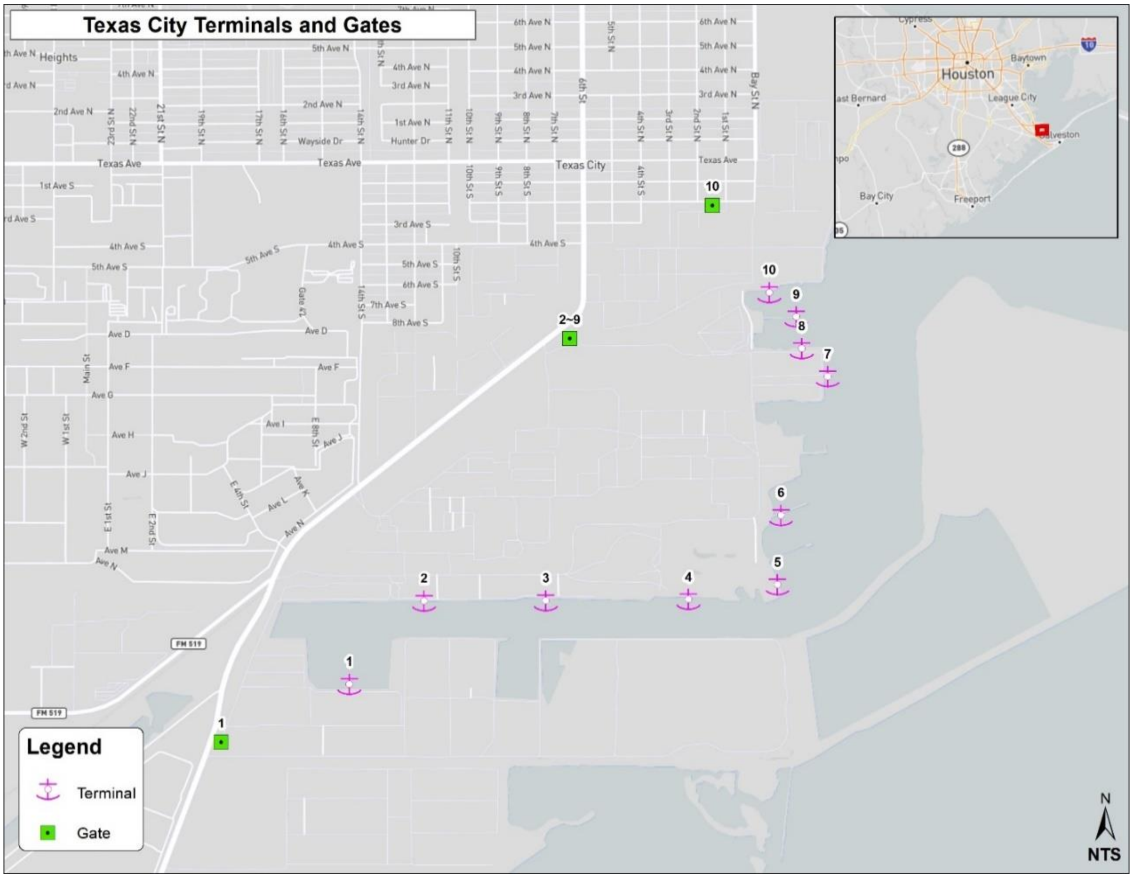
[97] H-GAC TIP, H-GAC Regional Transportation Plan 2040, Texas Freight Mobility Plan 2017

[98] Texas Freight Mobility Plan 2017

3.10 Port of Texas City- Highway Network and Trucking Operations

3.10.1 Location of Terminal Gates

The majority of terminals are accessed through one Port of Texas City main gate on SH 197. Eastman Chemical has a truck gate on 2nd Avenue South and Oiltanking has its own gate on SH 197.



1	Oiltanking	6	BP
2	Valero	7	Shared (NuStar/Valero/Marathon)
3	BP Chemicals	8	NuStar
4	Ox (Oxbow Carbon)	9	Enterprise
5	Bollinger Shipyard	10	Eastman Chemical

Source: HDR Inc.

Figure 3-50. Texas City Terminals and Gates

3.10.2 Highway Network Serving the Port of Texas City

The Port of Texas City has highway connections including access to Interstate 45. SH 197 is the main artery connecting port traffic to and from I-45. There are multiple east-west highways that can alleviate any potential incidents along SH 197 and provide alternative routing. I-45 connects south to Port of Galveston and north to Houston. SH

146 serves to connect Texas City to ports and industrial sites to the east of Houston and in Baytown.

3.10.3 Truck Volumes

Daily truck volumes were recorded and analyzed at three locations in Texas City:

- SH 3 south of Main Street
- FM 1764 just west of Amburn Road
- SH 146 south of Main Street

No truck traffic was observed on SH 3.

Sea Containers

Trucks with sea containers were only observed on SH 146, the access road to and from both Barbours Cut and Bayport Container Terminals. Twenty-three out of 154 (15 percent) southbound trucks on SH 146 were observed to transport sea containers and an additional 10 trucks were transporting empty dray chassis. The northbound count contained half those numbers.

Tank Trucks

On eastbound FM 1764, 52 out of 203 (26 percent) trucks observed were tank trucks, in the westbound direction 43 out of 156 (28 percent) trucks observed were tank trucks. On SH 146 northbound, 46 out of 150 (31 percent) and southbound 37 out of 154 (24 percent) of trucks were observed to be tank trucks. These trucks likely serve the many petrochemical industries in Texas City.

Box Tractor-Trailers

Thirty-six percent of all eastbound truck traffic on FM 1764 was box tractor-trailers, totaling 74 out of 203 trucks. In the westbound direction the count was 46 out of 156 trucks, or 29 percent. The numbers for SH 146 were 46 out of 150 (31 percent) trucks northbound and 37 out of 154 (24 percent) trucks southbound.

Flatbed Trucks

On FM 1764, 40 flatbed trucks were observed in the eastbound direction (20 percent of eastbound trucks), and 43 flatbed trucks were observed in the westbound direction (28 percent of westbound trucks). On SH 146, flatbed trucks comprised 28 percent of northbound truck traffic and 26 percent of southbound truck traffic.

3.10.4 Truck Observations and Interview Findings

A series of interviews with truck drivers and observations of trucks entering and leaving port terminals was undertaken to collect further information regarding truck type, Federal Highway Administration (FHWA) class, model year, commodity, origin or destination, employer, and whether the load was oversize or overweight.

Texas City Gatehouse Industrial Canal Road

The following observations are based on 46 surveys, performed on October 19, 2017. Approximately 95 percent of trucks passing the Gatehouse were class 9 tractor-trailers. These were all dry bulk tractor-trailers delivering byproduct from Marathon Refinery 1.5 miles away.

Texas City Main Gate

The following observations are based on 16 surveys, performed on October 19, 2017. A wide range of trucks, class 5 through 10, were observed using the Main Gate. The distribution of import collection versus export deliveries is approximately 25/75. The majority of trucks arrive without a load when picking up, or return without a load after a delivery.

Import Collection

No trend was observed for cargo collected at Main Gate.

Export Deliveries

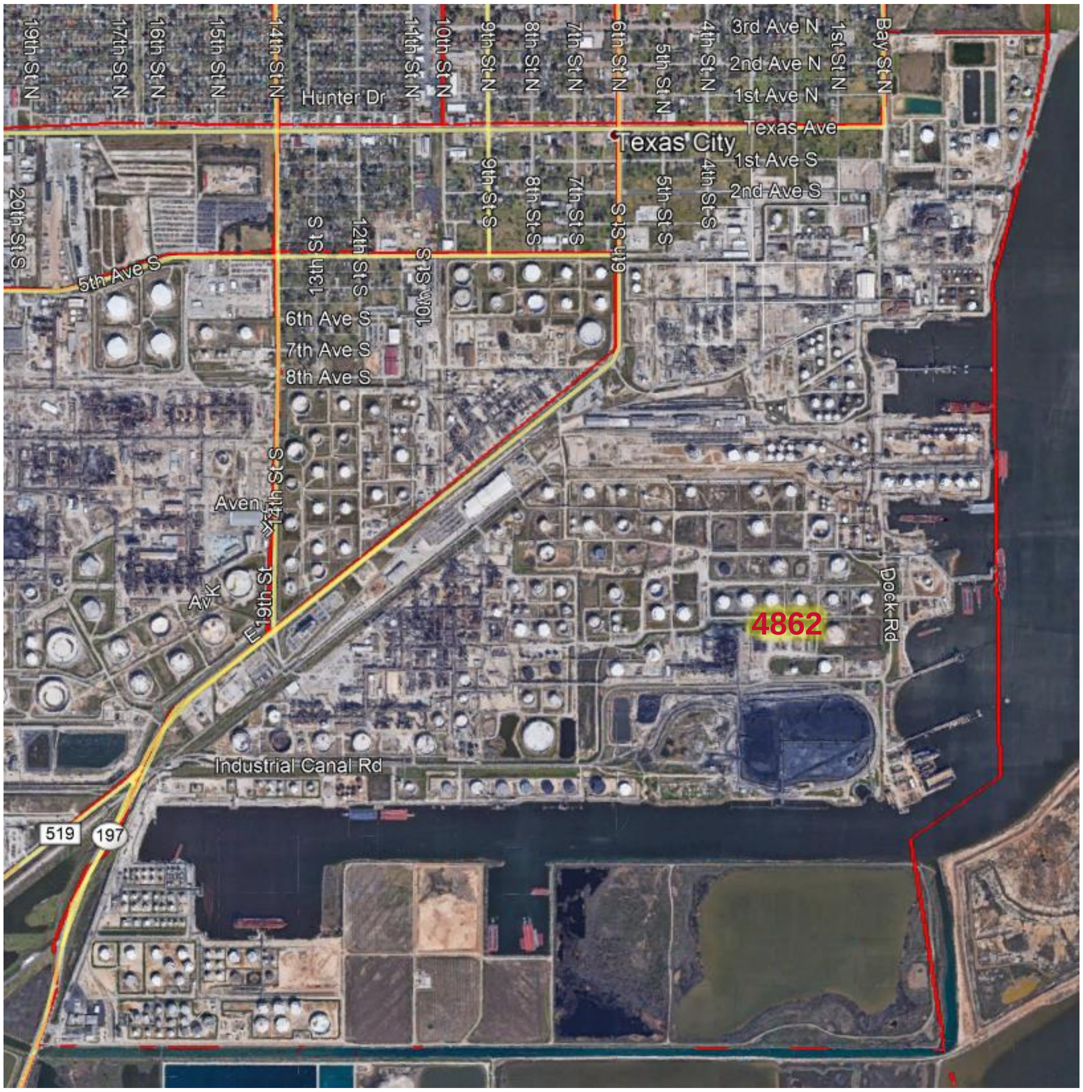
The majority of trucks were local class 6 and class 10 dump trucks delivering asphalt or petcoke. The remainder are trucks, including tanker trucks, carrying chemicals arriving from Tennessee, Jackson, MS, and Pasadena, TX.

3.10.5 Truck Origins and Destinations

GPS truck probe data from ATRI provides insight into the origins to and destinations from the Port of Texas City, including all of the port's petrochemical bulk liquids terminals, Oxbow Carbon's bulk terminal, and Bollinger Shipyard.

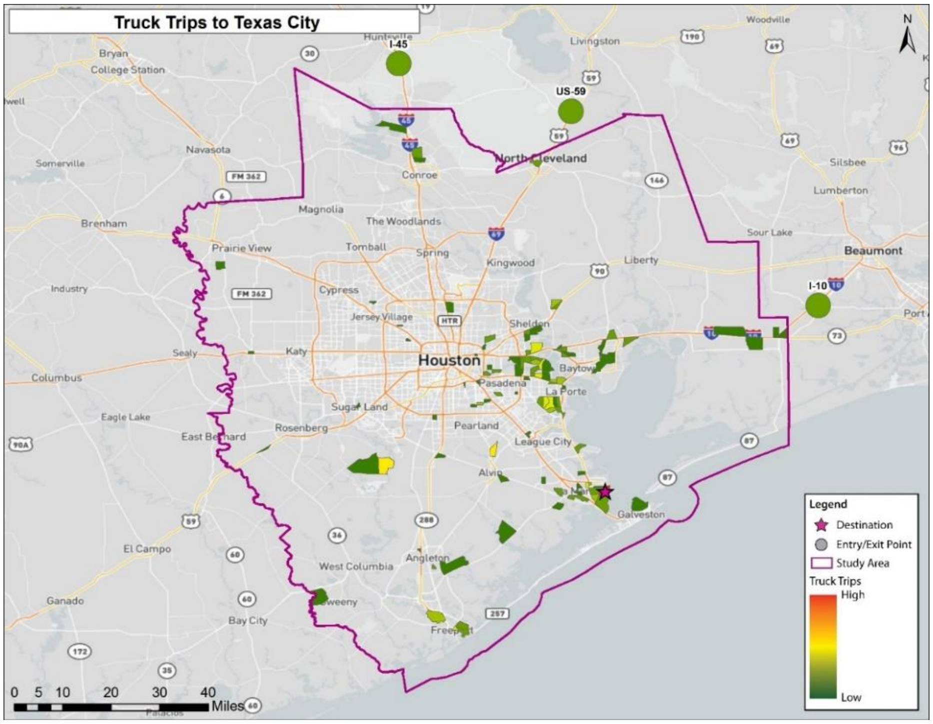
Truck trips to and from the Port of Texas City TAZ (#4862) focus on locations in the direct vicinity within Texas City- specifically an oil field five miles west of Juliff, and another five miles north of Alvin. Trucks from Texas City also go to the South East HSC area, where Vopak and Intercontinental Terminals Company are located, and to destinations east of the region via I-10.

The ATRI data identifies that 99.8 percent of truck trips originating in TAZ #4862 had destinations within the H-GAC region, and 97 percent of truck trips originating from this TAZ had a destination within the H-GAC region.



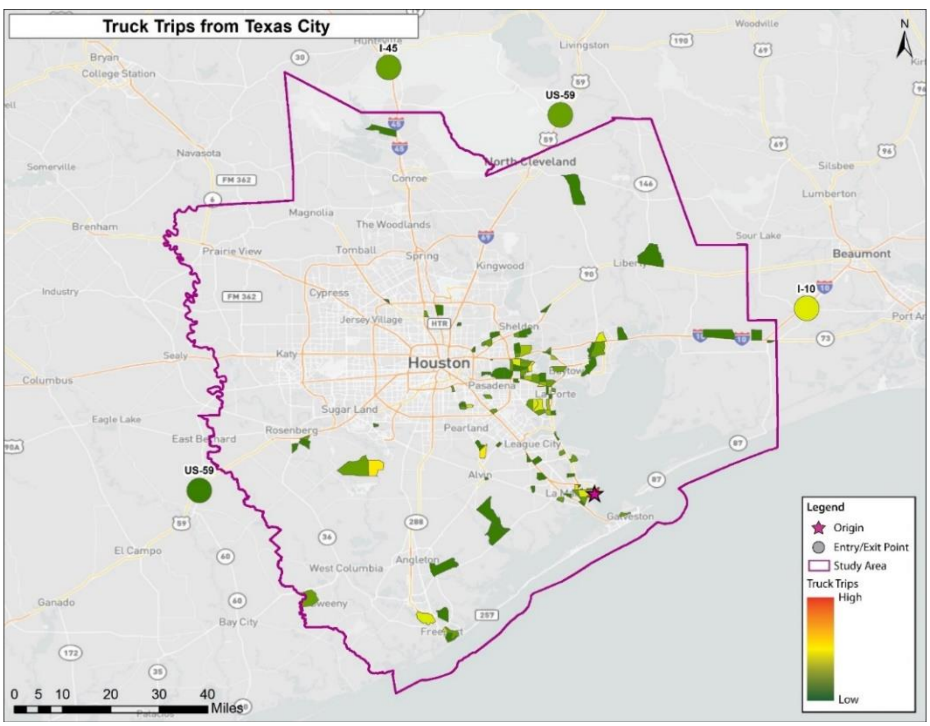
Source: Google Data SIO, NOAA, U.S. Navy, NGA, Gebco

Figure 3-51. Aerial Image of TAZ 4862



Source: HDR Inc., ATRI

Figure 3-52. Origins of Truck Trips to Texas City



Source: HDR Inc., ATRI

Figure 3-53. Destinations of Truck Trips from Texas City

3.10.6 Planned Infrastructure Projects

Because, the Port of Texas City is located in the County of Galveston, it will benefit from the same investments identified for the Port of Galveston, namely the widening of I-45 and SH 146 (see Section 3.9).

However, there are two local projects that specifically contribute to the accessibility of the Port of Texas City. These include two direct connectors between Loop 197 and I-45 that are expected to be completed to facilitate an uninterrupted traffic flow.[99] The construction of a new four-lane principal arterial named Shoal Point Access Road from Loop 197 to Southern End Terminal Site will create access to the newly developed southern part of the Port of Texas City.[100]

[99] H-GAC TIP, H-GAC Regional Transportation Plan 2040, Texas Freight Mobility Plan 2017
[100] H-GAC TIP, H-GAC Regional Transportation Plan 2040

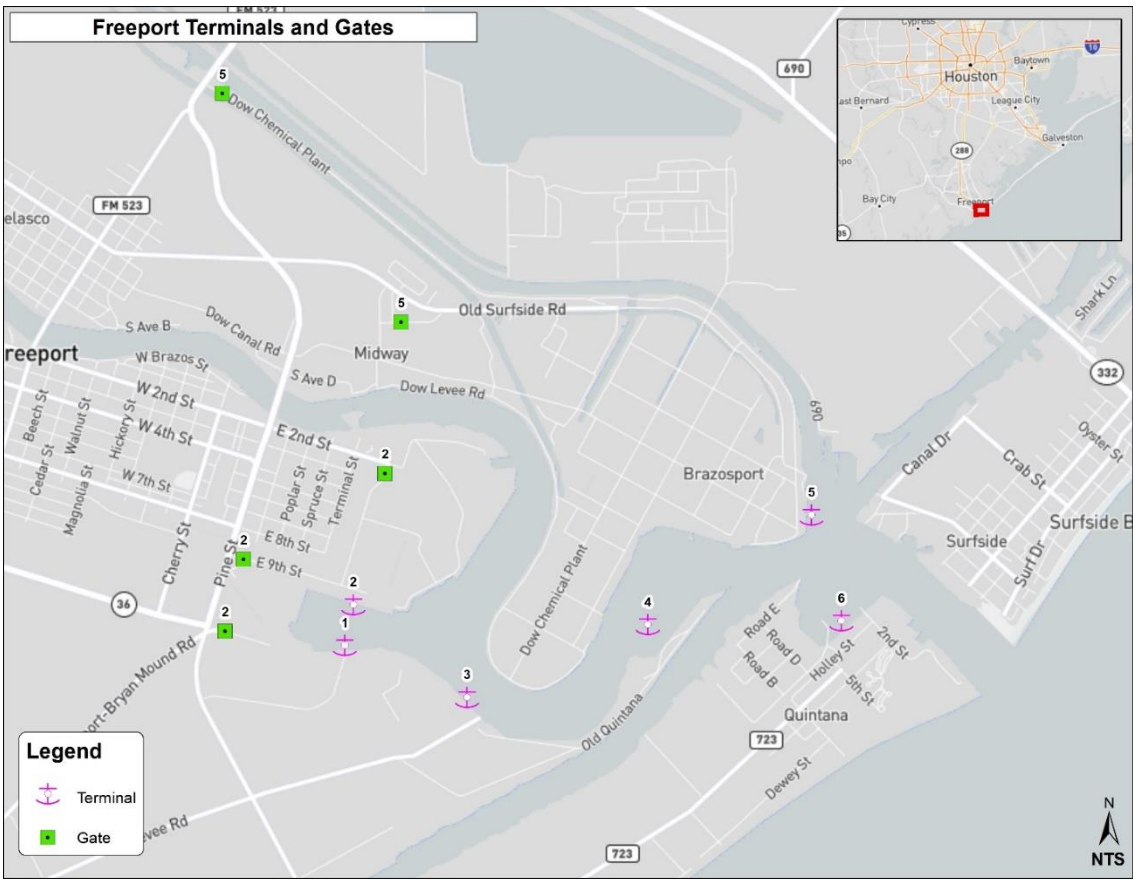
3.11 Port of Freeport- Highway Network and Trucking Operations

3.11.1 Location of Terminal Gates

The majority of the Port of Freeport's docks are accessible through three shared gates: South Gate (gate 4), Main Gate (gate 8), and North Gate (gate 14). The South and Main Gates are accessible via Pine Street (FM1495), and the North Gate is accessible from East 2nd Street.

Other facilities that have individual gates but are unlikely to experience high truck volumes include petrochemical bulk liquid terminals (BASF, Phillips 66, Enterprise Seaway) and Freeport LNG.

DOW Chemical operates a large industrial complex north of the Brazosport Turning Basin. There is a gate on FM 523 and another on Midway Road.



1	BASF	4	Enterprise Seaway
2	Port Freeport Docks	5	DOW
3	Phillips 66	6	Freeport LNG

Source: HDR Inc.

Figure 3-54. Freeport Terminals and Gates

3.11.2 Highway Network Serving the Port of Freeport

The Port of Freeport is accessible by two main arteries, SH 36 and SH 288. SH 288 provides connectivity to Houston and destinations further north and further east. SH 36 provides connectivity to I-10 West and destinations west of Houston. Although there is little evidence of truck trips between the Port of Freeport and the ports of Galveston and Texas City (see Section 3.11.5), Freeport is well connected to those ports via FM 2004.

3.11.3 Truck Volumes

Sea Containers

Approximately 21 (southbound) to 24 percent (northbound) of truck traffic on Pine Street north of East 8th Street transports sea containers, comprising 39 out of 183 trucks and 52 out of 221 trucks, respectively. Including dray chassis, 42 trucks or 23 percent (southbound) and 65 trucks or 29 percent of truck traffic (northbound) was sea container related. Practically no sea containers were observed on SH 36/288 just east of South Velasco Boulevard. However, 147 out of 335 trucks or 44 percent (eastbound) and 157 out of 227 trucks or 69 percent (westbound) of truck traffic at this location were empty drayage trailers.

Flatbed Trucks

Approximately 60 flatbed trucks were observed per direction at both locations. For the location on SH 36/288, just east of South Velasco Boulevard this means 18 percent of all eastbound truck traffic and 28 percent of all westbound truck traffic. On Pine Street north of East 8th Street, this translates to 26 percent of all northbound and 25 percent of all southbound truck traffic.

Box Tractor-trailers

On SH 36/288 just east of South Velasco Boulevard, 93 trucks or 28 percent of all eastbound trucks and 77 trucks or 34 percent of all westbound trucks were box tractor-trailers. On Pine Street north of East 8th Street, 68 or 31 percent of eastbound and 74 or 40 percent of westbound truck traffic were box tractor-trailers.

Other Trucks

Intermodal container and tank truck traffic were rarely observed in Freeport.

3.11.4 Truck Observations and Interview Findings

A series of interviews with truck drivers and observations of trucks entering and leaving port terminals was undertaken to collect further information regarding truck type, Federal Highway Administration (FHWA) class, model year, commodity, origin or destination, employer, and whether the load was oversize or overweight.

.

Freeport East 9th Street – Dole Gate

The following observations are based on 43 surveys, performed on October 17, 2017. One hundred percent of trucks going through Dole Gate were class 9 tractor-trailers. The distribution of import collection versus export deliveries was approximately 50/50. The majority of trucks arrive without a load when picking up or return without a load after a delivery.

Import Collection

The majority of trucks transport fruit and vegetables to a wide range of destinations:

- Galveston, TX
- Houston, TX
- Fort Bend, TX
- Austin, TX
- Dallas, TX
- Fort Worth, TX
- San Antonio, TX
- Biloxi, MS
- Alabama
- Denver, CO
- Iowa
- Ohio
- Wadena, MN

Trucks carry tanks to North Houston or Pasadena in Houston.

Export Deliveries

Approximately 85 percent of trucks transporting cars in 40-foot containers were observed arriving from the Paradise Shipping Yard. Occasionally a box tractor-trailer or 40-foot container with furniture, canned food, or cardboard was identified.

Freeport Gatehouse E 9th St – Main Gate – Gate 8

The following observations are based on 163 surveys, performed on October 17, 2017. Approximately 80 percent of trucks passing through Gate 8 were class 9 tractor-trailers. Some class 5 single tractor cabs and an occasional class 6 or class 10 truck were observed using Gate 8. A wide range of truck type equipment was observed: single tractor cabs, 40- and 20-foot sea containers, 53-foot intermodal containers, dry bulk tractor-trailers, tank, box and flatbed trucks. The distribution of import collection versus export deliveries is approximately 20/80. The majority of trucks arrive without a load when picking up, or return without a load after a delivery.

Import Collection

Two surveys identified that rice is collected for transport from the Port of Freeport and delivered to the Port of Houston and Oklahoma City.

Export Deliveries

The wide range of trucks observed is also reflected in the wide range of goods that get delivered. Most deliveries were made from nearby origins:

- An excavator from Freeport
- Rice from Freeport
- Gravel from Freeport
- Cars from Galveston
- Machinery parts from Houston

Two surveys identified rice from Salt Lake City and crane parts from Canada.

Freeport South Gate – Gate 4

The following observations are based on 18 surveys, performed on October 10, 2017. Approximately 95 percent of trucks passing through Gate 4 were class 9 tractor-trailers. Approximately two-thirds of trucks surveyed were flatbeds. The distribution of import collection versus export deliveries was approximately 30/70. The majority of trucks arrive without a load when picking up or return without a load after a delivery.

Import Collection

All pick-ups observed were flatbeds carrying pipes going to several locations throughout the region.

Export Deliveries

A wide range of goods are delivered on flatbed, dry-bulk, box and dray trucks from Houston: pipes, an oil compressor, chemicals, box crates, cars and a forklift were observed.

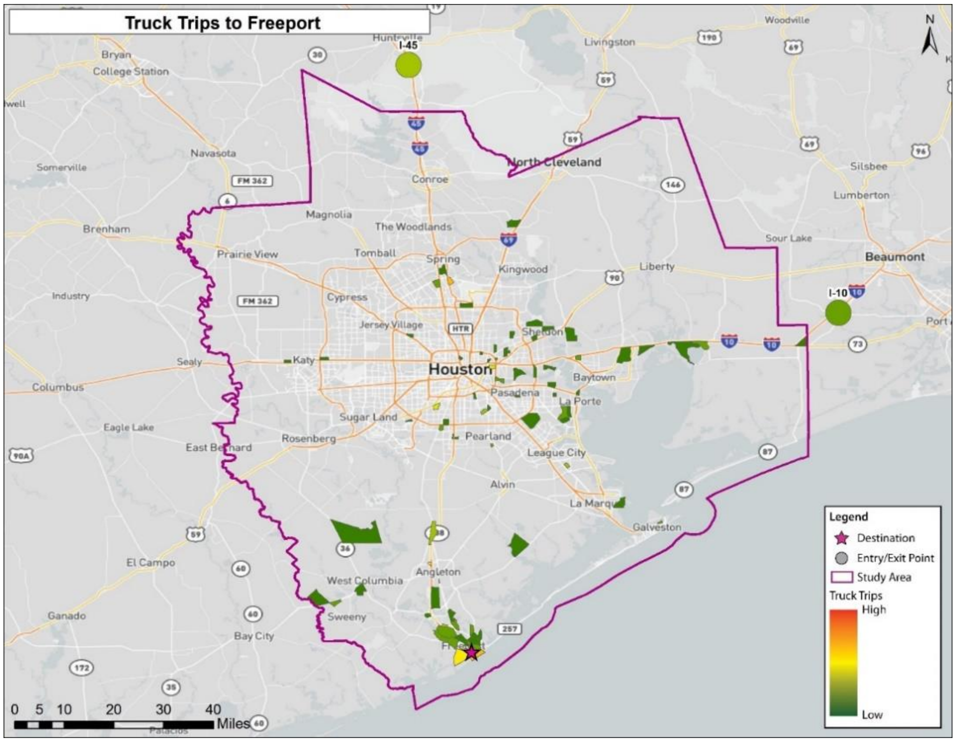
3.11.5 Truck Origins and Destinations

ATRI's GPS truck probe data provides insight in the origins and destinations from the Port of Freeport TAZs (#3234 and 3235), including the port's Roll-on/Roll-off (RORO), container, agricultural products, bulk steel and limestone terminals, and four petrochemical bulk liquid terminals.

Truck trips to and from the Port of Freeport focus on locations in the direct vicinity, and Westfield where multiple car processing facilities including RORO rail-terminals are located. The ATRI analysis identifies 99.9 percent for truck trips originating in TAZs #3234 and 3235 have an origin within the H-GAC region, while 82.8 percent of truck trips destined for these TAZs originated within the H-GAC region.

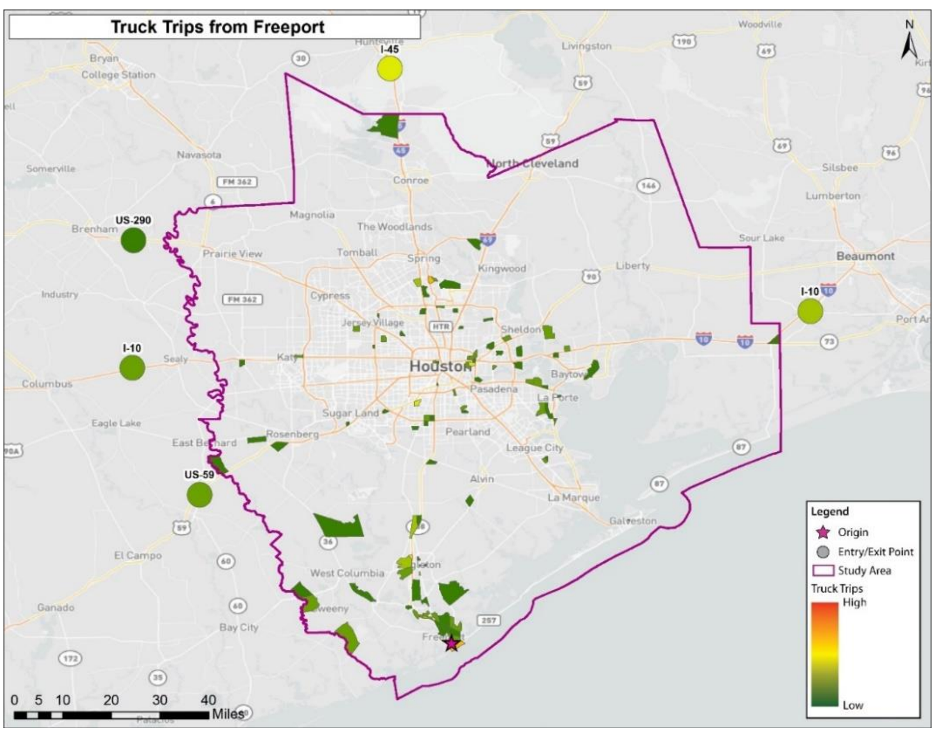
Source: Google Data SIO, NOAA, U.S. Navy, NGA, Gebco

Figure 3-55. Aerial Image of TAZs 3234 and 3235



Source: HDR Inc., ATRI

Figure 3-56. Origins of Truck Trips to Freeport



Source: HDR Inc., ATRI

Figure 3-57. Destinations of Truck Trips from Freeport

3.11.6 Planned Infrastructure Projects

Approximately $250 million worth of projects have been identified to upgrade the 55-mile stretch of SH 36 from the Port of Freeport to I-69 at Rosenberg.[101] These projects include a grade-separated crossing with SH 35 and widening the entire stretch from two to four lanes. Some segments do not have a set target date and realization of these improvements are set by TxDOT as ‘medium priority’. To accommodate anticipated growth at the port, efforts have been underway and are planned to create an improved route from the Port of Freeport via SH 36.

On SH 288, six grade separations and a one mile stretch of two-lane frontage road have been identified as future projects[102] between the Port of Freeport and Beltway 8. The timeline for the frontage road is 2025, timelines for the grade separations have yet to be determined by TxDOT.

In the direct vicinity of the Port of Freeport, three infrastructure investments are planned. Another grade separation project has been proposed for SH 332 and FM 523.[103] The construction date is not set yet by TxDOT. An elevated intersection has been planned for the intersection between Pine Street, or FM 1495, and SH 36. H-GAC assigned the project to be realized on the ‘interim term’.[104] There are long term plans to replace the Pine Street, or FM 1495, roadway with a five-lane typical section between SH 288 and the Port of Freeport Terminal on Pine Street.[105]

---

[101] Texas Freight Mobility Plan 2017, Port of Houston Prioritized Project List, H-GAC Regional Transportation Plan 2040, H-GAC TIP

[102] Texas Freight Mobility Plan 2017

[103] Texas Freight Mobility Plan 2017

[104] H-GAC Regional Goods Movement Plan, June 2013

[105] H-GAC Regional Goods Movement Plan, June 2013

3.12 Rules and Regulations on Heavyweight and Oversize Loads

The region's ports also specialize in the movement of oversize and overweight cargoes, sometimes referred to as project cargo. These cargoes exceed the specified regulations associated with "normal" truck operations such as height, length, width and overall gross vehicle weight. The Port of Freeport, Port of Galveston and Port of Houston are all engaged with heavyweight and oversized load shipments. The Port of Freeport has a tenant, Mammoet, which specializes in the receipt and handling of heavyweight and oversize loads.

The ability for the region's ports to receive and dispatch oversize and overweight loads, which cannot be broken down or disassembled into smaller loads, is vital to the petro chemical and manufacturing industries located in the region. A physical highway capable of accommodating such loads, combined with a permitting regulatory environment is crucial for allowing such loads to be moved to and from the ports.

Source: Port of Freeport

Figure 3-58. Mammoet operation – Port of Freeport

Smaller terminals, such as the Green Barge Terminal located on Cedar Bayou are also used to facilitate the movement of heavyweight and oversized loads as shown in Figure 3-59.

Commodities passing through the region's ports include power station turbines, wind power equipment including wind turbine blades, mining and drilling equipment and components of petro chemical manufacturing facilities. These cargoes have typically been reduced in size and weight as far as practicably possible, but still require special arrangements and planning to accommodate these loads on highway infrastructure.

The region's ports not only support the movement of these cargoes to and from Texas, but also across the nation. For example, components associated with the refurbishment of the Ottumwa Power Generating Station in Ottumwa, IA, were manufactured in Japan, moved by ship to the Port of Houston and then transported nearly 1,000 miles by truck to the construction site.

Source: txgulf.org

Figure 3-59. Oversize Load at Green Barge Terminal

Truck weight and size limits are meant to keep roads safe and in good condition by limiting the wear and tear on roads and bridges. These limits can sometimes restrict transportation carriers from using the full hauling potential of a truck, leading to inefficient use of truck capacity - ultimately resulting in more truck movements. This topic has come into sharper focus in the Houston area due to the increased production of resins typically exported in sea containers. A typical 40-foot sea container can carry a payload of 58,950 pounds (26,740 kgs), however the gross vehicle weight limit of a tractor trailer (80,000 pounds) typically limits payload of the container to 44,500 pounds. Proponents of raising weight limits note the importance of high gross container weights to retain companies in the area and keep the Port of Houston and Port of Freeport competitive with ports in other Gulf and East Coast states.

3.12.1 Texas Oversize and Overweight Regulations

Overweight Permit

Texas has established weight limits for vehicles and loads moving with and without overweight permits on Texas roadways and bridges.[106] The following maximum weight dimensions may be operated on Texas' highways without a permit:

[106] https://www.txdmv.gov/motor-carriers/oversize-overweight-permits/texas-size-weight-limits

Table 3-6. Maximum Weights per Axle Group without a Permit in Texas

Axle Group	Maximum Weight
Single axle	20,000 pounds
Tandem axle	34,000 pounds
Tridem axle	42,000 pounds
Quad axle	50,000 pounds
Gross	80,000 pounds

Source: Texas Department of Motor Vehicles

The maximum permit weight for an axle or axle group is based on 650 pounds per inch of tire width or the following axle or axle group weight, whichever is the lesser limit.

Table 3-7. Maximum Weights per Axle Group with a Permit in Texas

Axle Group	Maximum Weight
Single axle	25,000 pounds
Tandem axle	46,000 pounds
Tridem axle	60,000 pounds
Quadrem axle	70,000 pounds
Quint axle	81,400 pounds
Six or more axles	Determined by MCD based on engineering study of the equipment and measurements.

Source: Texas Department of Motor Vehicles

Intermodal Shipping Container Port Permit

Texas Department of Motor Vehicles (DMV) issues an annual permit for the transport of intermodal shipping containers transported in Texas within 30 miles of select port authorities or ports of entry that are located in a county contiguous to the Gulf of Mexico or a bay or inlet opening into the gulf.[107] Ports currently available:

- Port of Freeport
- Port of Houston – Barbours Cut
- Port of Houston – I-610

The truck-tractor and semitrailer combination must have six or seven axles, meet criteria on the distance between axles and have the following maximum gross weight limits:

[107] https://www.txdmv.gov/oversize-weight-permits/intermodal-shipping-container-port-permit

Table 3-8. Maximum Weights per Axle Group with a Permit in Texas for Trucks Transporting Intermodal Shipping Containers

Axle Group	Maximum Weight
Six	93,000 pounds
Seven	100,000 pounds

Source: Texas Department of Motor Vehicles

However, six and seven axle combinations are not common in the dray chassis market. Many chassis equipment rental companies do not carry them, or if they do, only in limited numbers. For some carriers, if they are transporting a significant number of overweight containers, it may be cost effective to purchase a six or seven axle combination.

Oversize Permit

Texas has established dimension limits for vehicles and loads moving with and without overweight permit on Texas roadways and bridges.[108] The following maximum dimensions may be operated on Texas' highways without a permit:

- Width: 8'6" for all non-passenger vehicles
- Height: 14'
- Length: see Table 3-9

Table 3-9. Maximum Lengths without a Permit in Texas

Vehicle Type	Maximum Length
Single motor vehicle	45 feet
Truck-tractor	Unlimited
Semitrailer, of two-vehicle combination	59 feet
Each trailer or semitrailer of a twin-trailer combination	28.5 feet
Stinger-steered auto/boat or traditional auto/boat transporter (truck-tractor)	Unlimited
Front overhang	3 feet
Rear overhang	4 feet

Source: Texas Department of Motor Vehicles

[108] https://www.txdmv.gov/motor-carriers/oversize-overweight-permits/texas-size-weight-limits

The following maximum dimensions may be operated on Texas highways with a permit:

Table 3-10. Maximum Dimensions with a Permit in Texas

Width	Maximum width permitted on holidays	14', except for manufactured housing
	Maximum width permitted on controlled access highways (Interstate Highway System)	16', except for manufactured housing
	Maximum width permitted without a route inspection certification by applicant on file	20'
Height	Maximum height permitted on holidays	16'
	Maximum height permitted without a route inspection certification by applicant on file	1'11"
Length	Maximum length permitted on holidays	110'
	Truck or single vehicle	75'
	Front overhang	25'
	Rear overhang	30'
	Maximum length permitted without a route inspection certification by applicant on file	125'

Source: Texas Department of Motor Vehicles

In addition to the requirements of the permit type applied, if a vehicle or load exceeds one of the following dimensions, a Route Inspection must be requested and certified prior to the permit being issued.

- Width – 20'
- Height – 18'11"
- Length – 125'

Houston's geographical location relative to its hinterland connections is favourable, as many different routes can lead to the same destination. In case of clearance constraints for oversized loads, an alternative route is likely to exist.

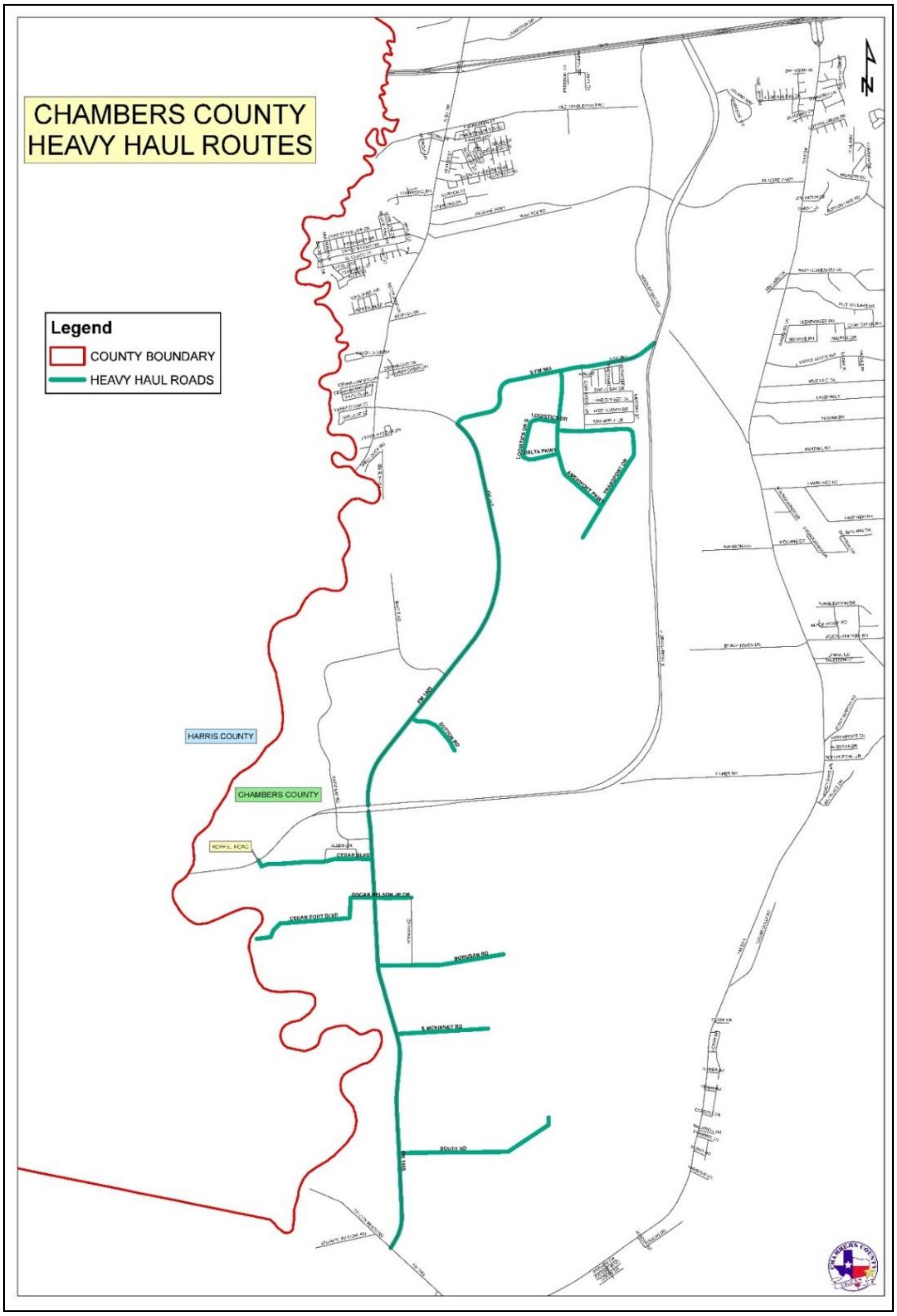
Chambers County

Chambers County allows shippers to order specialized overweight permits designed to service the Chambers County Public Dock.[109] The permits cover travel over the Chambers County roads listed below for vehicles weighing no more than 100,000 pounds:

- FM South 565 from State Hwy 99 (Grand Parkway) to FM 1405.
- FM 1405 from FM South 565 to FM 2354.
- FM 2354 (short distance 300 feet West of FM 1405).

The gross weight of cargo and equipment shall not exceed the allowable axle load or 100,000 pounds, whichever is less, and the dimensions of the load and vehicle shall not exceed 12' wide, 16' high, or 110' long. The permit allows overweight vehicles 24 hours a day, but oversized vehicles only during daylight hours.

[109] https://texas.promiles.com/chambers/Default.aspx



Source: Chambers County

Figure 3-60. Heavy Haul Routes in Chambers County

3.13 Summary

The Houston area and the surrounding Gulf Coast region continues to experience some of the largest economic growth occurring in the United States today. Higher than average population growth coupled with increasing economic activity and port development across the region has led to an overall increase in transportation demand, as well as a need for expanded transportation options among freight shippers and manufacturers in the area. Road transportation has played an important role in meeting the freight transportation needs of the Houston region and continues to do so.

TxDOT in cooperation with various stakeholders and Texas Freight Advisory Committee, developed a Texas Freight Mobility Plan, which identifies and prioritizes projects on the Texas Highway Freight Network. In addition, H-GAC has developed a Regional Transportation Plan in cooperation with the regional Ports and various counties to develop a list of infrastructure projects that are critical for the regional development and support freight growth. The primary challenges associated with implementing the projects listed on these state and regional documents include limited funding and the time taken to plan, design and construct such projects. While limited funding allows only a fraction of projects to be built, the existing conditions on remaining roadways exacerbates causing additional delays and costs to the shippers, trucking companies and the industries. Similarly, the amount of time taken to plan a project, design it, acquire right-of-way, relocate utilities and finish construction could take up to a number of years, causing economic disadvantage to the port related industries and thus to the region as a whole.

TxDOT is currently working on Planning and Environmental Linkage (PEL) Studies for SH 225 corridor and for I-10 East from I-69 to SH 99. TxDOT is also in the planning stages of expanding SH 36 from US 59 in Fort Bend County to FM 1495 in Brazoria County. Other major regional projects such as North Houston Highway Improvement Project (NHHIP), remaining Segments of Grand Parkway (SH 99) and I-69 Bypass will directly benefit the freight movement in the Houston region. However, very few of these projects are expected to be built in the next ten years while the rest are expected to be built beyond ten years. The rate of population, employment and thus freight growth is substantially ahead of the infrastructure projects in the region, thus posing a great risk to the economic growth and development.

The infrastructure projects required to serve the last mile connections to the ports and industries are often sidelined in order to serve greater demands associated with the non-freight traffic and flooding issues encountered by Houston in the recent years. Since Houston’s economic growth and prosperity is predominantly dependent on the port related industries, freight movement should be given equal importance in the project selection process.

4 Rail

4.1 Key Findings

- Railroad operations are firmly integrated into the region's local manufacturing, shipping, and logistics supply chains, with approximately 2,200 trains per week operating within the Houston region rail network.
- The HGAC region is served by three Class I railroads – the Union Pacific Railroad (UP), the BNSF Railway (BNSF), and the Kansas City Southern Railway (KCS)
- The majority of the main lines in the Houston region are owned and operated by two railroad companies: UP and BNSF. Other railroads, including KCS and Amtrak serve the area by operating on trackage rights as tenants of UP and/or BNSF
- Depending on customer location, rail service at the Port of Houston is provided by one of three rail carriers; UP, BNSF, and/or the PTRA.
- The majority of the rail-served industries on both sides of the Houston Ship Channel are served by the Port Terminal Railroad Association (PTRA), a terminal switching railroad. Its members include the Port of Houston Authority, UP, BNSF, and KCS. With 154 miles of track and seven serving yards, the PTRA serves 226 local customers on behalf of its association members.
- The Port of Texas City is served by the Texas City Terminal Railway (TCT), which is jointly owned by UP and BNSF. Handling over 25,000 carloads per year, the terminal switch carrier operates over 32 miles of yard and track including connections to both of its Class I owners.
- The Port of Galveston is served by the Galveston Railroad (GVSR). The City of Galveston owns the railroad and leases it to Genesee & Wyoming, the largest short line and regional railroad holding company in North America. The terminal switch carrier operates more than 39 miles of yard and industrial track and interchanges with both UP and BNSF in Galveston.
- The core rail network surrounding downtown Houston not only serves the needs of the port and its customers, but also includes the primary main line thoroughfares for the Class I railroads, including Amtrak passenger service. Approximately one-third of the tonnage moving on trains through Houston has been identified as "overhead" traffic that is passing through the region.
- The Houston region has approximately 1,200 public at-grade railroad crossings. Projects that construct grade separations and/or closures of public crossings provide safety and transit benefits to the general public, and also create additional operational flexibility and capacity for the railroads.

4.2 Introduction

This chapter provides an overview of the freight railroad network within the Houston-Galveston Area Council's (H-GAC) region, including rail service to the region's four ports located at Houston, Galveston, Texas City, and Freeport. This chapter focuses specifically on describing at a high-level existing rail conditions in the region and discussing how rail supports goods movement to and from ports in the Houston region. Future phases of the study will identify future growth at the region's ports

Houston is served by several large, national freight railroads, with routes that extend in every direction. The rail lines within the region itself form a network that ties numerous main lines, railroad yards, industrial spurs, and port facilities to the rest of the North American rail network. Many of Houston's rail lines were initially conceived to meet regional transportation needs. However, as corporate mergers absorbed regional railroad systems into common networks that spanned the entire western United States, and rail traffic itself began shifting toward longer, transcontinental flows, the railroad infrastructure in the City of Houston began handling larger shares of traffic moving through Houston headed to and from other places, in addition to shipments destined to and from the region itself. Railroad operations are firmly integrated into the local manufacturing, shipping, and logistics supply chains, with approximately 2,200 trains per week operating within the Houston region rail network[110] (see Figure 4-1). The freight railroad companies that serve the Houston region have spent substantial sums of money on capacity improvements in the region to enable rail lines to handle both originating/terminating rail traffic and through shipments.

[110] http://www.houston.org/newgen/11_Transportation-Facilities_and_Movements/11G%20W001%20Rail%20System%20-%20Freight.pdf

Source: Texas State Railroad Map 2016

Figure 4-1. Regional Rail Lines

4.3 Railroad Industry Background

Railroads in the United States can transport just about any type of commodity or product, and the U.S. economy depends on the productive and efficient freight railroad network that has been established. American railroads transport 16 percent of all freight by weight (in tons) transported in the U.S. and 40 percent of all-ton-miles (weight plus distance) of freight transported in the U.S.[111] The difference between weight and ton-miles moved illustrates the advantage that freight railroads have regarding their ability to move large volumes of goods and materials long distances efficiently and cost-effectively. The U.S. freight rail network stretches 140,000 miles from coast to coast and has multiple strategic connections with railroads in neighboring countries of Canada and Mexico.

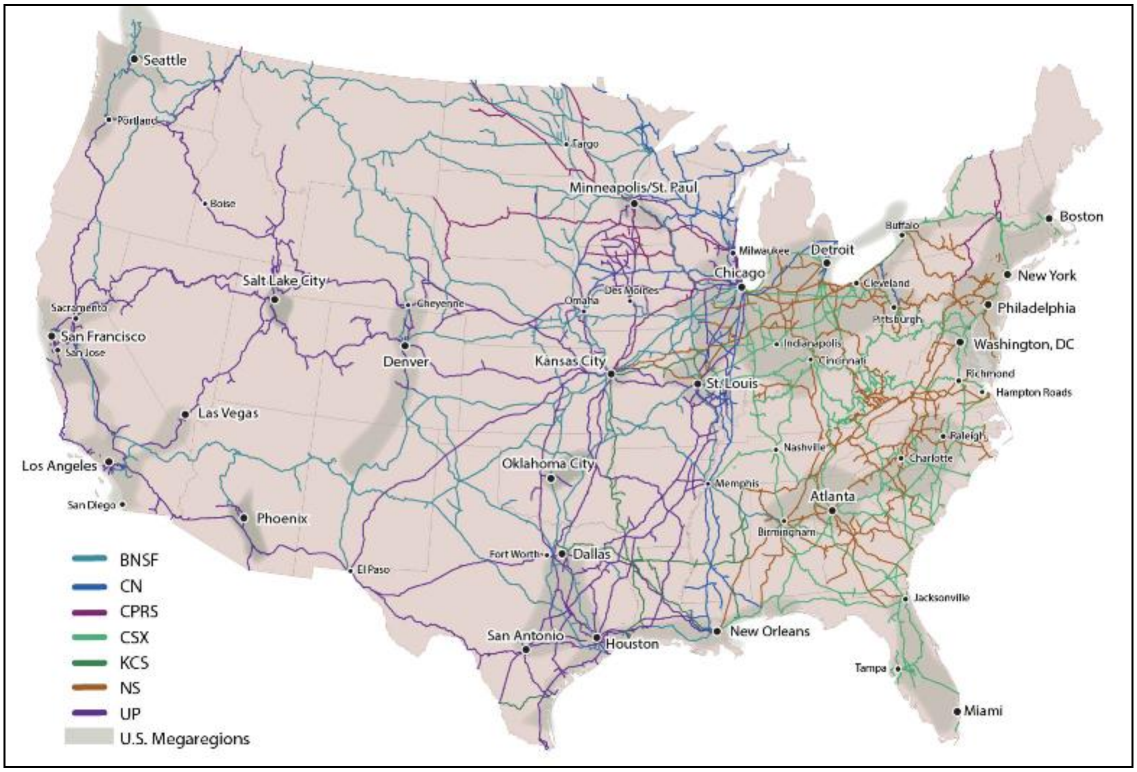
U.S. freight railroads are privately owned and operated as for-profit corporations, with only a few exceptions. Collectively, the freight rail industry generated almost $70 billion in revenue in 2016. Although there are nearly 600 freight railroads in the United States, the majority of the track miles, revenue, and ton-miles are generated by the seven largest railroads in the country, which are classified by the Surface Transportation Board as Class I railroads (railroads with 2016 revenue of $447.6 million or more).[112] According to the Association of American Railroads (AAR), the seven Class I railroads in the U.S. collectively account for approximately 69 percent of all U.S. freight rail mileage, 90 percent of U.S. freight rail employees, and 94 percent of U.S. freight rail revenues.[113] Each of the seven Class I railroads own and operate their own independent networks, but freely exchange freight traffic with each other to afford national access to shippers and receivers located on any railroad. In many locations, the Class I railroads will share the same infrastructure under contractual agreements. Railroads with lesser revenue are defined as “regional” (Class II) or “short line” (Class III) railroads. Regional and short line railroads are generally traffic-gathering and delivering lines for the Class I railroads, as most railroad carloads move long distances. Regional and short line railroads have localized operations confined to specific cities, states, or regions, in contrast to the network of the Class I railroads, which span up to half the country.

Figure 4-2 shows the lines of the current U.S. rail network operated by the seven Class I railroads. Houston is served by two Class I railroads that own track in the city—Union Pacific Railroad (UP) and BNSF Railway (BNSF)—and is also served by a third Class I railroad, Kansas City Southern Railway (KCS), which accesses the city using trackage rights. (Trackage rights are rights granted for a tenant-railroad to operate trains on an owner-railroad’s tracks.) Amtrak, the U.S. government’s passenger-operating railroad, operates in most locations as a tenant on the rail lines of the freight railroad carriers, including through the City of Houston.

[111] https://www.fra.dot.gov/Page/P0362

[112] https://www.stb.gov/stb/faqs.html

[113] https://www.aar.org/BackgroundPapers/Overview%20of%20America%27s%20Freight%20RRs.pdf



Source: Federal Railroad Administration (https://www.fra.dot.gov/Page/P0362)
(BNSF Railway Company-BNSF; Canadian National Railway-CN; Canadian Pacific Railway-CPRS); CSX Transportation-CSX; Kansas City Southern Railway Company-KCS; Norfolk Southern Railway-NS; Union Pacific Railway-UP)

Figure 4-2. United States Rail Network

American freight railroads play a critical role in the movement of exported and imported goods and products. U.S. railroads received 35 percent of their revenue from international trade in 2014, which represented 42 percent of all railcars and intermodal containers moved that year and 27 percent of all U.S. rail tonnage, according to the AAR.[114] Freight rail traffic in the U.S. can be divided into two basic types: bulk carload traffic, in which the freight is loaded directly into a railcar that moves from origin to destination, or intermodal traffic, in which the freight is loaded into a shipping container or truck trailer, which is then moved by various modes of transportation (rail, truck, ship) to transport the container or trailer from one place to another. The freight itself is typically moved as part of a supply chain that will require packaging or repackaging of products from one container to another at warehouses or logistics centers located at various points between the origin and final destination of the product.

Almost all of the freight rail traffic that arrives and departs the Houston region's ports, freight yards, and rail customer facilities, will make a rail journey of several hundred to several thousand miles. Large-volume rail shipments of a single bulk commodity such as grain, fertilizer, or energy products are typically transported in unit trains, which are single-commodity trains that cycle between a loading point (such as a grain elevator) and

[114] https://www.aar.org/BackgroundPapers/Overview%20of%20America%27s%20Freight%20RRs.pdf

unloading point (such as an export pier), with no intermediate stops required to set out or pick up other cars. Smaller volumes shipments may move in containers on dedicated intermodal trains, or within individual carloads on mixed manifest trains, both of which can handle many different commodities and include shipments from a variety of different origins moving to any number of destinations across the continent.

4.4 Railroad Network Overview

The network of railroad lines within and surrounding the Houston region was formed from historic predecessor railroads that were originally built to connect Houston with other regional and national industrial and manufacturing centers. Over time, the majority of the predecessor railroads have been merged with, or acquired by, other Class I railroads. Today, the majority of the main lines in the Houston region are owned and operated by two railroad companies: UP and BNSF. Other railroads, including KCS and Amtrak serve the area by operating on trackage rights as tenants of UP and/or BNSF. In addition to the Class I railroads mentioned above, several terminal switching railroads exist in the Houston region. These switch carriers serve the various ports and adjoining industrial customers, interchanging rail traffic with the connecting Class I railroads.

The following section provides a high-level overview of each Class I railroad that operates within the region as well the terminal switching railroads that serve specific ports and industrial areas.

4.4.1 Union Pacific Railroad

The UP network encompasses more than 32,000 route miles in the western two-thirds of the United States (Figure 4-3). Its network covers 23 states and has key connections to Class I railroads in Mexico, Canada, and the eastern U.S. region.

Source: Union Pacific Railroad 2017

Figure 4-3. Union Pacific Railroad Network Map

UP has the largest presence of all the Class I railroads operating within the region. The Houston area is a hub for UP lines radiating from the Texas Gulf Coast, linking the region by rail to the West Coast, Midwest, Louisiana Gulf Coast, and Mexico. UP's network of rail lines in the region is made up of many predecessor railroads that the UP has acquired or merged with, the most recent being the Southern Pacific Railroad (SP), which merged with UP in 1996. Although Houston generates a significant amount of rail traffic of all kinds for UP, the railroad also operates trains that pass through Houston while moving to and from other regions of the continent.

UP serves three intermodal terminals in the region, two in northeast Houston and one serving Port Houston. UP's Houston (Settegast) intermodal terminal is located on Kirkpatrick Boulevard off of I-610 and handles both truck trailers and containers, while the Englewood intermodal terminal is located on Wallisville Road north of I-10 and handles only containers. UP also serves the Barbours Cut intermodal ramp at Port Houston. In addition to operating numerous local freight yards that serve as the base for local freight trains to switch area manufacturers and other shippers, UP also operates a large freight car classification yard in Houston. This yard receives and originates manifest freight trains with a mix of commodities destined to and from cities across the Western U.S., sorting freight cars that originate and terminate in Houston as well as cars passing through, to and from more distant locations.

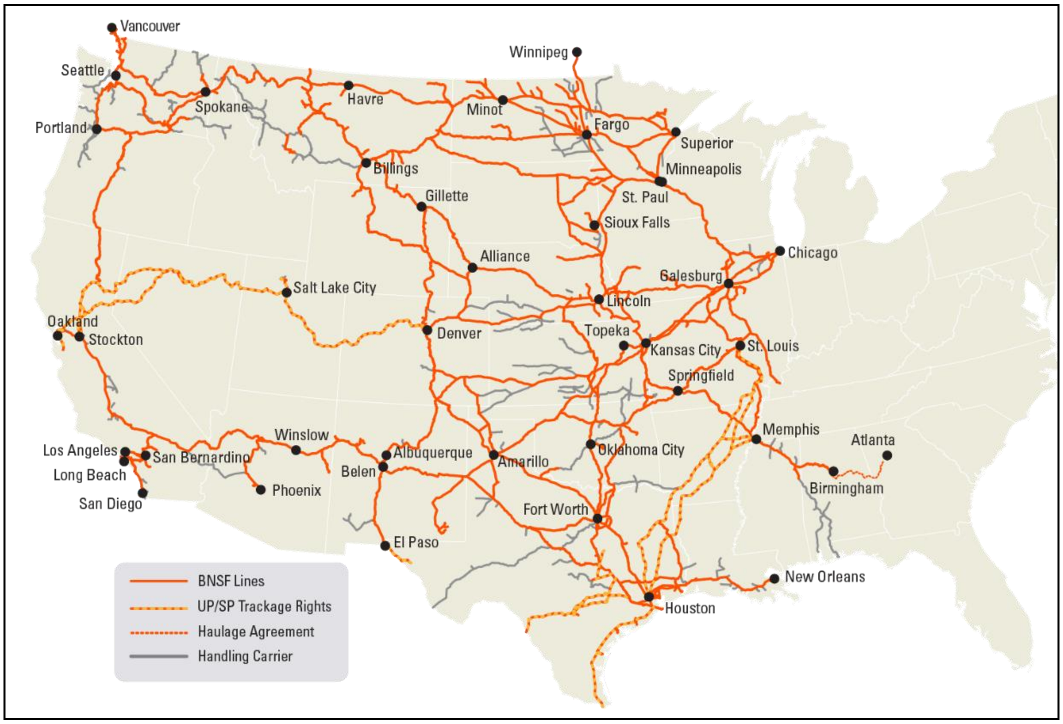
As a result of the many mergers and acquisitions over the years, UP now has many different rail yards and industrial spurs across the Houston region. Because UP controls the majority of the rail routes through the City of Houston, many other railroads operate over UP's lines on trackage rights including BNSF, KCS, the Port Terminal Railroad Association (PTRA), and Amtrak.

Union Pacific's most recent fact sheet about Texas notes that since 2013, UP has invested more than $3.6 billion in capital projects to expand rail capacity and enhance operations across the state.[115] These projects include the construction of 14 miles of double mainline track on the west side of Houston, as well as the construction or extension of dozens of miles of siding tracks across the state. The fact sheet also notes that the $550 million Brazos Yard project, described above, is the largest capital investment in a single facility in Union Pacific's 155-year history. In March 2018, UP announced that it would invest $450 million this year in the maintenance and expansion of its Texas rail infrastructure and facilities, representing about 14 percent of UP's total 2018 capital program.

4.4.2 BNSF Railway

The BNSF network stretches over 32,500 route miles, covering 28 states and 3 Canadian Provinces. The BNSF network exists primarily within the western United States but provides connections to all U.S. and Canadian Class I railroads, in addition to several Mexican rail gateways (see Figure 4-4).

[115] https://www.up.com/cs/groups/public/@uprr/@corprel/documents/up_pdf_nativedocs/pdf_texas_usguide.pdf



Source: BNSF Railway 2017

Figure 4-4. BNSF Railway Network Map

BNSF has a significant presence in the region, operating primarily on trackage rights over UP through the City of Houston, although it owns lines that extend north to Dallas-Fort Worth (DFW), northwest to Amarillo, and south to Galveston. The majority of BNSF's trackage rights were gained during the 1996 UP-SP merger. Trackage rights on the Port Terminal Railroad Association also provide BNSF access to various customers and industrial railways in the Houston region. The BNSF network and connections tie together its Texas Gulf Coast trackage with the Louisiana Gulf Coast, Midwest, northern states, West Coast, and Mexico.

Houston is a significant traffic generating hub for BNSF. Trains moving between the West Coast and Gulf Coast and trains moving between the central U.S. and South Texas or Mexico pass through the Houston region. BNSF operates a Houston-area intermodal facility and adjacent automotive ramp on Brisbane Road by the William P. Hobby Airport. In addition, BNSF intermodal trains service the Barbours Cut intermodal rail ramp at Port Houston.

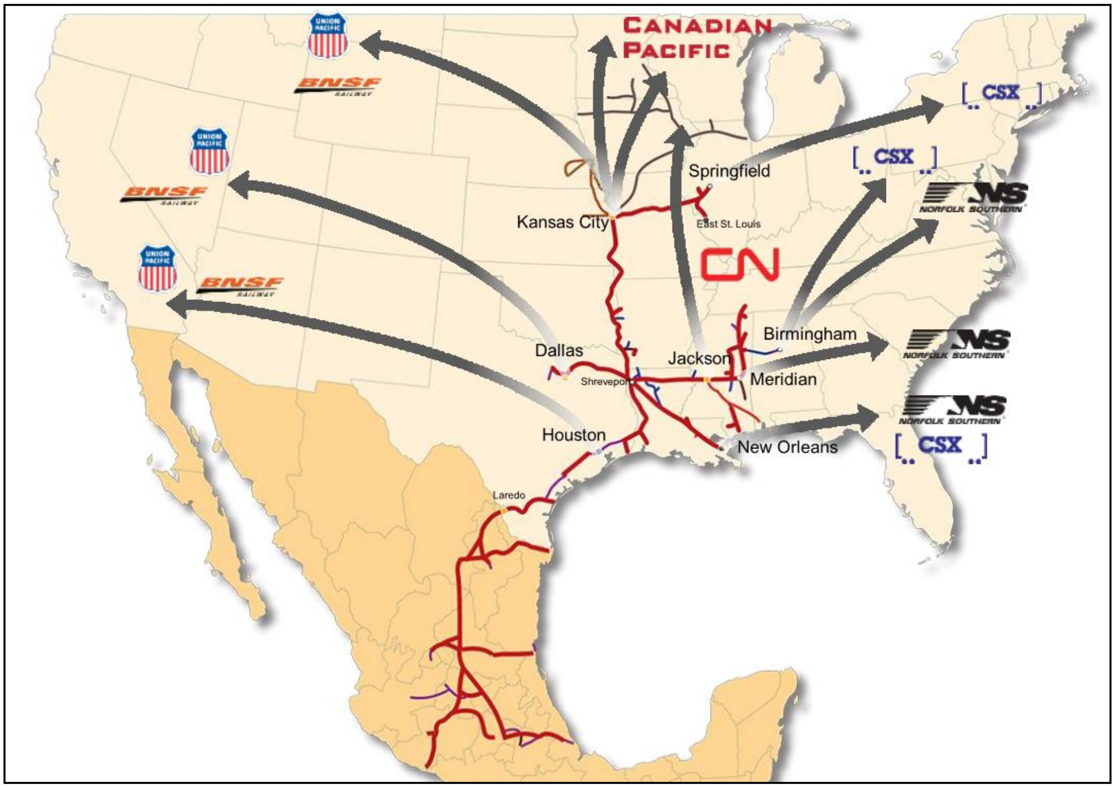
BNSF Railway has invested nearly $1.8 billion over the past five years in the expansion and maintenance of its rail lines in Texas, according to a recent capital spending announcement released by the railroad[116]. In 2018, BNSF stated it will commit $375 million for maintenance and expansion projects in Texas, representing more than 11 percent of its total 2018 capital program. The announcements states that nearly half the amount earmarked for Texas rail infrastructure will go to maintenance, and the other half to capacity expansion projects, including a project in the Houston area to construct a new

[116] http://www.bnsf.com/news-media/news-releases/BNSF-plans-$375-million-capital-program-in-Texas-for-2018.html

connection and siding in Dobbin, on the Conroe Subdivision, that will improve train operations between Houston and Dallas-Fort Worth.

4.4.3 Kansas City Southern Railway

With more than 6,600 miles of track in the U.S. and Mexico, KCS operates a north-south rail corridor within North America. Through its 181 interchange points with other railroads, KCS has connections to all U.S., Canadian, and Mexican Class I railroads (see Figure 4-5).



Source: KCS Investor Relations General Book 2017

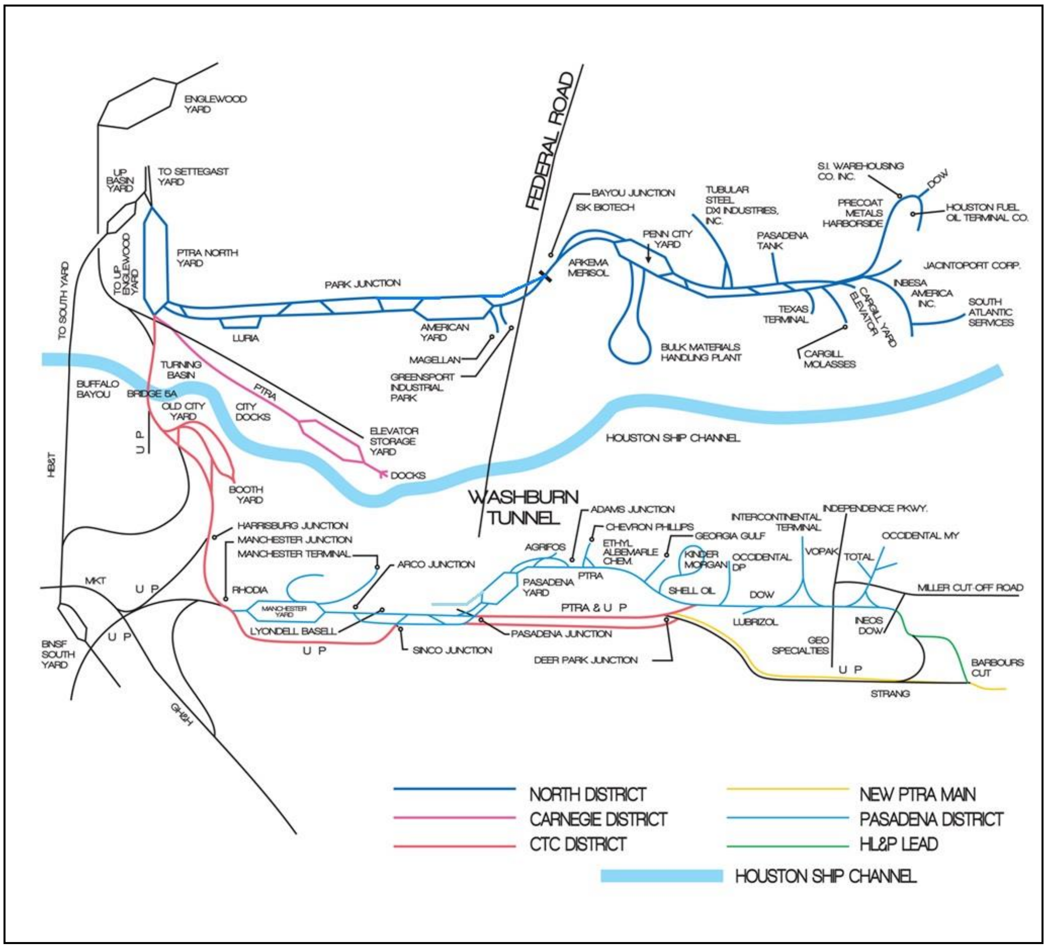
Figure 4-5. KCS Railway Network Map

Kansas City Southern's main line between the Midwest/South Central regions of the U.S. and Mexico passes through Houston. KCS owns no trackage in the city itself, instead operating on UP trackage rights, from as far east as Beaumont (where a connection exists with KCS's main U.S. north-south artery) through Houston and west to Rosenberg, Texas, where KCS-owned trackage begins again headed south to Victoria, Texas. Through additional trackage rights plus connecting trackage it acquired with its purchase of the Texas Mexican Railway, the KCS system extends south from Houston to the Mexican border at Laredo, where it connects to its Mexican affiliate, Kansas City Southern de Mexico (KCSM).

As a result, KCS operations in Houston consist mostly of run-through trains moving between the U.S. and Mexico that do not serve local customers, except in some cases for Houston-area traffic destined to and from Mexico. However, in Kendleton, KCS operates an intermodal terminal and automotive ramp that serves the Houston region. Occupying 185 acres, the Kendleton terminal has 10,000 feet of working track for intermodal traffic and a lift capacity of 152,400 units per year, as well as 5,000 feet of working track for automotive traffic. Between 2014 and 2016, activity at the terminal averaged approximately 29,000 intermodal lifts and 30,000 finished vehicles handled per year.

4.4.4 Port Terminal Railroad Association

The majority of the rail-served industries on both sides of the Houston Ship Channel are served by the Port Terminal Railroad Association (PTRA), a terminal switching railroad (see Figure 4-6). The PTRA was formed in 1924 to provide the railroads of Houston access to industries along the ship channel. Today, its members include the Port of Houston Authority, UP, BNSF, and KCS.



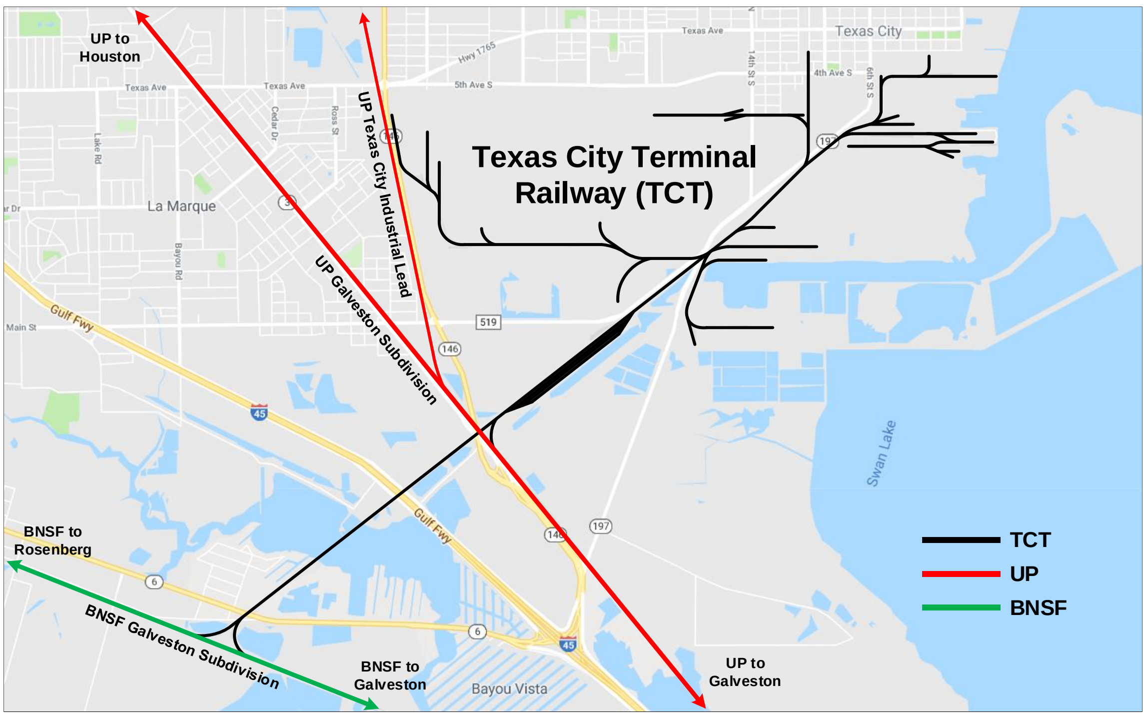
Source: Port Terminal Railroad Association 2017

Figure 4-6. Port Terminal Railroad Association Network Map

With 154 miles of track and seven serving yards, the PTRA serves 226 local customers on behalf of its association members[117]. The PTRA interchanges seven days per week with both the UP and BNSF at both its North and Pasadena Yards. It also interchanges with the KCS (Mexican traffic only) at North Yard five days per week (Monday to Friday). Through its Class I connections, PTRA customers have access to the entire North American rail network.

4.4.5 Texas City Terminal Railway

The Port of Texas City is served by the Texas City Terminal Railway (TCT), which is jointly owned by UP and BNSF. Handling over 25,000 carloads per year[118], the terminal switch carrier operates over 32 miles of yard and industrial track including connections to both of its Class I owners (Figure 4-7).



Source: Google Maps 2017

Figure 4-7. Texas City Terminal Railway Map

4.4.6 Galveston Railroad

The Port of Galveston is served by the Galveston Railroad (GVSR). The City of Galveston owns the railroad and leases it to Genesee & Wyoming, the largest short line and regional railroad holding company in North America. The terminal switch carrier operates more than 39 miles of yard and industrial track and interchanges with both UP and BNSF in Galveston (Figure 4-8).

117 http://www.ptra.com/

118 http://tctrr.com/

Source: Galveston Railroad 2014

Figure 4-8. Galveston Railroad Map

4.5 Port Railroad Operations and Infrastructure

4.5.1 Port of Houston

Depending on customer location, rail service at the Port of Houston is provided by one of three rail carriers; UP, BNSF, and/or the PTRA. The PTRA serves the majority of the customers on either side of the Houston Ship Channel, while UP and BNSF serve the rest of the Port's customers directly. All three rail carriers have established local rail operations to serve customers at the Port including several switching yards and storage in transit (SIT) yards outside the Port area in the surrounding region.

In recent years, the PTRA has made investments to add rail corridor capacity to its lines on both sides of the Houston Ship Channel. In order to maximize rail throughput while still allowing time for switching customers and maintaining track, the PTRA has implemented several rail capacity projects at the Port over the last few years including:

1. **Pasadena Yard - Run Through Track:** A new bypass track on the south side of Pasadena Yard was constructed primarily dedicated to allow trains to operate through Pasadena Yard. The run through track increases fluidity of train movements and minimizes interruption to yard operations from run through trains operating through the yard.
2. **Pasadena Yard - Independent Switching Lead:** A dedicated switching lead was constructed at the west end of Pasadena Yard. This dedicated switching lead allows switching operations to continue uninterrupted at Pasadena Yard as other train movements arrive, depart, or utilize the bypass track to operate through the rail terminal.
3. **North District - Double Track Project:** Additional double track was installed on the north side of the Shipping Channel. The existing double track was extended eastward from Federal Road to Green's Bayou. This project created additional meet/pass capability for train movements in addition to providing a bypass track while switching customers on the west side of the Bayou (including the Greens Port Industrial Park).

The Port of Houston handles more than two-thirds of the U.S. Gulf Coast international container traffic, making it the largest container port on the Gulf of Mexico. Container traffic is handled through the following two container terminals at Port Houston:

1. **Barbours Cut Container Terminal:** Situated on Morgan's Point at the mouth of Galveston Bay in La Porte Texas, the Barbours Cut container terminal provides intermodal rail service via a 42-acre rail ramp adjacent to the terminal. The intermodal facility has four working tracks (each approximately 2,700 feet in length) as well as an additional 12,000 feet of railcar storage in the adjacent five track storage yard. UP, BNSF, and PTRA all have rail access to the facility. In 2018, UP announced it would cease its intermodal rail service linking the container terminal with its facility Dallas.
2. **Bayport Container Terminal:** Located on the south side of the Bayport ship channel, the Bayport Container Terminal is located between the communities of La Porte and Seabrook, Texas. Although not currently served by rail, future development plans include a new rail spur, rail yard, and intermodal facility

adjacent to the container terminal. The rail facility would connect to the UP's Seabrook Industrial Lead, with potential for PTRA and BNSF to have access via new line construction adjacent to UP's industrial lead into the Bayport area.

The Port of Houston also handles a significant amount of carload and bulk traffic both inbound and outbound by rail. Chemicals, resin, and energy products make up a large portion of the rail traffic handled by the Port, driven by the presence of petrochemical complexes in the Houston area and along the Gulf Coast. Other noteworthy commodities handled by Port Houston include grain, coal, forest products, automobiles, minerals and steel. Bulk commodities are typically handled in unit train quantities at the Port, and many customer facilities have loop tracks or similar types of track arrangements capable of handling unit trains intact.

4.5.2 Port of Galveston

Owned by the City of Galveston, the Port of Galveston handles a variety of commodities by rail, including chemical and energy products, grain and feed products, fertilizer, food products, machinery, forest products, and wind generation components.

UP and BNSF jointly operate over a single track causeway and lift bridge spanning the Galveston Bay to access the Port of Galveston. Each Class I rail carrier has its own rail yard on Galveston Island. The majority of the rail customers on the island are served by the Galveston Railroad (GVSR), a 38-mile short line railroad owned by Genesee & Wyoming that provides access for Port of Galveston customers to either Class I rail carrier.

Future growth at the Port of Galveston may be accommodated across the Galveston Channel on Pelican Island (Figure 4-9). In addition to port properties and facilities held by the Port of Galveston, the Port of Houston Authority owns a large green field parcel on Pelican Island for future development. Although there is evidence of railroad tracks across the existing Pelican Island causeway, a newly proposed rail bridge is envisioned to serve any future new developments on Pelican Island. The Galveston County Rural Rail Transportation District was formed in 2012 with the primary purpose of supporting rail development on the island, including a new rail bridge.

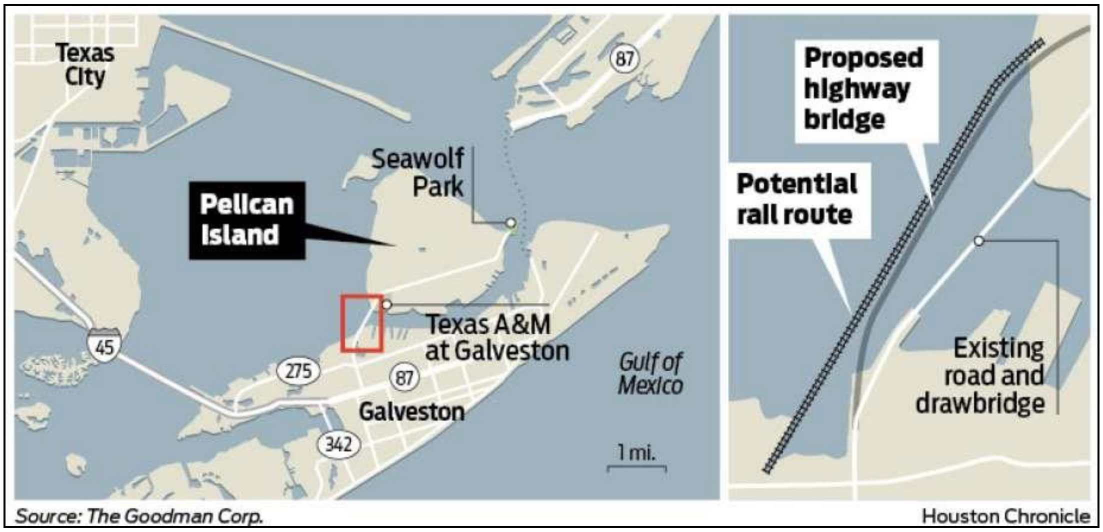


Figure 4-9. Pelican Island Potential Rail Route

4.5.3 Port of Texas City

As the only privately owned port in the state, its shareholders include both the UP and the BNSF. The Texas City Terminal Railway (TCT) is the serving rail carrier for the port and interchanges daily with both of its parent Class I rail carriers.

Almost 100 percent of the Port's traffic is liquid commodities such as crude oil, petroleum products, and chemicals. Much of the port land is occupied by petrochemical facilities, many with rail racks and adjacent railcar storage yards. The lone dry bulk facility at Texas City handles coal and petroleum coke products and is equipped with a rail unloading loop and rotary dumper; however, the dry bulk facility has not been utilized for rail shipments in quite some time.

With direct connections to the UP and BNSF rail networks, waterways, and local pipeline networks, the Port of Texas City has been an attractive location for petrochemical industrial development on the Gulf Coast and continues to see increased investment in existing facilities with several new projects proposed as well. In order to keep up with increased demand for petrochemical traffic and stricter safety regulations, the Texas City Terminal Railway completed a large rail yard expansion project in 2010, including the construction of a new locomotive maintenance shop. The new hazardous material storage yard, south of FM 519, replaced an existing similar sized rail yard that was adjacent to Loop 197 and within the petrochemical complex. Moved approximately one mile to the southwest, the new rail yard is further away from existing petrochemical facilities, is completely fenced in, and includes increased security features to protect railcars awaiting delivery to the local customers on the railway. The site also has space for additional track expansion.

4.5.4 Port of Freeport

Rail service to the Port of Freeport is provided by the UP. The UP's Freeport Industrial Lead stretches 17 miles from the main line and rail yard at Angleton Texas to the Port of Freeport. Several additional spurs branch off the Freeport Industrial Lead, serving the port and other rail customers in the Freeport area. With significant petrochemical industry in the area, including those of Dow Chemical Company's integrated complex (the company's largest integrated site), chemical and energy products make up the vast majority of the rail traffic in and out of the Freeport area. This includes large amounts of resin traffic from several producers in Freeport. Other commodities moved by rail include grain and food products, aggregate, steel and scrap metal, machinery, and wind generation components. The port is also studying a new rail corridor along Highway 36A from Freeport to Rosenberg, along with an integrated intermodal hub in the Rosenberg area.

The Port recently broke ground on Phase 1 of its Parcel 14 Rail Development. The project will develop a 250-acre parcel of land into a multimodal industrial park, which will include new warehousing for distribution centers, plastic resin packing facilities, and cross docking activities. The initial rail component includes a 6,000- foot lead off the existing UP industrial lead at Cherry Street, as well as three ladder tracks, each approximately 5,000 feet in length. The new industrial park will be complementary to the area's petrochemical industry, providing supply chain efficiencies with current and future port tenants. This port rail infrastructure compliments expansion investments being made by other customers in the Port including Dow Chemical Company and Shintech Inc.

4.6 Types of Rail Freight Services

Railroads serving the Houston area carry a diverse mix of commodities to meet the needs of various types of rail shippers operating in the area, including the Port of Houston, regional manufacturing and industrial operations, and distributors supplying consumer goods and products for Houston, the fourth largest city in the United States. Rail is an especially cost-effective and environmentally friendly way of moving large quantities of goods and products over long distances. Many rail cars can hold one hundred tons or more of freight, and each loaded freight car moves the equivalent volume of approximately 3.85 trucks.[119] The length of an average freight train in the United States has grown consistently through the decades, reaching 72.5 cars per train in 2015, according to the Association of American Railroads.[120]

In general terms, railroads offer four different types of rail freight services, each of which are offered using specific types of freight trains. These services are summarized below.in the following subsections.

4.6.1 Intermodal Services

UP, BNSF, and KCS operate daily intermodal trains through the Houston region. These trains carry shipping containers and truck trailers and provide an easy method of transporting products and materials undisturbed while packed inside a container that can be easily transferred between rail and ship or truck. In 2017, 91 percent of all U.S. intermodal shipments were made with containers[121]. Intermodal trains typically carry time-sensitive cargo, often on expedited schedules to compete with trucks. To maximize efficiency, truck and ship containers are stacked two-high on railroad flatcars. The most common container types used in ship/rail/truck shipments of export and import products are 20 feet long, 40 feet long, or 45 feet long, whereas the most common container types used in the movement of North American (domestic) intermodal shipments are 53 feet long and 48 feet long. UP, BNSF, and KCS each operate their own intermodal terminals in the Houston area.

Despite increased container volume through the Port of Houston, UP will terminate the once a week intermodal rail service between Barbours Cut and Dallas ending on April 26th, 2019. The rail route took three days to reach Dallas. According to the Journal of Commerce, the service was eliminated due to low volumes and it wasn’t conducive to the railroad’s precision scheduling railroading program, which seeks to remove low yielding routes and deploy assets to busier routes.

All three railroads operate intermodal trains between Houston and cities in the U.S. Midwest, Southwest, West, and Mexico. Intermodal services also include the movement of finished automobiles moving from auto assembly plants and import docks to unloading ramps for distribution to area dealerships or ports for export overseas.

---

[119] http://business.tenntom.org/why-use-the-waterway/shipping-comparisons/

[120] Association of American Railroads, “Railroad Facts 2016 Edition”

[121] Association of American Railroads. “Rail Time Indicators – January 5, 2018”

4.6.2 Manifest Train Services

Manifest trains carry multiple goods and commodities in individual carloads for multiple shippers between multiple origin and destination pairs. These carloads are batched together in a manifest train for movement between rail yards, where the cars will then be sorted and re-blocked with other cars headed for a common destination. This method of transportation leverages railroading's cost-efficient ability to move large quantities of freight in one train. Manifest trains carry a variety of commodities, including plastic products, food products, lumber, metals, chemicals, auto parts, paper products, waste, and scrap using different car types, such as boxcars, gondolas, tank cars, covered hopper cars, and other specialized rail equipment. Most manifest traffic moves door-to-door, although customers without direct rail access or who need less-than-carload quantities will use transload facilities, where products can be transferred from railcars to trucks for further shipment. Manifest trains are usually classified (i.e., sorted) at originating and terminating yards and may set out or pick up cars at intermediate yards en route. UP and BNSF operate several daily scheduled manifest trains to and from Houston between major yards in the Western U.S., Southwest, Gulf Coast, Midwest, and Mexico, as well as the Eastern U.S. via connections with Eastern railroads.

4.6.3 Bulk Freight Train Services

Bulk freight trains, often called unit trains, carry one single commodity and generally originate, operate, and terminate as intact train sets between one shipper and one receiver. Bulk trains do not require intermediate switching en route. Bulk freight trains operating in the Houston region corridor carry coal, grain, rock, crude oil, ethanol, frac sand, and other commodities. Unit train commodities operating to and from the Port of Houston include grain, ethanol, petroleum coke, coal, rock, and windmill components.

4.6.4 Local Freight Train Services

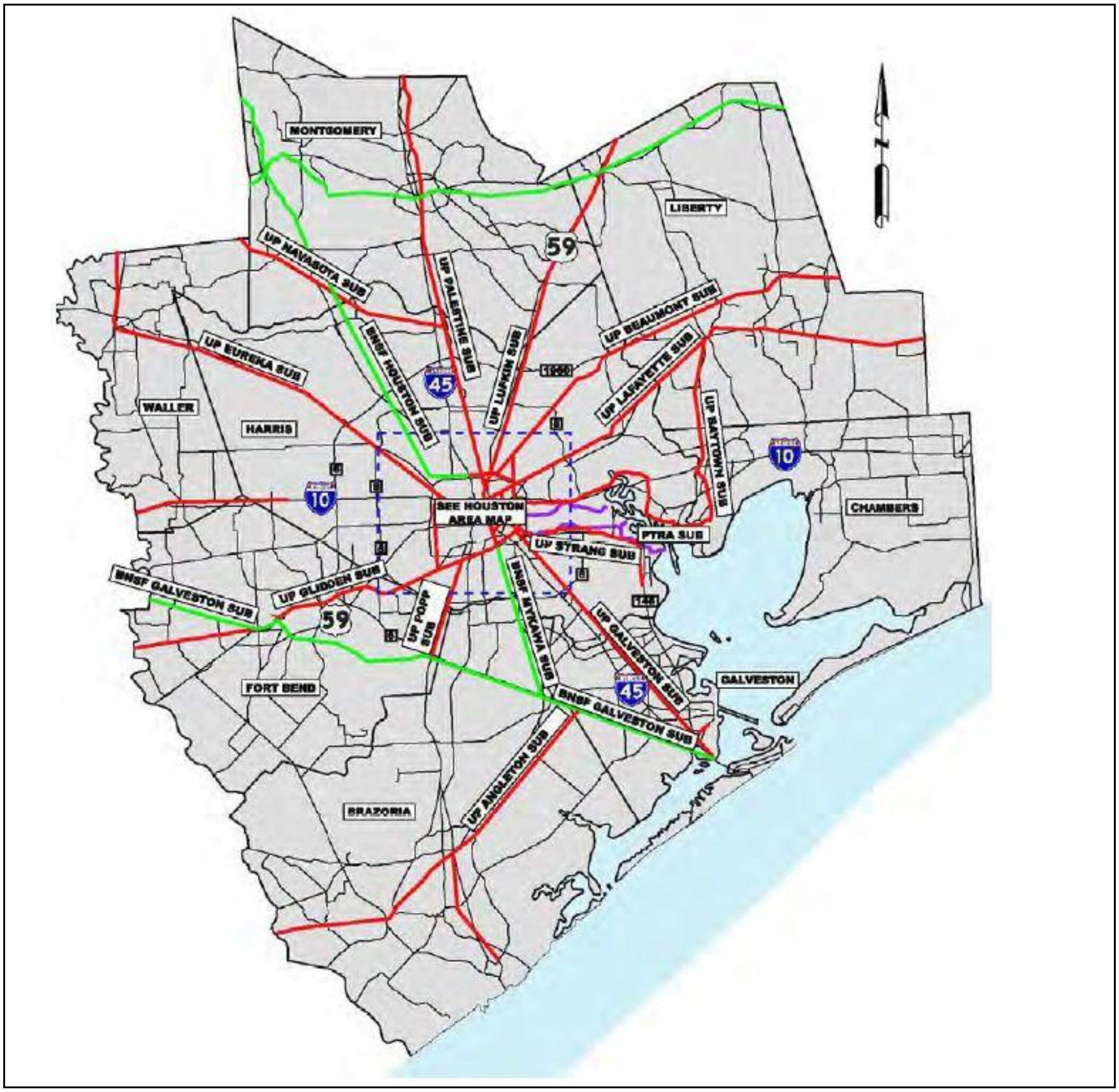
Local freight trains pick up and drop off cars at businesses, bulk transfer facilities, industrial parks, ports, and other locations requiring rail service. Local freight trains are based out of rail yards, where the cars for local customers are picked up, or set out by long-haul manifest freight trains. Local freight trains usually operate on schedules designed to meet individual customer needs and requirements.

4.7 General Trends and Challenges Affecting Rail Infrastructure in Houston

The Houston regional rail network's infrastructure, operational methods and practices, and railway traffic have changed in response to industrial growth, change in industrial methods and activities, population growth, shifts in logistics and supply chains, and railway economic regulation that allowed mergers, acquisitions, and line sales to occur.

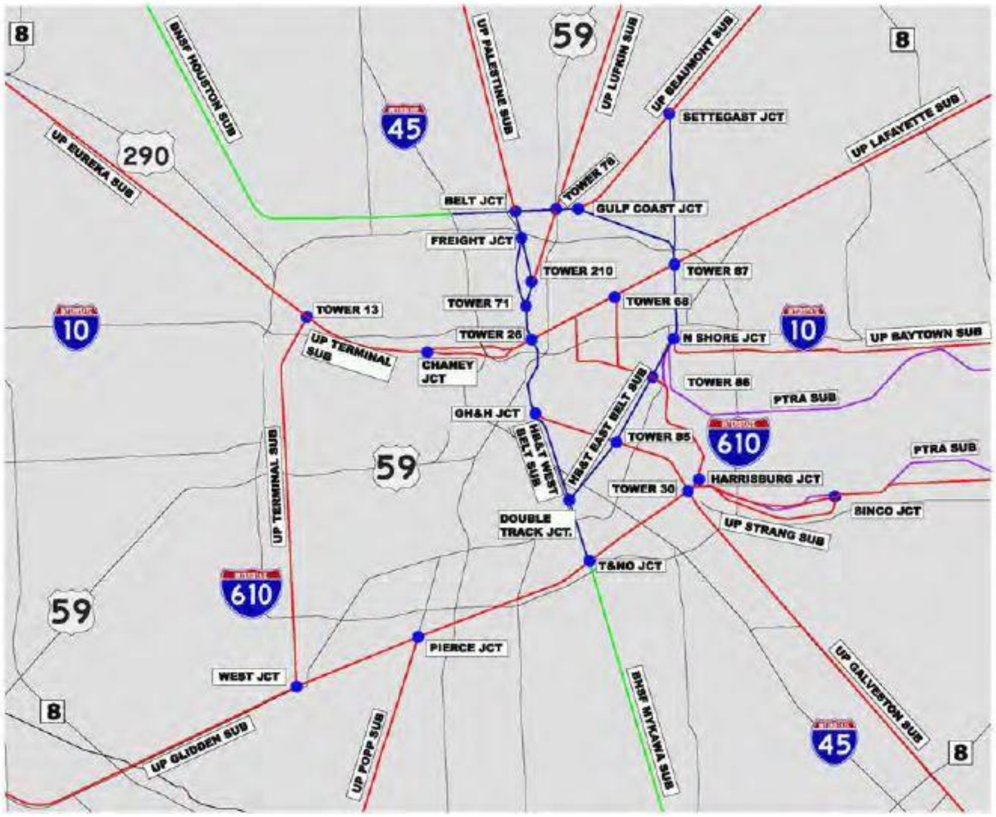
4.7.1 At-Grade Rail Junctions and Single-Track Main Lines

More than 300 trains a day traverse the railroad network of the Houston area, moving to, from, or between 14 different railroad lines linking Houston with other cities, according to the Greater Houston Partnership Research. The railroad network in the Houston region consists of about 1,000 track-miles, including main line tracks, passing sidings, connecting tracks, yard tracks, and industrial tracks. Figure 6-1 shows the rail lines radiating from the Houston area, identified by railroad and subdivision. Figure 6-2 shows the rail lines by subdivision within the Houston area.



Source: Texas Department of Transportation

Figure 4-10. Rail Lines Leading to Houston



Source: Texas Department of Transportation and Port Terminal Railroad Association

Figure 4-11. Rail Lines within the Houston Area

As can be seen in the illustration above, central Houston is ringed by a railroad inner belt line (formed by UP's East Belt Subdivision and West Belt Subdivision) and an outer belt line (UP's Terminal Subdivision, since renamed the Strang Subdivision), from which railroad main lines diverge in all directions. The major diverging points are identified in the figure above by their junction names.

However, unlike a highway interchange where dedicated lanes separate the merging traffic from through traffic without interference or interruption from vehicles traveling the opposite direction, the railroad junctions of Houston are at ground level, and are designed more like three-way or four-way street intersections. Rail traffic merging to or from the belt lines may have to stop and wait for other rail traffic continuing around the belt lines to pass.

In addition, many of the railroad lines merging into the belt lines, and portions of the Terminal Subdivision, have only one main line track, a condition similar to a one-lane road. Rail traffic cannot move in two directions simultaneously on a single-track railroad. Instead, trains moving one direction must pull into passing sidings to stop and wait for opposing traffic on the single-track main line to pass before resuming their journey. In Houston, trains may also stop and wait on the double-track segments of the belt lines for oncoming trains to move off the single-track main lines.

4.7.2 Track Capacity for Main Line Movements and Switching Activities

The core rail network surrounding downtown Houston not only serves the needs of the port and its customers, but also includes the primary main line thoroughfares for the Class I railroads, including Amtrak passenger service. Approximately one-third of the tonnage moving on trains through Houston has been identified as “overhead” traffic that is moving through the city on a longer journey from a distant originating point to a distant terminating point, according to the 2007 Texas DOT “Houston Region Freight Study.” Trains with overhead traffic, trains destined to and from Houston-area rail terminals, and local freight trains switching customers share the same tracks in the Houston area.

Railroad switching requires train movements to operate at slow speeds, generally less than 10 miles per hour. As a result, switching activities consume more track capacity than main line train operations. When possible, as space and surrounding conditions permit, railroads will look for ways to segregate switching operations on tracks separate from main line tracks in order to expedite main line train movements while also providing uninterrupted opportunity for switching yards and customers.

4.7.3 Replacing Grade Crossings with Grade Separations

The Houston region has approximately 1,200 public at-grade railroad crossings. Projects that construct grade separations and/or closures of public crossings (with road traffic redirected to a grade separation or an improved at-grade crossing nearby) provide safety and transit benefits to the general public, and also create additional operational flexibility and capacity for the railroads. Minimizing the interaction between railroad traffic and roadway traffic also can open up opportunities for industry expansion as well as new opportunities for train staging and progression. One project proposed for the Houston area, along the West Belt Subdivision, would include several new grade separations and crossing closures. Under discussion between the various stakeholders, the proposed locations for new grade separations include Lyons Avenue, Commerce Street/Navigation Boulevard, and York Street. Public benefits of the project, as currently proposed, would include improved safety and emergency response time, reduced delays and emissions at crossings, as well as creation of a quiet zone (no whistling at crossings).

4.7.4 Use of Directional Running to Create Capacity and Improve Operations

UP and BNSF have established directional running on parallel lines to improve capacity and velocity in the Houston region. The table below summarizes the major rail traffic lanes serving the Houston.

Table 4-1. Major Traffic Lanes Serving Houston

Traffic Lane	Railroad
East to Louisiana	UP, BNSF, KCS, Amtrak
North to Arkansas/Chicago	UP, BNSF
North to Dallas-Fort Worth/Chicago	UP, BNSF
West to Lubbock/California	BNSF
West to El Paso/California	UP, Amtrak
Southeast to Galveston	UP, BNSF
South to Corpus Christi/Brownsville	UP, BNSF, KCS
Southwest to Mexico rail gateways (Laredo, Eagle Pass)	UP, BNSF, KCS

Lines used for directional running are not always able to be exclusively one-way routes, however. Trains will move against the primary flow of traffic as required, most commonly passenger trains, local trains, or unit trains destined to and from a loading or unloading facility such as a grain elevator or electric generating station. On some routes, including UP's lines between Houston and New Orleans and BNSF's line between Fort Worth and Galveston, directional traffic flows are overlaid on lines that also have a fair amount of two-way traffic.

4.8 Summary

Railroads play a significant role in supporting the region's port related commerce. The majority of port related movements are associated with dry bulk, energy and petrochemical commodities. The Class 1 Railroads, predominately UP and BNSF, work with the various port switching railroads to ensure products are moved to and from the ports and their respective customers.

The railroads operate in the commercial sector and are responsible for investing in their infrastructure. Since 2013, UP has invested more than $3.6 billion in capital projects to expand rail capacity and enhance operations across the state. This investment is funded by revenue from operations, which also has to support operating costs and returns to shareholders. If particular operations are not generating sufficient revenue or return, then they may be cancelled. This was the case with the UP service operating from the Bayport container terminal to Dallas, which was cancelled in 2019 with the railroad citing relatively low volumes.

5 Barge and Short Sea Shipping

5.1 Key Findings

- Domestic marine transportation is an integral part of the nation's freight transportation system and in particular for those supply chains that depend upon the movement of bulk commodities.
- Benefits of shipping over water are the reductions in trucks on the highways, pavement damage, and greenhouse gas emissions.
- H-GAC's ports are served by the Marine Highway Network and the Gulf Intracoastal Waterway (GIWW) serving as a critical link between the deep draft and shallow draft ports while providing an interstate link for commodities transported in and out of the state.
- Approximately half the vessels that move on the GIWW between Sabine River and Galveston, originate from or terminate their trips in the Houston region, which based on 2016 USACE statistic is approximately 15,000 vessel trips each way per annum.
- In 2016, Galveston had the highest share amongst the region's ports of cargoes carried to and from inland waterways and intra-port shipping of 34.3 percent of its cargoes. This was followed by the Houston Ship Channel at 29.9 percent, Texas City at 27.3 percent and Freeport at 22.4 percent.
- COB bare capacities can easily be adjusted to shipping needs both for coastal and intra-port shipping, effortlessly accommodating heavy and high cube containers.
- Marine facilities that handle COB operations require minimal ground equipment and minimal draft.
- Houston currently only has one provider of COB services. These include the movement of laden, typically heavy weight containers containing plastic resins from Cedar Bayou to the Barbours Cut and Baytown Terminals.
- The growth in plastic resins packaging facilities in the Baytown area and in Freeport may present future growth opportunities for COB movements between these areas and the region's container terminals. One of the largest operational challenges may be the low priority COB receives at the Barbours Cut and Baytown Terminals, causing delay and missed connections with ocean-going vessels.

5.2 Introduction

The context of this Barge and Short Sea Shipping chapter describes how the domestic Marine Highway system supports goods movement to and from ports in the Houston region. This document provides an overview of operations related to the Marine Highway network and the region's four ports within the Houston-Galveston Area Council's (H-GAC) area.

Domestic marine transportation is considered to be an integral part of the nation's freight transportation system and in particular for those supply chains that depend upon the movement of bulk commodities. Use of the Marine Highway system has a number of public benefits which include:

Reducing the number of trucks on highways. In addition, truck traffic, particularly during peak periods, has a dramatic impact on roadway congestion and perceived highway safety. The marine highway can reduce roadway congestion related to port to port trucking moves or moves within a port.

Table 5-1. Comparisons of Capacity by Mode

Modal Freight Unit	Standard Cargo Capacity	Cargo
Truck-Trailer by Highway	25 Tons	910 Bushels
Rail-Bulk Car	110 Tons	4,000 Bushels
Barge-Dry Bulk	1,750 Tons	52,500 Bushels
Barge-Liquid Bulk	27,500 Barrels	454,000 Gallons

Source: IOWA DOT

Reducing carbon dioxide emissions. Barges produce 74 percent of what railroads produce and only 10 percent of what trucks produce. Particulate emissions are 75 percent and 11 percent respectively.

Reduced pavement damage. According to the USDOT, the damage caused by one loaded truck move is the equivalent to the damage caused by 10,000 average car moves.

Table 5-2. Comparison of Costs, Per Ton Miles and Emissions by Mode

Equivalent Units	Barge	Rail	Truck
Number of Units	1	16	70
Cost per Ton Mile (2017)	0.90 Cents	2.30 Cents	27.10 Cents
Ton Miles per Gallon Fuel	576	413	155
Tons CO2 per 1 Million Ton Miles	19.3	26.9	71.6

Use of smaller waterways has been explicitly linked to the historical development and prosperity of the region. In 1854, the Galveston and Brazos Canal connected West Galveston Bay to the Brazos River. This canal ranged in depth from three to six feet and was the first navigable link to be constructed on the Texas coast.

5.3 The Region's Marine Highways

For the purposes of this memo, the Marine Highway Network includes those navigable waterways that have been designated by the Secretary of Transportation as Marine Highways, as they have demonstrated the ability to provide additional capacity to relieve congested landside routes serving freight and passenger movement. Each marine highway has a corridor designation that reflects the congested landside route it parallels. This memo also describes those navigable waterways that do not have an official Marine Highway designation but are used by marine operators to move cargoes to, from and within the region's ports on domestic journeys.

5.3.1 Maritime Administration Designated Marine Highways

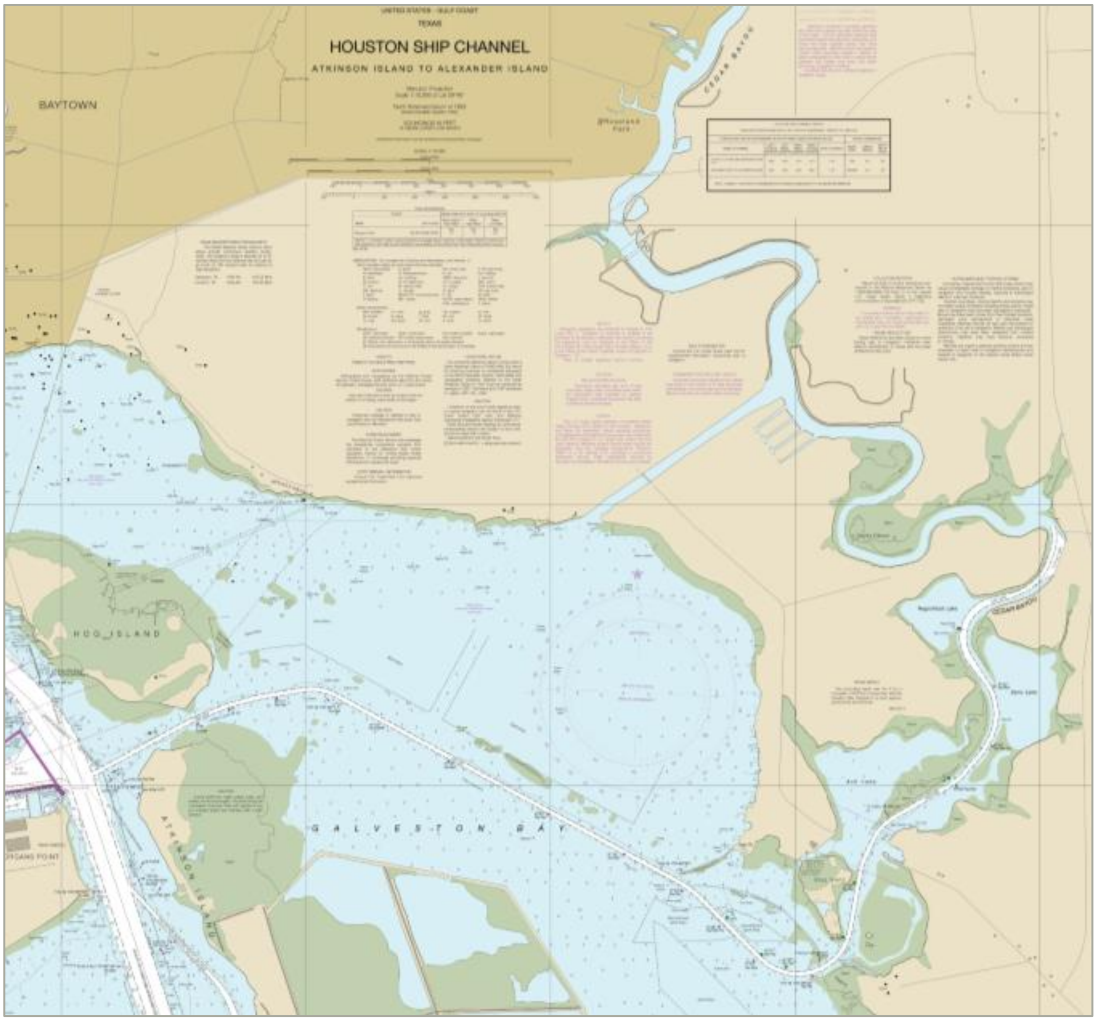
M-10

The M-10 Route includes the Gulf of Mexico, the Gulf Intracoastal Waterway, and connecting commercial navigation channels, ports, and harbors. It stretches from Brownsville, TX to Jacksonville and Port Manatee, FL and includes Texas, Louisiana, Mississippi, Alabama, and Florida. It connects to the M-49 Route at Morgan City, LA, the M-65 Route in Mobile, AL, and the M-55 in New Orleans, LA.

Figure 5-1. Gulf Coast Marine Highways

M-146

The M-146 Marine Highway Route includes the navigable waters between the Cedar Crossing Industrial Park in Chambers County, Texas and the Port of Houston. The route is located in southeast Texas, along the Gulf of Mexico on Galveston Bay. These commercially navigable waters along the Cedar Bayou provide a direct route from the Houston Ship channel to the Cedar Crossing Industrial Park, one of the largest industrial parks in the nation.



Source: NOAA

Figure 5-2. Cedar Bayou

Facilities served by barge along Cedar Bayou include:

- Covestro manufacturing facility, Baytown.
- Chambers County Improvement District Public Dock 1 (CCID1), a public barge facility available to all qualified operators and stevedores.
- Richardson Companies operate the Green Transport Barge Terminal north of CCID1.
- Aggregates facility serving Baytown Concrete.
- Combined barge, rail and road terminal that serves the JSW Steel Works.
- Cedar Marine Terminals, a truck to barge petroleum and biofuel facility located at the mouth of Cedar Bayou.

Originally authorized as a federal navigation project in the River and Harbor Act of 1890, subsequently amended in 1930, the project was de-authorized in 1986 and then reapproved in 2000. It has a maintained depth of 11 feet. In 2017, there were a total of 3,569 vessel trips along this waterway.

Source: © 2018 Google

Figure 5-3. Green Transport Barge Terminal

Source: TGS Cedar Port

Figure 5-4. Chambers County Improvement District Public Dock 1

Source: © 2018 Google

Figure 5-5. JSW Barge, Rail and Truck Facility

M-69

The M-69 Route includes the Gulf of Mexico, the Gulf Intracoastal Waterway, and connecting commercial navigation channels, ports, and harbors within the State of Texas. It includes 11 deep-water and 13 shallow-draft ports between Brownsville and Port Arthur. It intersects with the M-146 Route and connects with the M-10 Route in Port Arthur, which extends and intersects with the M-49 Route in Morgan City, LA; the M-55 Route in New Orleans, LA; and the M-65 Route in Mobile, AL.

Channels within this route include:

Greens Bayou. Extending from the Houston Ship Channel 2.73 miles north westwards. Mile 0 to 0.37 is 175 feet wide with maintained depth of 40 feet. Mile 0.37 to 1.65 is 100 feet wide with maintained depth of 15 feet. Mile 1.65 to mile 2.73 is 100 feet wide with maintained depth of 12 feet. In 2017, there were a total of 3,937 vessel trips on Greens Bayou.

Source: Map data: Google, DigitalGlobe

Figure 5-6. Greens Bayou leading North from the Houston Ship Channel

San Jacinto River. San Jacinto River branches north from the ship channel at Lynchburg, 8 miles above Morgans Point. It has a navigable depth of about 12 feet for about 5 miles, thence 5 to 6 feet to the Interstate Route 10 bridge on the Beaumont-Houston highway about 13.8 miles above the mouth. The bridge has a fixed span with a clearance of 24 feet. The river also supports the largest single barge fleeting area in Texas.

Source: San Jacinto River Fleet

Figure 5-7. San Jacinto River Fleeting Area

The San Jacinto River adjoins the San Jacinto River and Rail Park, a development at the Champion Paper Mill facility that closed in 2002 and is being repurposed as a heavy industrial park with both rail and barge access.

Houston Ship Channel. From Galveston to the Houston Turning Basin. This also includes the waterways that serve the two container terminal facilities, Barbour Terminal Channel and the Bayport Channel. The Houston Ship channel in 2017 accommodated 150,136 vessel trips,

Texas City Channel. A channel from Galveston to the Texas City Turning Basin that accommodated 11,099 vessel trips in 2017.

Dickinson Bayou. An 11.4-mile channel from Galveston Bay to Dickinson. Analysis of aerial imagery identifies a barge repair facility, concrete supply facility served by barge and a metal recycling facility with a 1,200’ barge dock. Vessel trips amounted to 499 in 2017.

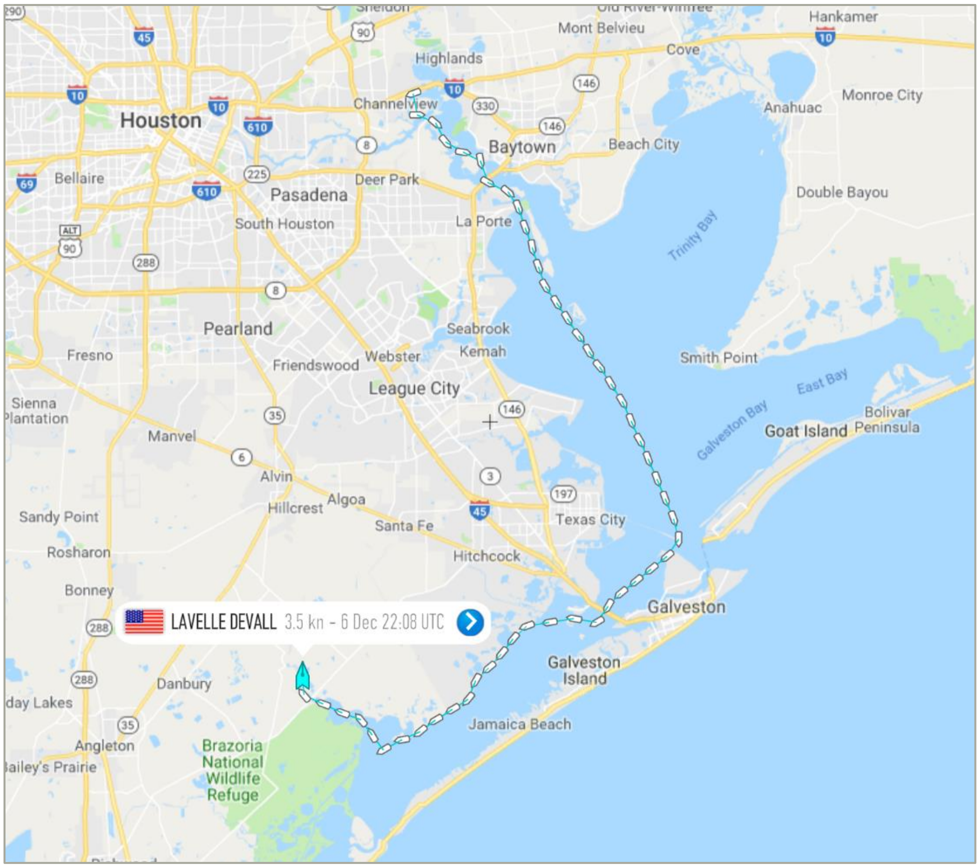
Source: Map data: Google, DigitalGlobe

Figure 5-8. Dickinson Bayou

Galveston Channel. Channel serving the Port of Galveston, with 43,350 vessel trips in 2017.

Chocolate Bayou. A 13.4 mile long channel from the GIWW that serves the 2,400 acre INEOS Chocolate Bayou Works facility which comprises two hydrocarbon cracking units and two polypropylene lines which produce 2,753,000 tons of material per year and the Ascend industrial facility that is the largest acrylonite plant in the world. Vessel trips amounted to 2,078 in 2017. Source: Marine Traffic

Figure 5-9 illustrates the journey of a barge from Houston to one of the manufacturing facilities on Chocolate Bayou.



Source: Marine Traffic

Figure 5-9. Barge Journey from Houston to Chocolate Bayou

Dow Barge Canal. A canal that joins the GIWW and has barge loading/unloading facilities serving the adjacent Dow petro-chemical plant.

Freeport Harbor. A 9-mile-long channel leading from the Gulf of Mexico along the Old Brazos River. In 2017 the harbor channel accommodated 7,593 trips.

Many of the channels are also used by larger vessels serving the various port terminals. Channels such as Chocolate Bayou, Dickinson Bayou and the Dow Barge Canal are solely served by domestic barge operations.

5.3.2 Gulf Intracoastal Waterway

The Gulf Intracoastal Waterway (GIWW) is a 1,100–mile shallow-draft, man-made, protected waterway that connects ports along the Gulf of Mexico from St. Marks, Florida to Brownsville, Texas. It includes the Marine Highway designation of M-10 and M-69. The GIWW is now dually designated, making it eligible for federal funding for both M-69 specific projects, as well as M-10 projects that address overarching challenges along the entire GIWW.

The Texas portion extends for approximately 423 miles from Sabine River to Port Isabel, Texas, and serves as a critical link between the deep draft and shallow draft ports while providing an interstate link for commodities transported in and out of the state.

The importance of the GIWW to the Houston region facilitating movement to the east is illustrated in Figure 5-10. Approximately half the vessels that move on the GIWW between Sabine River and Galveston, originate from or terminate their trips in the Houston region, which based on 2016 USACE statistic is approximately 15,000 vessel trips each way per annum.

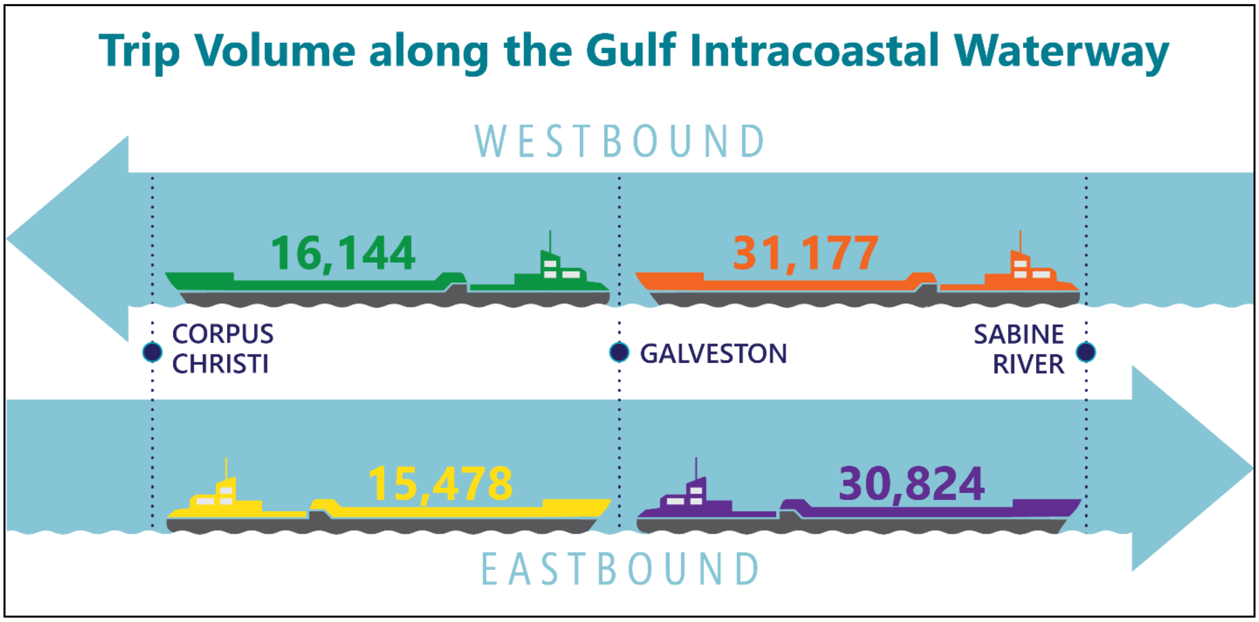


Figure 5-10. GIWW Trip Volumes

5.4 Inland and Intraport Volumes

The amount of cargo for each of the region's ports that originated or was destined for locations on inland waterways, was moved by coastwise shipping (defined as a domestic movement but carried over the ocean) or was cargo transferred within the same port is significant. In 2016, Galveston had the highest share amongst the region's ports of cargoes carried to and from inland waterways and intraport shipping of 34.3 percent of its cargoes. This was followed by the Houston Ship Channel at 29.9 percent, Texas City at 27.3 percent and Freeport at 22.4 percent.

Table 5-3. Houston Ship Channel Tonnage by Movement Type

Movement Type	Direction	Tons (2016)	Percentage
Foreign Imports & Exports	Import	68,734,000	27.72
	Export	93,565,000	37.73
Domestic & Canada Coastal Shipping	Receipts	3,440,000	1.39
	Shipments	8,026,000	3.24
Inland Waterways	Receipts	33,353,000	13.45
	Shipments	19,920,000	8.03
Intraport	-	20,945,000	8.45
Total		247,983,000	

Table 5-4. Texas City Tonnage by Movement Type

Movement Type	Direction	Tons (2016)	Percentage
Foreign Imports & Exports	Import	13,169,000	31.20
	Export	13,453,000	31.87
Domestic & Canada Coastal Shipping	Receipts	1,068,000	2.53
	Shipments	2,976,000	7.05
Inland Waterways	Receipts	4,239,000	10.04
	Shipments	7,059,000	16.73
Intraport	-	242,000	0.57
Total		42,206,000	

Table 5-5. Galveston Tonnage by Movement Type

Movement Type	Direction	Tons (2016)	Percentage
Foreign Imports & Exports	Import	1,640,000	16.60
	Export	3,247,000	32.86
Domestic & Canada Coastal Shipping	Receipts	62,000	0.63
	Shipments	1,544,000	15.63
Inland Waterways	Receipts	2,366,000	23.94
	Shipments	954,000	9.65
Intraport	-	68,000	0.69
Total		9,881,000	

Table 5-6. Freeport Tonnage by Movement Type

Movement Type	Direction	Tons (2016)	Percentage
Foreign Imports & Exports	Import	10,230,000	52.10
	Export	4,549,000	23.17
Domestic & Canada Coastal Shipping	Receipts	220,000	1.12
	Shipments	235,000	1.20
Inland Waterways	Receipts	2,680,000	13.65
	Shipments	1,715,000	8.73
Intraport	-	8,000	0.04
Total		9,881,000	

5.5 Container on Barge

5.5.1 Background

With the growth in container imports and exports in the Houston region, Container on Barge (COB) can be a low-cost form of transportation related to the repositioning of empty containers or the delivery of loaded containers to consignee designated port locations. Like rail and trucking, in international moves, COB operations are often the extension of carrier services and may be included in the final Bill of Lading listed destination. In domestic moves, they may be developed by shippers who handle and pay for the initial movement. It is most cost effective when the cargo originates near a domestic port facility and is delivered to an international or domestic hub, or delivered to a domestic facility via an international hub.

COB operations can be a cost-effective alternative to trucking or rail because they provide a large platform for container movement and in most cases are nearly all water moves except for the initial or delivery dray which is normally by truck. COB operations have been undertaken in numerous markets including New England, New York, Virginia, US Southeast, Gulf of Mexico and Alaska. The route determines the type of equipment that can be utilized, but the most common remains a tug and barge combination.

Depending on if a route is coastal or intra-port, barge capacities can vary. An average coastal barge can carry around eighty (80) forty-foot (equivalent units) containers (FEU) or one-hundred sixty (160) twenty-foot (equivalent) units (TEU's) in a single move.

Source: IAMPE

Figure 5-11. Common Coast Feeder Barge

Intra-port, where cargo moves from one facility in a port district to another facility in the same district, generally uses a smaller capacity barge. Most common are the standard 195-foot-long hopper barges which have a capacity of forty-eight (48) forty foot units, or twice that in twenty-foot (20-TEU) units. Carriage capacity can increase significantly with multiple barge lash-ups in a single shipment.

Source: IAMPE

Figure 5-12. Typical Inland Hopper Barge Used for Container Transport and a Multiple Lash-up

Marine facilities that handle container on barge do not require the same amount of dock equipment as barge facilities however in many cases, at least one load or discharge facility may also be a gateway or port ship terminal. Generally ground equipment such as reach stackers, chassis and yard hostlers are common at all facilities that handle containers. Ship facilities mostly use gantry cranes for handling vessel to shore transfers but barge facilities may use ground equipment or smaller cranes for handling transfers.

Source: SECOR AHM

Figure 5-13. Container on Barge Facility-Port Allen, LA

5.5.2 Container on Barge Requirements

There are a number of parameters that determine if container on barge operations can achieve success. These include:

1. Sustained and balanced volumes
2. Correct vessels
3. Reliable schedules
4. Integration within container terminals
5. Frequency
6. Cost and efficiency equal or better than truck or rail
7. Routes
8. Connecting facilities
9. Commercial support
10. Public Benefit (Roads)
11. Carrier partnerships
12. Competition

1. Sustained and Balanced Volumes

Cargo volumes are the most critical element in regard to COB services. The volumes must be consistent, regular and ideally balanced in the legs of the voyage. Several services failed because there were loads in one direction but only repositioned empties in the return voyage. This drove the cost of the average loaded container higher and eventually makes it uncompetitive.

2. Correct Vessels

Keeping costs under control is often a function of utilizing the correct vessel for COB operations. Tug and barge is the least costly in comparison to small feeder ships mostly due to crewing requirements. Tug and barge operations involve slower transit times and have a great impact from adverse weather. Standard hopper barges on the inland river system and in protected waterways have shown to be the most useful. There are a large number of these types of vessel available and they are easy to interchange with various cargoes. For other operations, flat deck barges with appropriate securing provisions, can be used for inter-harbor or protected waterway transport. Coastal barges tend to have raked hulls and protective cowls to keep containers secure. There is also a MARAD[122] design for an Articulated Tug Barge (ATB). This vessel is designed to carry over 100 forty-foot containers and is specifically planned for coastal and offshore operations. Availability of equipment is also an issue as demand for towing services increase.

Source: MARAD

Figure 5-14. MARAD Design for Container ATB

3. Reliable Schedules

One of the biggest challenges for tug and barge operations is remaining on schedule for connecting with ships at gateway or hub ports. Tug and barge schedules can be impacted by several adverse issues. These include adverse weather which can slow the vessels down. Another issue is delays in transit caused by unanticipated delays at locks, but this issue is only significant on the Western River system.

4. Integration within Container Terminals

At container terminals it is only natural that liner service ships are prioritized, while barge handling is generally relegated to second priority. For loading containers to barges, many container terminals will use ship to shore cranes that are also used for loading/unloading larger ships. Barges may also use wharf space that is assigned to the larger vessels. Movement of containers within the terminal such as import containers being offloaded from a ship and subsequently directed to barge movement, may disrupt the normal flow and direction of containers. For example, all import containers pass through a US Customs Border Protection radiation portal, but for many container terminals, these are positioned for truck movement and situated at the exit gates. Transporting the container through the exit gates and then back into the terminal adds time, cost and management effort.

5. Frequency

Many barge operations operate on a weekly schedule or when there are sufficient container loads to transport. Rail can be faster with adequate high volumes, but truck

[122] US Department of Transportation, Maritime Administration.

generally operates on an on call basis and can move a container quickly and whenever necessary. Trucking represents over 80% of international container moves in the US currently.[123] Many shippers and goods receivers will demand a barge service frequency of two to three times a week. This can be challenging to operate services cost effectively at low volumes.

6. Cost and Efficiency Better Than Truck or Rail

According to NASSTRAC, most transportations decisions are based on cost.[124] Shippers are always exploring alternative modes of transportation. This is being driven predominantly by price and efficiencies. In the past year, a majority of shippers have shifted freight to different modes (66.2%). Manufacturers made the greatest shift with 78.6% shifting to a different mode, compared to 53.8% of retailers and 43.8% of wholesalers/distributors.[125] To be an effective choice for shippers, the total cost of handling by barge must be better than truck or rail, including all costs. For barge movement that includes not only the cost of transport and equipment, but also tug fuel surcharges and the loading and discharging cost of handling the containers between the barge and the connecting marine facilities.

7. Routes

Connecting routes between facilities is a significant issue due to the potential for delays, distance, schedules, weather and other route delays have a major impact on operations. Barges may miss ship calls when connecting and time of transit can vary. Consideration of the most direct and efficient route to minimize variables is an operational necessity. This includes operations within port areas where traffic considerations become more of an issue.

8. Connecting Facilities

Transportation between key facilities is a critical factor with COB. Like rail and trucking, COB operations are part of a hub and spoke system which feeds smaller volumes to and from hub ports where containers are loaded to ships. Since most containers are ocean carrier owned or controlled, efficient connection to the ocean carrier services is essential. COB operations can be spread out with calls at various terminals to meet volume requirements for barge operations. This adds additional time to transport schedules which may impact shipper requirements.

9. Commercial Support

All COB operations require shipper commitments and the willingness on their part to trade off transport times for cost. Shippers can influence carriers in the international trade and can make direct arrangements with COB operators in the domestic trade. Shippers and ocean common carriers must also be willing to utilize COB services if cost, time, predictability (schedule) and a level of confidence that the service will be long lasting are key considerations.

10. Competition

[123] American Trucking Association, 2017 Annual Report

[124] The National Shippers Strategic Transportation Council (NASSTRAC) Annual Report, 2013-Updated

[125] IBID

In transportation, ports compete with road and rail and all carrier services, including COB, compete with each other. Competition is certainly a matter of cost and often shippers are willing to compromise time, if the savings have a reasonable impact. Reliability of transit, as well as predictability of service are substantial considerations in addition to customer service. Carriers generally include the truck drays as well as COB costs in their rates to the shipper in the Bill of Lading, particularly in “door to door” shipments. Having fixed rates from the barge operator or trucker are essential. It is most convenient when the container can be handled all water however the initial dray as well as the final dray are always by truck. If the ocean carrier quotes it “port to port” or “point to point” then the shipper or the consignee can be responsible for the initial or final truck dray. This requires management time and effort to coordinate all the different facets together including port operations, barge movement and onward transportation.

A number of changes within the trucking market can also influence the uptake of COB services. These include the addition of Electronic Log Books (ELB) which have an impact on maximum truck driver times, security requirements for drivers at marine terminals and a general lack of truck drivers which are raising trucking costs and adding to challenges of securing truck capacity to move containers. Other advantages of COB over road transportation include the movement of heavy weight containers. Truck gross vehicle weights are typically limited to 80,000lbs, though this can be increased with permits. A standard 40-foot shipping container typically has a gross weight of 71,650 lb, resulting in a cargo payload of 63,052 lbs. However, when carried under the typical 80,000lbs gross vehicle weight limit, a 40-foot container may be limited to about 44,000lbs. Therefore nearly 21,000lbs of weigh capacity is underutilized. COB has the potential to be used for the movement of heavy weight containers, producing a cost and efficiency benefit to the shipper as well as reducing road wear and tear.

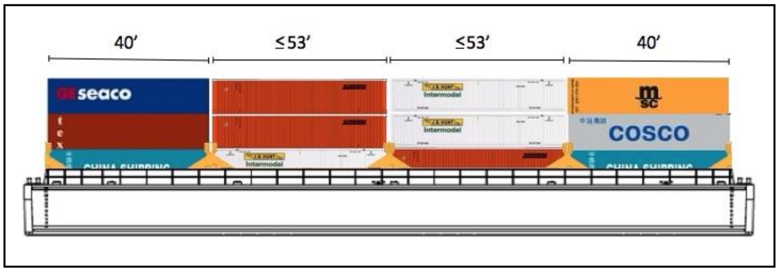
5.5.3 Container on Barge Operations

Barge operations do not necessarily use the same infrastructure for handling of ships at container terminals because of the smaller volumes. In many cases, standard construction cranes can be used to load or discharge containers as long as they have the lifting capacity for a 30-ton load. In many situations, containers can be loaded from a dock or wharf by a reach stacker or driven on a barge by a top loader. The difference is attributable to the market and type of barge used such as a river hopper barge or an ocean-going (flat) container barge.

Source: IAMPE

Figure 5-15. Container Handling by Crane, Handling by Ground Equipment

Container stacking and positioning on barges must be carefully planned with loaded containers placed down low to ensure barge stability. Hopper barges can be loaded with 48 empty containers or 36 loaded units. Most barge moves have a mix of loaded and empty containers. Barges also have maximum draft restrictions. Barges can be loaded in water depths of less than 15 feet and the maximum load on the barge is calculated by measuring the barge's draft during operations.

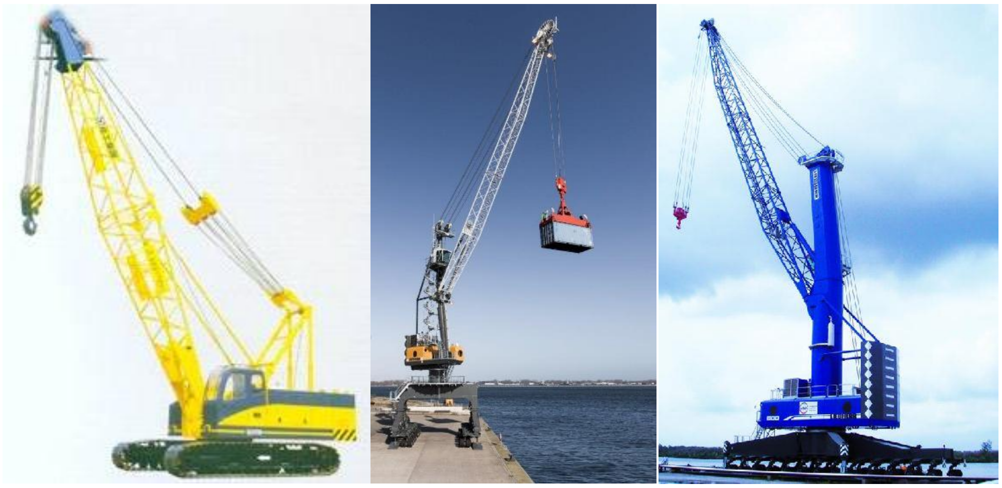


Source: IAMPE

Figure 5-16. Container Stack on Barges-Standard Hopper Barge

Barges can also handle a wider variety of containers of different lengths. Very long containers (53 feet) and high cube (9 feet, 6 inches) containers can be easily stacked on a barge. Larger containers require different length chassis and must use roads with sufficient overhead clearances.

Depending on the number of barges handled, facilities my elect to use a faster mobile harbor crane. These cranes are multi-purpose, less expensive than gantry crane and well suited for container on barge operations. They are also capable of handling more units per hour than construction cranes. Construction cranes often use wires for handling where mobile harbor cranes can be equipped with spreaders designed to handle a container. Mobile harbor crane handling speed (pick rates) can be twice to three times that of a construction crane. They are also used for feeder ships at smaller terminals. Mobile harbor cranes have significantly higher lifting capacities than construction or even some gantry cranes. They are moved directly onto or off chassis or special transporters from or to storage locations.



Source: IAMPE

Figure 5-17. Conventional Construction Crane and Mobile Harbor Cranes

Source: IAMPE

Figure 5-18. Container Spreader and Chassis

COB operations can use smaller terminals as well as be located on shallow channels or estuaries within port areas. Storage can be optimized by stacking or containers can be handled directly on and off chassis and stored on the chassis for pick up, or drop off. Based on a single barge per week handling 48 containers per move, a terminal can handle between 2,000 and 2,500 containers per year on a five to ten-acre site. For storage, containers can be stacked or left on chassis. One acre of land can accommodate between 100 and 125 parked forty-foot containers including traffic patterns. Stacked containers can average as high as 140 units per acre in a single stack, double or triple that depending on the height of the stacks and the handling equipment available. The site must also be capable of supporting heavy loads (static landing weight).

Source: MARAD

Figure 5-19. Container on Barge Facility Concept

5.5.4 Gulf Container on Barge Services

Existing Operations

There are several companies that are or have been involved in COB services in the Gulf of Mexico and connecting waterways such as the Gulf Intracoastal Waterway. These include Kirby/Osprey Lines, Richardson Stevedoring, formerly Couch Lines (currently in receivership), Texas International Freight and SEACOR AHM. One operation that appears to be moving predominately plastic resins is the SEACOR AHM service that involves transporting empty containers from Memphis to Port Allen, LA where they are distributed to plastic resin packagers. Once loaded, the containers are transported back to Port Allen and then moved by barge to the Port of New Orleans. The service was averaging 200 containers per week, with a potential for 400 containers.

In Houston, according to the Great Houston Port Bureau as well as Richardson Stevedoring, Richardson is the only apparent current provider of container on barge services. The company has terminal facilities along the Ship Channel, on the Cedar Bayou and at the Alabama State Docks in Mobile.

COB services include the movement of laden, typically heavy weight containers containing plastic resins from Cedar Bayou on a three-hour barge journey to the Barbours Cut and Baytown Terminals. A number of challenges with this barge service have however been identified. On arrival at the Port of Houston container terminals, the barge is unloaded by the ship to shore cranes. But, when a container ship arrives, the barge often has to relocate to another berth or move and then wait for another berth to become free. This adds costs and increases the risk of an export container missing its scheduled sailing.

Potential Future Operations

The growth in plastic resins, particularly in the Baytown area with the concentration of plastic packaging facilities that are coming online, may present future growth opportunities for container movements between Baytown and the region's container terminals. However, the integration of COB operations within the container terminals requires further investigation in order to resolve some of the operational issues identified during this study and deliver more efficient and cost-effective services for COB users and operators.

The development of plastic resin packaging facilities in Freeport may also present opportunities to transport containers loaded in Freeport to be moved by barge to Houston container terminals to connect with container line services that don't call at Freeport.

In January of 2020, MARAD announced its latest round of grants for its America's Marine Highway Program. Port Houston was one of nine U.S. ports awarded grant funding. Port Houston received a grant of $180,000 to fund the development of a business case study to explore options of building a container-on-barge facility.

5.6 Summary

H-GAC's ports are served by the Marine Highway Network and the Gulf Intracoastal Waterway (GIWW). The Marine Highway Network includes those navigable waterways that have been designated by the Secretary of Transportation as Marine Highways, as they have demonstrated the ability to provide additional capacity to relieve congested landside routes serving freight and passenger movement. In addition to these Marine Highways, the GIWW is a 1,100–mile shallow-draft, man-made, protected waterway that connects ports along the Gulf of Mexico from St. Marks, Florida to Brownsville, Texas. It includes the Marine Highway designations of M-10 and M-69. It serves as a critical link between the deep draft and shallow draft ports while providing an interstate link for commodities transported in and out of the state. Approximately half the vessels that move on the GIWW between Sabine River and Galveston, originate from or terminate their trips in the Houston region, which based on 2016 USACE statistic is approximately 15,000 vessel trips each way per annum.

In 2016, Galveston had the highest share amongst the region's ports of cargoes carried to and from inland waterways and intraport shipping of 34.3 percent of its cargoes. This was followed by the Houston Ship Channel at 29.9 percent, Texas City at 27.3 percent and Freeport at 22.4 percent.

With the growth in container imports and exports in the Houston region, Container on Barge (COB) can be a low-cost form of transportation related to the repositioning of empty containers or the delivery of loaded containers. COB operations can be a cost-effective alternative to trucking or rail because they provide a large platform for container movement and in most cases are nearly all water moves except for the initial or delivery dray which is normally by truck.

COB operations are highly adaptable to shipping needs and barge capacities can vary. An average coastal barge can carry around 160 TEU in a single move. Intra-port, where cargo moves from one facility in a port district to another facility in the same district, generally uses a smaller capacity barge. Most common are the standard 195-foot-long hopper barges which have a capacity of 96 TEU. Carriage capacity can increase significantly with multiple barge lash-ups in a single shipment. COB easily accommodates heavy and high cube containers.

Marine facilities that handle COB operations do not require the same amount of dock equipment as ship and barge facilities. Minimal ground equipment or smaller cranes for handling transfers can be sufficient. The barges require minimal draft.

A major operational challenge is the low priority COB receives at the region’s container terminals. Sea going vessels are prioritized, displacing and delaying COB service and risking export containers to miss their scheduled sailing.

There are several companies that are or have been involved in COB services in the Gulf of Mexico and connecting waterways such as the GIWW. Houston currently only has one provider of COB services. The company has terminal facilities along the Ship Channel, on the Cedar Bayou, and at the Alabama State Docks in Mobile. COB services include the movement of laden, typically heavy weight containers containing plastic resins from Cedar Bayou on a three-hour barge journey to the Barbours Cut and Baytown Terminals.

The growth in plastic resins packaging facilities in the Baytown area and in Freeport may present future growth opportunities for COB movements between these areas and the region’s container terminals.

6 Commodity Flow

This chapter provides an overview of the key commodity flows within the Houston-Galveston Area Council's (H-GAC) region and how they relate to goods movement to and from the region's ports. It should be read in conjunction with the Ports Area Mobility Study's other technical reports

The objective of this analysis is to gain insight in how the region's commodity flow supply chains and specifically how import and export flows are supported by:

- Trucks
- Rail
- Short Sea and Inland Waterways

It provides a high-level view of commodity and modal flow analysis using datasets such as Transearch, Public and Confidential Rail Waybill data and U.S. Army Corps Waterborne Statistics.

6.1 Key Findings

- Chemicals and petroleum products dominate the commodities carried to, from and within the region by truck, rail and inland waterway/short sea shipping.

Truck

- Around 14 percent of truck tons in H-GAC port counties are associated with import and export flows.
- Nine percent of total tons is moving between origins and destinations in Texas, and one-quarter is moving between Texas and other states
- For export flows moving from U.S. origins to the region's ports, Harris County terminates around 78 percent of truck tonnage and 85 percent of truck value; Brazoria County terminates around 10 percent of tonnage and 8 percent of value; and Galveston County terminates around 12 percent of tonnage and 8 percent of value.
- For import flows moving from the region's ports to US destinations, Harris County originates around 90 percent of truck tonnage and 90 percent of truck value; Brazoria County originates around 7 percent of tonnage and 5 percent of value; and Galveston County originates around 3 percent of tonnage and 5 percent of value.
- The leading truck commodities by tonnage are petroleum products (21 percent), chemicals (19 percent), nonmetallic minerals (18 percent), and waste and scrap (10 percent). These four commodities alone account for around two-thirds of all truck tonnage.

Rail

- In 2016, the Houston-Galveston-Brazoria TX waybill analysis region received 1,032,866 carloads of terminating traffic and generated 476,942 carloads of originating traffic, for a total of 1,509,808 carloads originated and terminated. Roughly two-thirds of rail carloads were inbound receipts from other regions; 9 percent were moves within the region; and 25 percent were outbound shipments to other regions.

- In 2016, the leading commodities for rail traffic terminated in the region were: chemical products; coal; nonmetallic minerals; miscellaneous mixed shipments (intermodal containers); transportation equipment; and agricultural produce. Together, these commodity groups represent about 88 percent of terminated rail carloads.
- In 2016, the leading commodities for rail traffic originated in the region were: chemical products; miscellaneous mixed shipments (intermodal containers); transportation equipment; refined petroleum products; and empty shipping containers. Together, these commodity groups represent about 95 percent of originated rail carloads

Short Sea and Inland Waterway

- The majority of the cargoes moved between the region’s port and the inland waterways and within each port (intraport movement) consist of bulk petroleum or chemical products.
- Other commodities moved to, from and within the Port of Houston by inland waterway include:
  - Coal coke
  - Iron and Steel scrap, in 2017 957,000 tons were moved by inland waterways
  - Other iron and steel products including plates, bars and pipe
  - Grain including corn and wheat
  - Oilseeds such as soybeans
  - Sand and gravel, in 2017 153,000 tons were moved by inland waterways

6.2 Introduction

The supply chain analyses presented in this report are based on many different sources of information. One of the key datasets was the Transearch Database for year 2015.

Transearch is a commercial product obtained from a vendor (IHS Markit) by the Texas Department of Transportation, made available to H-GAC and its consultants for use in this study. Transearch provides information on tons, value, and units of commodity movements by mode, origin-destination, commodity, and trade type, based on a variety of public and private data sources and collection methods.

Transearch addresses all transportation modes. Its rail data is based on the Surface Transportation Board (STB) public waybill sample and is therefore highly aggregated (county-level information is not available), and its water data is not as detailed or complete as information available directly from the ports and other sources. For trucking, however, Transearch provides a level of detail and analytical utility unavailable from other datasets. Therefore, this analysis focuses on the use of Transearch to analyze truck movements for the H-GAC port counties.

To assist the reader, some key definitions are as follows:

- Mode Group – Transearch modes include truck, rail, water, air, pipeline, and other. The reporting of data by mode does not link intermodal or multimodal trips -- each move by a particular mode is reported as a unique trip. For example, a 20-ton shipment arriving at the Port of Houston by water, moving by truck from the port to a warehouse in Harris County, and then moving from the warehouse to a customer in Austin would be reported as 20 tons by water, 20 tons by truck, and 20 tons again by truck.
- Trade Type – Transearch trade types include domestic (excluding Alaska), Alaska, NAFTA (trade with Canada and Mexico), import (non-NAFTA), and export (non-NAFTA). Transearch creates associations of trade types across different modes; in the example above, the move by water would be flagged as 'import', and the move from port to warehouse would also likely be flagged as 'import', although the second move from warehouse to customer would probably not be flagged. It's not possible to determine how rigorously or accurately these trade type flags are applied, especially with respect to truck movements. It seems certain that at best, Transearch reports some of the trucking activity related to international trade, but not all. Nevertheless, even partial data is useful within the larger analysis framework.
- Commodity Groups – Transearch uses the Standard Transported Commodity Classification (STCC) system. STCC codes have different levels of specificity; this analysis uses the 2-digit level groupings, which are fairly general but useful for high-level overview analyses.
- The analysis year is 2015.
- Tons are short tons and generally expressed as millions (M); value is 2015 dollars and generally expressed as billions (B).
- H-GAC Port Counties and direction of flow. The analysis considers only Harris, Galveston, and Brazoria counties. Some analyses consider the direction of flow (inbound, outbound, or internal to the set of these three counties); others consider volumes originating or terminating in each individual county.

6.3 Multimodal Totals from Transearch

According to Transearch, the H-GAC port counties handled 538 million tons, 18 million units, and 449 billion dollars in freight value in year 2015.

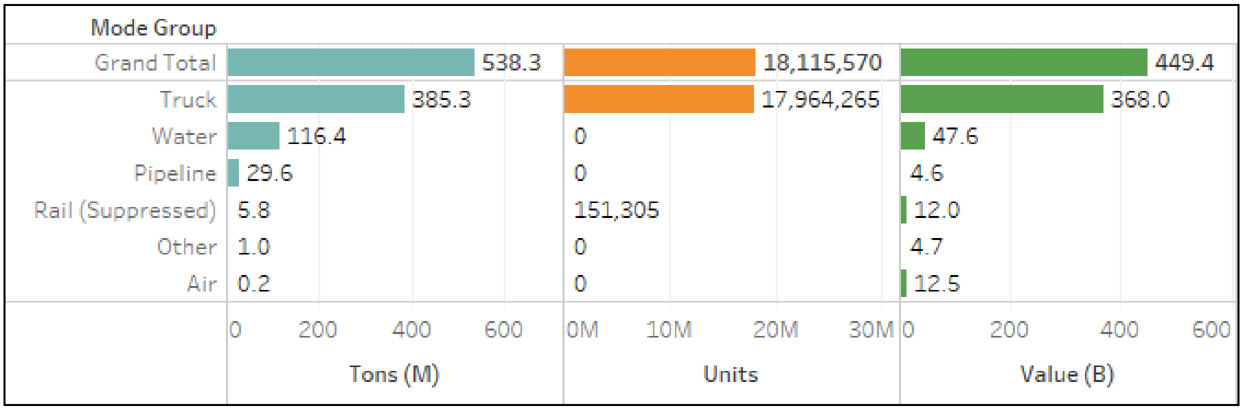


Figure 6-1. H-GAC Port County Volume by Mode (2015)

Note that rail is shown at just 5.8 million tons; however, Transearch reports another 84 million tons for the region as a whole that is not allocated to specific counties, and we would expect perhaps 90 percent of this unallocated tonnage to be associated with the three Port counties, meaning the 'real' rail total would be somewhere closer to 80 million tons. Also note that water is shown at 116 million tons for the three Port counties. (For the state of Texas as a whole, Transearch cites around 190 million tons in total.) This is much lower than the figure of 240 million tons cited by the American Association of Port Authorities for Houston region ports foreign and domestic trade in 2015.

We have not attempted to adjust the Transearch results, but the reader should bear in mind that the significance of rail and water to the region are not fully represented in Figure 6-1 following. These totals are presented for context only. In an 'adjusted' world, truck would probably represent between 50 percent and 60 percent of total tonnage moved into, out of, and within the three Port counties.

Some of this tonnage – the exact figure cannot be determined – is associated with connections to ports, rail terminals, and airports. It is possible, given that rail and water volumes appear under-estimated, that the 'connecting truck' volumes may also be under-estimated. Additionally, it is known that Transearch does not capture much of the "last mile" truck traffic associated with moves between warehouse/distribution centers and end users. For these reasons, the Transearch truck volumes are probably conservative and representative of a 'lower bound' estimate.

Notwithstanding the known data limitations, the most important and useful data points from Figure 6-1 are the truck totals: 385 million tons, moving in nearly 18 million truck units, with a value of around 368 billion dollars, for the H-GAC port counties in year 2015. These are extremely large numbers. The remainder of this analysis focuses exclusively on Transearch truck data.

6.4 Commodity Analysis - Truck

6.4.1 Truck Flows by Direction and Trade Type

Figure 6-2 following present summaries of Transearch truck tonnage and value data based on the directional relationship with H-GAC port counties (inbound, outbound, or within) and trade type (domestic, import, export, NAFTA, or Alaska). These dimensions, when combined, capture a number of interesting effects: for example, “import + outbound" represents imports through the region’s ports and airports that then move out from the region via truck; import + inbound represents imports through ports and airports outside the region that then come into the region via truck; etc.

Relation to HGAC Port Counties	Grand Total		Inbound		Outbound		Within	
Trade Type	Tons (M)	Value (B)	Tons (M)	Value (B)	Tons (M)	Value (B)	Tons (M)	Value (B)
Grand Total	385.3	368.0	136.9	126.0	94.7	127.5	153.8	114.6
Domestic	330.2	252.5	122.2	81.9	71.4	77.7	136.6	92.9
Import	26.2	46.9	1.4	3.4	18.1	33.0	6.7	10.5
Export	21.6	26.9	8.2	13.1	2.9	2.7	10.5	11.1
NAFTA	7.4	41.7	5.2	27.6	2.2	14.0		
Alaska	0.0	0.0	0.0	0.0	0.0	0.0		

Figure 6-2. H-GAC Port County Truck Tons (M) and Value (B) by Trade Type and Direction (2015)

Relation to HGAC Port Counties	Grand Total		Inbound		Outbound		Within	
Trade Type	% of Tons	% of Value	% of Tons	% of Value	% of Tons	% of Value	% of Tons	% of Value
Grand Total	100.0%	100.0%	35.5%	34.2%	24.6%	34.6%	39.9%	31.1%
Domestic	85.7%	68.6%	31.7%	22.3%	18.5%	21.1%	35.4%	25.2%
Import	6.8%	12.8%	0.4%	0.9%	4.7%	9.0%	1.8%	2.9%
Export	5.6%	7.3%	2.1%	3.6%	0.8%	0.7%	2.7%	3.0%
NAFTA	1.9%	11.3%	1.3%	7.5%	0.6%	3.8%		
Alaska	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%		

Figure 6-3. H-GAC Port County Truck Tons and Value Shares by Trade Type and Direction (2015)

Key findings include the following:

- Around 86 percent of truck tons in H-GAC port counties are associated with domestic trade. The largest share – nearly 70 percent of all truck tons – are domestic trucks moving between origins and destinations in Texas. Around 16 percent of all truck tons are domestic trucks moving between Texas and other states.
- Around 12 percent of truck tons in H-GAC port counties are associated with import and export flows other than NAFTA. Around three-quarters (nine percent of total tons) is moving between origins and destinations in Texas, and one-quarter is moving between Texas and other states. (Note that Transearch is not reporting the import or export country; Transearch is reporting only the truck component of the international end-to-end trip that appears in the H-GAC port counties.)
- Around two percent of truck tons in the H-GAC port counties are associated with NAFTA. Around one percent is moving from Mexico to Texas; the remainder

(less than one percent is Canada to Texas, Texas to Canada, and Texas to Mexico.

Figure 6-4 following shows the distribution of trade by origin/destination country and its relationship to Texas (e.g., Texas-to-Texas or Texas and Other partners). Note that domestic moves can be Texas-to-Texas or Texas and Other; NAFTA flows are all Texas and Other; and export/import flows can be either Texas-to-Texas (these are moves between Texas shippers/receivers and Texas ports and airports) or Texas and Other (these are moves between Texas shippers/receivers and out of state ports and airports).

- Overall, around 79 percent of trucks in the H-GAC port counties are associated with moves within Texas, and 21 percent are associated with moves to/from other states. From Figure 6-3, we know that 40 percent of all truck tons are within the port counties, so the other 39 percent of Texas-to-Texas truck tons are between the H-GAC port counties and the remainder of Texas.

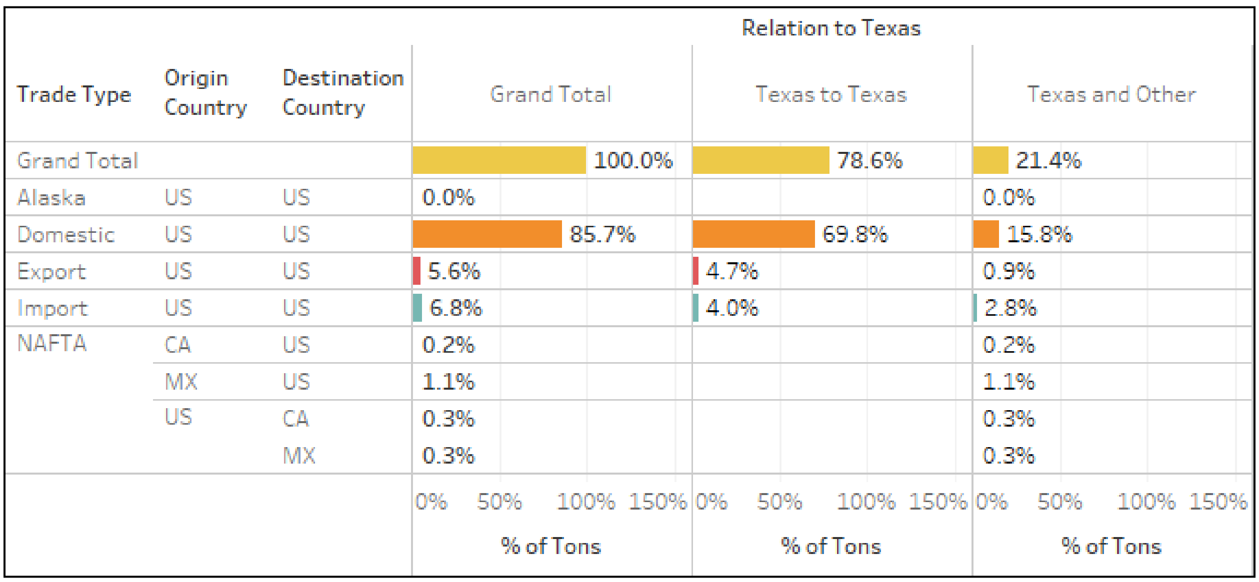


Figure 6-4. H-GAC Port County Truck Trade Partners by Trade Type (2015)

For internal truck flows, the leading origins are Harris County (132 million tons), Brazoria County (15 million tons), and Galveston County (6 million tons). The leading destinations are Harris County (131 million tons), Brazoria County (15 million), and Galveston County (8 million). Just over 120 million tons are moving entirely within Harris County, which represents around 31 percent of the 385 million truck tons associated with the H-GAC port counties. See Figure 6-5 following.

Origin Region Name	Grand Total	Destination Region Name: Harris County, TX	Brazoria County, TX	Galveston County, TX
Grand Total	153.8	131.0	14.9	7.9
Harris County, TX	132.4	120.1	6.9	5.4
Brazoria County, TX	15.2	7.1	7.4	0.6
Galveston County, TX	6.2	3.8	0.5	1.9

Figure 6-5. H-GAC Port County Truck Tons, Origins/Destinations for Internal Flows (2015)

For inbound truck flows, the leading destinations for inbound truck flows are Harris County (120 million tons), Brazoria County (11 million tons), and Galveston County (6 million tons). The leading origins are: the state of Louisiana; Jefferson Co. TX; Bexar Co. TX; Montgomery Co. TX; Fort Bend Co. TX; Comal Co. TX; Dallas Co. TX; Williamson Co. TX; Colorado Co. TX; and the state of Illinois. See Figure 6-6 following.

Origin Region Name	Grand Total	Destination Region Name: Harris County, TX	Brazoria County, TX	Galveston County, TX
Grand Total	136.9	120.1	11.0	5.7
Louisiana	10.2	7.8	1.7	0.7
Jefferson County, TX	8.6	6.4	1.3	0.9
Bexar County, TX	7.4	6.6	0.7	0.2
Montgomery County, TX	6.8	6.3	0.3	0.2
Fort Bend County, TX	6.6	6.3	0.3	0.1
Comal County, TX	4.3	3.9	0.2	0.1
Dallas County, TX	4.0	3.7	0.1	0.1
Williamson County, TX	3.7	3.3	0.2	0.1
Colorado County, TX	3.4	3.2	0.1	0.1
Illinois	3.1	2.9	0.1	0.1
Arkansas	2.8	2.7	0.1	0.0
Limestone County, TX	2.8	2.5	0.1	0.1
Nueces County, TX	2.7	2.3	0.1	0.3
Oklahoma	2.3	2.1	0.1	0.1
Bell County, TX	2.2	1.9	0.2	0.1
Missouri	1.9	1.9	0.0	0.0
Waller County, TX	1.9	1.7	0.1	0.0
Calhoun County, TX	1.9	0.9	0.9	0.1
Travis County, TX	1.8	1.7	0.1	0.1
Burnet County, TX	1.8	1.7	0.0	0.0

Figure 6-6. H-GAC Port County Truck Tons, Top 20 Origin/Destinations for Inbound Flows (2015)

For outbound truck flows, the leading origins are Harris County (80 million tons), Brazoria County (11 million tons), and Galveston County (5 million tons). The leading destinations are: Fort Bend Co. TX; state of California; Jefferson Co. TX; state of Louisiana; Montgomery Co. TX; Dallas Co. TX; Bexar Co. TX; state of Oklahoma; Tarrant Co. TX; and Matagorda Co. TX. See Figure 6-7 following.

		Origin Region Name		
Destination Region Name	Grand Total	Harris County, TX	Brazoria County, TX	Galveston County, TX
Grand Total	94.7	79.6	10.6	4.5
Fort Bend County, TX	9.5	8.5	0.9	0.1
California	6.8	5.5	0.9	0.5
Jefferson County, TX	6.1	5.3	0.3	0.5
Louisiana	5.1	3.8	0.8	0.6
Montgomery County, TX	3.5	3.1	0.3	0.1
Dallas County, TX	3.1	2.8	0.1	0.1
Bexar County, TX	2.3	2.1	0.2	0.1
Oklahoma	2.1	1.9	0.1	0.1
Tarrant County, TX	2.0	1.8	0.1	0.1
Matagorda County, TX	1.9	0.7	1.1	0.1
Travis County, TX	1.9	1.7	0.1	0.1
Florida	1.6	1.3	0.2	0.1
Arkansas	1.5	1.3	0.1	0.1
Michigan	1.4	1.1	0.2	0.1
Wisconsin	1.2	0.9	0.2	0.1
Indiana	1.2	1.0	0.2	0.1
Ohio	1.1	0.8	0.2	0.1
Arizona	1.1	0.9	0.1	0.0
Illinois	1.0	0.8	0.1	0.1

Figure 6-7. H-GAC Port County Truck Tons, Top 20 Origins/Destinations for Outbound Flows (2015)

6.4.2 Truck Flows by Commodity Group

Truck flows to, from, and within the H-GAC port counties are generated by a diverse set of commodity groups; however, a limited number of groups tend to account for most of the tonnage and most of the value. Moreover, the leading tonnage and leading value groups tend to show important differences. As shown in Figure 6-8 following:

- The leading commodities by tonnage are petroleum products (21 percent), chemicals (19 percent), nonmetallic minerals (18 percent), and waste and scrap (10 percent). These four commodities alone account for around two-thirds of all truck tonnage. Other important commodity groups include stone/clay/glass, warehouse/distribution center, primary metal products, food products, farm products, fabricated metal products, rubber and plastic products, lumber and wood products, and machinery except electrical.

- The leading commodities by value are chemicals (21 percent), machinery except electrical (13 percent), petroleum and coal products (12 percent), warehouse/distribution center (7 percent), transportation equipment (7 percent), primary metal products (6 percent), fabricated metal products (6 percent), rubber and plastic products (5 percent), and electrical machinery and equipment (5 percent).

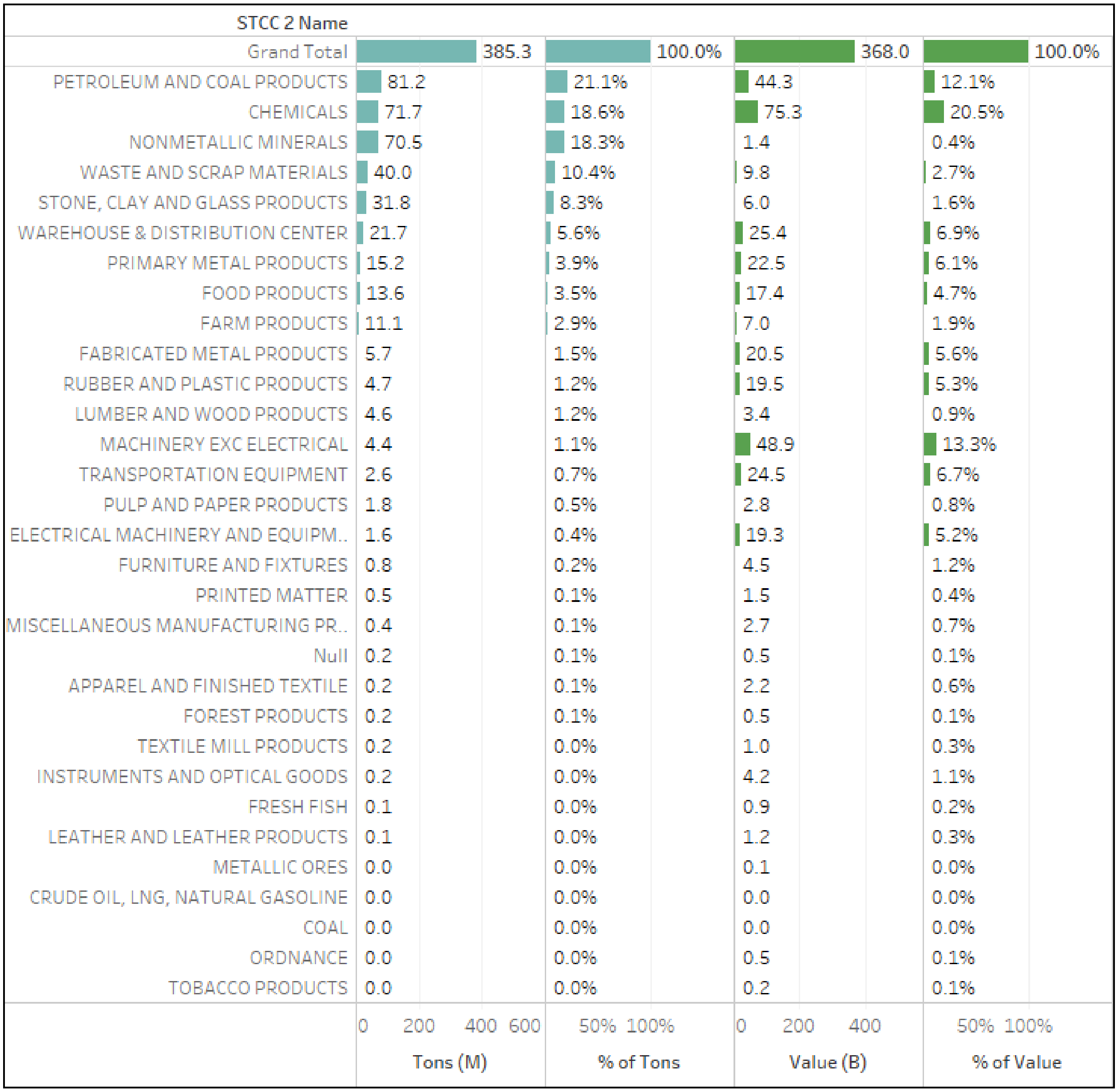


Figure 6-8. H-GAC Port County Truck Tons (M) and Value (B) by Commodity (2015)

Looking at commodity tonnage by directional movement (see Figure 6-9 following), most commodities are moving in all directions, but there are some dominant themes:

- Around 70 percent of petroleum and coal products tonnage and around 50 percent of chemicals tonnage is moving within the port counties.
- Nonmetallic minerals, food products, and farm products tonnage is largely in the inbound direction.
- Warehouse and distribution center traffic and primary metal products tonnage is largely in the outbound direction

STCC 2 Name	Relation to HGAC Port Counties			
	Grand Total	Inbound	Outbound	Within
Grand Total	385.3	136.9	94.7	153.8
PETROLEUM AND COAL PRODUCTS	81.2	10.1	14.6	56.5
CHEMICALS	71.7	13.7	23.3	34.7
NONMETALLIC MINERALS	70.5	50.7	5.2	14.6
WASTE AND SCRAP MATERIALS	40.0	14.0	9.5	16.5
STONE, CLAY AND GLASS PRODUCTS	31.8	9.4	7.5	14.9
WAREHOUSE & DISTRIBUTION CENTER	21.7	6.6	11.3	3.7
PRIMARY METAL PRODUCTS	15.2	1.2	10.9	3.1
FOOD PRODUCTS	13.6	7.2	3.6	2.8
FARM PRODUCTS	11.1	9.7	1.2	0.3
FABRICATED METAL PRODUCTS	5.7	1.4	2.4	2.0
RUBBER AND PLASTIC PRODUCTS	4.7	2.6	1.4	0.7
LUMBER AND WOOD PRODUCTS	4.6	3.5	0.5	0.7
MACHINERY EXC ELECTRICAL	4.4	1.7	1.4	1.3
TRANSPORTATION EQUIPMENT	2.6	1.4	0.3	0.9
PULP AND PAPER PRODUCTS	1.8	1.4	0.3	0.2
ELECTRICAL MACHINERY AND EQUIPME..	1.6	1.0	0.3	0.2
FURNITURE AND FIXTURES	0.8	0.6	0.1	0.1
PRINTED MATTER	0.5	0.3	0.1	0.1
MISCELLANEOUS MANUFACTURING PRO..	0.4	0.2	0.1	0.1
Null	0.2	0.0	0.2	0.0
APPAREL AND FINISHED TEXTILE	0.2	0.1	0.1	0.1
FOREST PRODUCTS	0.2	0.0	0.2	0.0
TEXTILE MILL PRODUCTS	0.2	0.1	0.0	0.0
INSTRUMENTS AND OPTICAL GOODS	0.2	0.1	0.0	0.0
FRESH FISH	0.1	0.0	0.0	0.0
LEATHER AND LEATHER PRODUCTS	0.1	0.0	0.1	0.0
METALLIC ORES	0.0	0.0	0.0	0.0
CRUDE OIL, LNG, NATURAL GASOLINE	0.0	0.0	0.0	
COAL	0.0	0.0		
ORDNANCE	0.0	0.0	0.0	0.0
TOBACCO PRODUCTS	0.0	0.0	0.0	0.0
	0 200 400 600	0 200 400 600	0 200 400 600	0 200 400 600
	Tons (M)	Tons (M)	Tons (M)	Tons (M)

Figure 6-9. H-GAC Port County Truck Tons (M) by Commodity and Direction (2015)

Looking at commodity tonnage by trade type (see Figure 6-10 following), the leading domestic commodities are: petroleum and coal products; chemicals; nonmetallic minerals; waste and scrap; stone, clay and glass products; warehouse and distribution center; and food products. For trucks associated with exports, the leading commodities are chemicals, petroleum and coal products, and farm products. For trucks associated with imports, the leading commodities are primary metal products, chemicals, and nonmetallic minerals. For trucks associated with NAFTA trade, a wide range of commodities are handled, with chemicals representing the highest share.

STCC 2 Name	Trade Type: Grand Total	Domestic	Export	Import	NAFTA
Grand Total	385.3	330.2	21.6	26.2	7.4
PETROLEUM AND COAL PRODUCTS	81.2	72.8	7.5	0.4	0.5
CHEMICALS	71.7	59.5	7.6	3.1	1.5
NONMETALLIC MINERALS	70.5	67.3	0.2	2.9	0.1
WASTE AND SCRAP MATERIALS	40.0	39.0	0.8	0.0	0.1
STONE, CLAY AND GLASS PRODUCTS	31.8	28.4	0.1	3.0	0.3
WAREHOUSE & DISTRIBUTION CENTER	21.7	21.7			
PRIMARY METAL PRODUCTS	15.2	3.4	0.2	11.1	0.6
FOOD PRODUCTS	13.6	10.6	1.1	1.2	0.7
FARM PRODUCTS	11.1	6.6	2.7	0.9	0.9
FABRICATED METAL PRODUCTS	5.7	4.7	0.1	0.6	0.2
RUBBER AND PLASTIC PRODUCTS	4.7	3.9	0.1	0.4	0.3
LUMBER AND WOOD PRODUCTS	4.6	4.0	0.1	0.4	0.1
MACHINERY EXC ELECTRICAL	4.4	2.7	0.5	0.7	0.5
TRANSPORTATION EQUIPMENT	2.6	1.7	0.1	0.2	0.6
PULP AND PAPER PRODUCTS	1.8	1.4	0.3	0.1	0.1
ELECTRICAL MACHINERY AND EQUIPME..	1.6	0.7	0.1	0.3	0.6
FURNITURE AND FIXTURES	0.8	0.5	0.0	0.2	0.2
PRINTED MATTER	0.5	0.5	0.0	0.0	0.0
MISCELLANEOUS MANUFACTURING PRO..	0.4	0.2	0.0	0.1	0.0
Null	0.2	0.0	0.0	0.2	0.0
APPAREL AND FINISHED TEXTILE	0.2	0.1	0.0	0.1	0.0
FOREST PRODUCTS	0.2	0.0	0.0	0.2	0.0
TEXTILE MILL PRODUCTS	0.2	0.1	0.0	0.1	0.0
INSTRUMENTS AND OPTICAL GOODS	0.2	0.1	0.0	0.0	0.0
FRESH FISH	0.1	0.1	0.0	0.0	0.0
LEATHER AND LEATHER PRODUCTS	0.1	0.0	0.0	0.0	0.0
METALLIC ORES	0.0	0.0	0.0	0.0	0.0
CRUDE OIL, LNG, NATURAL GASOLINE	0.0				0.0
COAL	0.0	0.0	0.0		
ORDNANCE	0.0	0.0	0.0	0.0	0.0
TOBACCO PRODUCTS	0.0	0.0	0.0	0.0	0.0
	0 200 400 600 Tons (M)	0 200 400 600 Tons (M)	0 200 400 600 Tons (M)	0 200 400 600 Tons (M)	0 200 400 600 Tons (M)

Figure 6-10. H-GAC Port County Truck Tons (M) by Commodity and Trade Type (2015)

STCC 2 Name	Grand Total	Inbound	Outbound	Within
	Relation to HGAC Port Counties			
Grand Total	368.0	126.0	127.5	114.6
CHEMICALS	75.3	15.6	33.5	26.2
MACHINERY EXC ELECTRICAL	48.9	20.2	16.1	12.7
PETROLEUM AND COAL PRODUCTS	44.3	6.3	7.7	30.4
WAREHOUSE & DISTRIBUTION CENTER	25.4	7.7	13.3	4.4
TRANSPORTATION EQUIPMENT	24.5	12.1	3.2	9.2
PRIMARY METAL PRODUCTS	22.5	3.5	14.7	4.3
FABRICATED METAL PRODUCTS	20.5	4.7	9.0	6.9
RUBBER AND PLASTIC PRODUCTS	19.5	9.8	6.7	3.0
ELECTRICAL MACHINERY AND EQUIPM..	19.3	11.5	4.9	2.8
FOOD PRODUCTS	17.4	10.0	4.0	3.4
WASTE AND SCRAP MATERIALS	9.8	3.6	2.3	4.0
FARM PRODUCTS	7.0	3.8	2.9	0.3
STONE, CLAY AND GLASS PRODUCTS	6.0	1.9	1.8	2.2
FURNITURE AND FIXTURES	4.5	3.2	0.6	0.6
INSTRUMENTS AND OPTICAL GOODS	4.2	2.3	0.7	1.2
LUMBER AND WOOD PRODUCTS	3.4	2.5	0.4	0.5
PULP AND PAPER PRODUCTS	2.8	2.1	0.4	0.3
MISCELLANEOUS MANUFACTURING PR..	2.7	1.0	1.1	0.6
APPAREL AND FINISHED TEXTILE	2.2	1.0	0.8	0.5
PRINTED MATTER	1.5	0.8	0.4	0.4
NONMETALLIC MINERALS	1.4	1.2	0.0	0.1
LEATHER AND LEATHER PRODUCTS	1.2	0.2	0.9	0.1
TEXTILE MILL PRODUCTS	1.0	0.5	0.3	0.2
FRESH FISH	0.9	0.2	0.5	0.2
ORDNANCE	0.5	0.2	0.3	0.1
FOREST PRODUCTS	0.5	0.0	0.4	0.0
Null	0.5	0.0	0.4	0.0
TOBACCO PRODUCTS	0.2	0.0	0.2	0.0
METALLIC ORES	0.1	0.1	0.0	0.0
CRUDE OIL, LNG, NATURAL GASOLINE	0.0	0.0	0.0	
COAL	0.0	0.0		
	0 200 400 Value (B)	0 200 400 Value (B)	0 200 400 Value (B)	0 200 400 Value (B)

Figure 6-11. H-GAC Port County Truck Value (B) by Commodity and Direction (2015)

Looking at commodity value by directional movement (see Figure 6-11 above), key messages are:

- Chemicals are moving in all directions, but the leading direction for value is outbound. Other major commodities where the outbound direction is dominant include warehouse and distribution center, primary metal products, and fabricated metal products.

- Commodities where inbound moves are dominant include machinery except electrical, transportation equipment, electrical machinery and equipment, food products, and rubber and plastic products.
- The only leading commodity with a pronounced preference for internal movement is petroleum and coal products.

Looking at commodity value by trade type (see Figure 6-12 following), the leading domestic commodities are chemicals, petroleum and coal products, machinery except electrical, warehouse and distribution center, transportation equipment, fabricated metal products, and rubber and plastic products. For trucks associated with exports, the leading commodities are chemicals and machinery except electrical. For trucks associated with imports, the leading commodities are primary metal products, machinery except electrical, electrical machinery and equipment, and chemicals. For trucks associated with NAFTA trade, the leading commodities are machinery except electrical, electrical machinery and equipment, chemicals, and transportation equipment.

	Trade Type				
STCC 2 Name	Grand Total	Domestic	Export	Import	NAFTA
Grand Total	368.0	252.5	26.9	46.9	41.7
CHEMICALS	75.3	56.9	8.2	3.1	7.1
MACHINERY EXC ELECTRICAL	48.9	26.8	5.1	6.6	10.4
PETROLEUM AND COAL PRODUCTS	44.3	39.1	4.8	0.2	0.2
WAREHOUSE & DISTRIBUTION CENTER	25.4	25.4			
TRANSPORTATION EQUIPMENT	24.5	15.7	1.2	1.6	5.9
PRIMARY METAL PRODUCTS	22.5	6.0	0.4	14.6	1.6
FABRICATED METAL PRODUCTS	20.5	15.3	0.8	2.9	1.6
RUBBER AND PLASTIC PRODUCTS	19.5	15.0	0.6	2.4	1.6
ELECTRICAL MACHINERY AND EQUIPME..	19.3	6.9	1.1	3.8	7.5
FOOD PRODUCTS	17.4	12.9	2.0	1.6	0.9
WASTE AND SCRAP MATERIALS	9.8	9.5	0.2	0.0	0.1
FARM PRODUCTS	7.0	2.0	1.1	2.3	1.6
STONE, CLAY AND GLASS PRODUCTS	6.0	4.6	0.2	0.9	0.3
FURNITURE AND FIXTURES	4.5	2.3	0.0	0.9	1.3
INSTRUMENTS AND OPTICAL GOODS	4.2	2.2	0.5	0.5	0.9
LUMBER AND WOOD PRODUCTS	3.4	2.9	0.0	0.3	0.2
PULP AND PAPER PRODUCTS	2.8	2.2	0.4	0.1	0.1
MISCELLANEOUS MANUFACTURING PRO..	2.7	1.3	0.1	1.2	0.2
APPAREL AND FINISHED TEXTILE	2.2	1.0	0.0	1.1	0.1
PRINTED MATTER	1.5	1.4	0.0	0.1	0.0
NONMETALLIC MINERALS	1.4	1.4	0.0	0.0	0.0
LEATHER AND LEATHER PRODUCTS	1.2	0.2	0.0	0.9	0.1
TEXTILE MILL PRODUCTS	1.0	0.6	0.0	0.3	0.0
FRESH FISH	0.9	0.6	0.0	0.3	0.0
ORDNANCE	0.5	0.1	0.1	0.3	0.0
FOREST PRODUCTS	0.5	0.0	0.0	0.4	0.0
Null	0.5	0.3	0.0	0.2	0.0
TOBACCO PRODUCTS	0.2	0.0	0.0	0.2	0.0
METALLIC ORES	0.1	0.0	0.0	0.1	0.0
CRUDE OIL, LNG, NATURAL GASOLINE	0.0				0.0
COAL	0.0	0.0	0.0		
	0 500	0 500	0 500	0 500	0 500
	Value (B)	Value (B)	Value (B)	Value (B)	Value (B)

Figure 6-12. H-GAC Port County Truck Value (B) by Commodity and Trade Type (2015)

6.4.3 Trucks Associated with Import and Export Activity

As mentioned in the introduction to this analysis, while Transearch associates trucks with import and export activity, it does not capture all of the import and export related trucking activity. What it does report, however, is of interest, for both general freight planning and for county-level supply chain analysis.

Figure 6-13 and Figure 6-14 attempt to isolate the Transearch-reported truck movements most likely to be associated with port activity in the H-GAC port counties. Figure 6-13 shows export-flagged trucks moving inbound to or within the H-GAC port counties; Figure 6-14 shows import-flagged trucks moving outbound from or within the H-GAC port counties. This 'filtered' analysis captures truck moves associated with 18.6 million tons / 24.2 billion dollars in exports and 24.8 million tons / 43.6 billion dollars in imports.

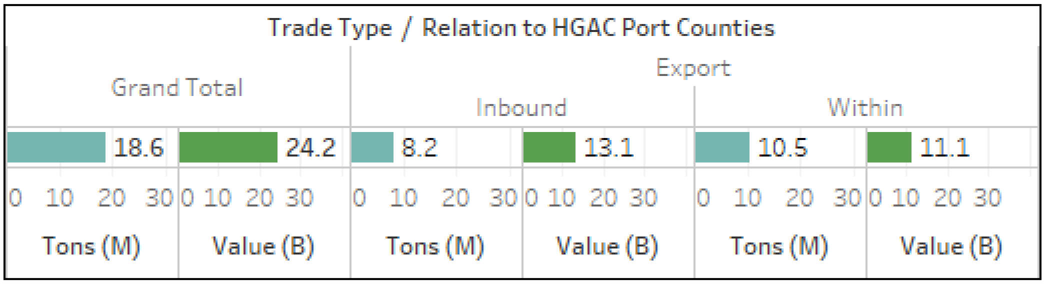


Figure 6-13. H-GAC Export Commodities Moving Inbound or Internally by Truck (2015)

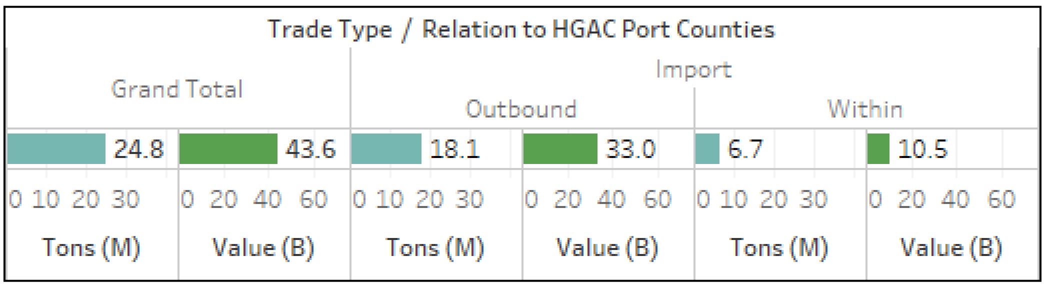


Figure 6-14. H-GAC Import Commodities Moving Outbound or Internally by Truck (2015)

The total truck tonnage from Figure 6-13 and Figure 6-14 – 43.4 million tons – is far lower than the 163 million tons of import/export trade reported for the Houston port district by the American Association of Port Authorities for year 2015. One reason for the large discrepancy is that some share of port import and export trade is associated with rail, or pipeline, or no landside transport mode (where there is waterfront production or consumption); the other is that Transearch is not capturing the relationship between the port move and the landside move.

The USDOT Freight Analysis Framework estimate for Houston waterborne import/export traffic moving inland by truck in year 2015 is around 72.0 million tons; the remainder is assigned as rail, barge, pipeline, or no inland mode. From this, we can infer that Transearch seems to be capturing around 60 percent (43.4 million tons / 72.0 million tons) of landside truck moves associated with waterborne imports and exports.

If we think of the 60 percent as a representative sample, then we can best use Transearch for proportional and share analysis. This may not be completely accurate, as the Transearch omissions may reflect some bias, but on the whole, a share analysis can provide useful and interesting data about where port-related trucks are originating and terminating.

Figure 2-15 and Figure 6-16 below look at the trucks related to export flows, considering trucks moving into H-GAC port counties from other counties and states, as well as trucks moving between H-GAC port counties. Figure 6-17 and Figure 6-18 below look at the trucks related to import flows, considering trucks moving out of H-GAC port counties to other counties and states, as well as trucks moving between H-GAC port counties.

For trucks related to export flows moving from US origins to the region's ports:

- Harris County terminates around 78 percent of truck tonnage and 85 percent of truck value; Brazoria County terminates around 10 percent of tonnage and 8 percent of value; and Galveston County terminates around 12 percent of tonnage and 8 percent of value.
- Of the top ten US regions where trucks related to export tonnage are originated, nine are in Texas, and the top three are the H-GAC counties themselves -- Harris, Brazoria, and Galveston. The single largest origin-destination pair is Harris County to Harris County, which accounts for nearly 36 percent of truck tons associated with exports. Louisiana is the only non-Texas region in the top ten.
- Of the top ten US regions where trucks related to export value are originated, six are in Texas, and the top three are (again) the H-GAC counties themselves -- Harris, Brazoria, and Galveston. The single largest origin-destination pair is (again) Harris County to Harris County, which accounts for nearly 33 percent of truck tons associated with exports. However, unlike tonnage, there is a greater geographic distribution based on value, with Louisiana, Illinois, Oklahoma, California, and Arkansas being among the top 11 trading partners.

For trucks related to import flows moving from the region's ports to US destinations:

- Harris County originates around 90 percent of truck tonnage and 90 percent of truck value; Brazoria County originates around 7 percent of tonnage and 5 percent of value; and Galveston County originates around 3 percent of tonnage and 5 percent of value.
- Of the top ten US regions where trucks related to import tonnage are terminated, seven are in Texas but the H-GAC counties themselves do not dominate. The leading terminating regions are Harris County, California, Louisiana, Fort Bend County, and Oklahoma. Import tonnage tends to involve more states than export tonnage, and the single largest origin-destination pair – Harris County to Harris County – represents 21 percent of tonnage.
- Of the top ten US regions where trucks related to import value are terminated, six are in Texas. The leading terminating regions are Harris County, California, Louisiana, Dallas County, and Oklahoma. Like import tonnage, import value tends to involve more states than export value, and the single largest origin-destination pair – Harris County to Harris County – represents 20 percent of value.

	Destination Region Name			
Origin Region Name	Grand Total	Harris County, TX	Galveston County, TX	Brazoria County, TX
Grand Total	100.0%	78.3%	11.5%	10.3%
Harris County, TX	40.0%	35.9%	1.1%	3.1%
Galveston County, TX	8.3%	3.9%	4.1%	0.3%
Brazoria County, TX	7.9%	2.8%	1.0%	4.1%
Nueces County, TX	5.8%	4.4%	1.3%	0.1%
Jefferson County, TX	4.7%	3.3%	0.7%	0.7%
Louisiana	3.5%	2.9%	0.4%	0.2%
Fort Bend County, TX	1.4%	1.3%	0.1%	0.0%
Wharton County, TX	1.3%	1.0%	0.2%	0.0%
Calhoun County, TX	1.1%	0.6%	0.1%	0.4%
Chambers County, TX	1.0%	0.7%	0.1%	0.2%
San Patricio County, TX	0.9%	0.6%	0.3%	0.1%
Arkansas	0.8%	0.7%	0.0%	0.0%
Orange County, TX	0.7%	0.4%	0.0%	0.2%
California	0.7%	0.6%	0.0%	0.0%
Oklahoma	0.6%	0.6%	0.0%	0.0%
Illinois	0.6%	0.5%	0.1%	0.0%
Jackson County, TX	0.6%	0.6%	0.1%	0.0%
Tarrant County, TX	0.6%	0.6%	0.0%	0.0%
Matagorda County, TX	0.6%	0.4%	0.1%	0.0%
Georgia	0.5%	0.5%	0.0%	0.0%
Dallas County, TX	0.5%	0.5%	0.0%	0.0%
Cameron County, TX	0.5%	0.4%	0.1%	0.0%
	% of Tons	% of Tons	% of Tons	% of Tons

Figure 6-15. Origin-Destination Regions for H-GAC Exports Moving Inbound or Internally by Truck (Tons), 2015

Origin Region Name	Grand Total	Harris County, TX	Brazoria County, TX	Galveston County, TX
Grand Total	100.0%	84.7%	7.7%	7.6%
Harris County, TX	35.6%	32.6%	2.0%	1.0%
Brazoria County, TX	5.3%	2.0%	2.7%	0.5%
Galveston County, TX	5.1%	2.5%	0.2%	2.5%
Nueces County, TX	3.6%	2.8%	0.1%	0.8%
Jefferson County, TX	3.0%	2.2%	0.4%	0.4%
Louisiana	2.7%	2.3%	0.1%	0.2%
Fort Bend County, TX	2.6%	2.5%	0.1%	0.0%
Illinois	2.1%	1.7%	0.1%	0.3%
Oklahoma	1.9%	1.8%	0.0%	0.1%
California	1.9%	1.8%	0.1%	0.0%
Arkansas	1.7%	1.6%	0.0%	0.1%
Tarrant County, TX	1.5%	1.4%	0.1%	0.0%
Dallas County, TX	1.3%	1.2%	0.0%	0.0%
Wisconsin	1.3%	1.1%	0.0%	0.2%
Bexar County, TX	1.2%	1.0%	0.3%	0.0%
Chambers County, TX	1.2%	1.0%	0.1%	0.0%
Travis County, TX	1.1%	1.0%	0.1%	0.0%
Montgomery County, TX	1.0%	1.0%	0.0%	0.0%
Potter County, TX	0.9%	0.9%	0.0%	0.0%
McLennan County, TX	0.9%	0.9%	0.0%	0.0%
Kansas	0.9%	0.8%	0.0%	0.0%
Georgia	0.8%	0.8%	0.0%	0.0%
Calhoun County, TX	0.8%	0.5%	0.3%	0.0%
Indiana	0.8%	0.7%	0.0%	0.0%
Alabama	0.7%	0.6%	0.0%	0.1%
Missouri	0.7%	0.7%	0.0%	0.0%
Michigan	0.7%	0.6%	0.0%	0.0%
Ohio	0.7%	0.6%	0.0%	0.1%
Tennessee	0.7%	0.6%	0.0%	0.0%
Mississippi	0.6%	0.5%	0.0%	0.0%
Guadalupe County, TX	0.6%	0.5%	0.0%	0.0%
Collin County, TX	0.5%	0.5%	0.0%	0.0%
Kentucky	0.5%	0.5%	0.0%	0.0%
Moore County, TX	0.5%	0.5%	0.0%	0.0%
Orange County, TX	0.5%	0.3%	0.1%	0.0%
Nebraska	0.5%	0.5%	0.0%	0.0%

Destination Region Name; axes: 0% 50% 100% 150% — % of Value

Figure 6-16. Origin-Destination Regions for H-GAC Exports Moving Inbound or Internally by Truck (Value), 2015

	Origin Region Name			
Destination Region Name	Grand Total	Harris County, TX	Brazoria County, TX	Galveston County, TX
Grand Total	100.0%	90.2%	7.2%	2.6%
Harris County, TX	23.2%	21.2%	1.8%	0.2%
California	7.7%	6.7%	0.5%	0.5%
Louisiana	4.1%	3.9%	0.1%	0.1%
Fort Bend County, TX	3.5%	3.0%	0.5%	0.0%
Oklahoma	3.3%	3.2%	0.0%	0.1%
Brazoria County, TX	2.9%	1.3%	1.5%	0.1%
Dallas County, TX	2.8%	2.6%	0.1%	0.1%
Montgomery County, TX	2.5%	2.2%	0.2%	0.0%
Tarrant County, TX	2.2%	2.1%	0.1%	0.1%
Bexar County, TX	1.7%	1.6%	0.1%	0.0%
Kansas	1.4%	1.2%	0.1%	0.1%
Travis County, TX	1.3%	1.3%	0.1%	0.0%
Missouri	1.3%	1.2%	0.1%	0.0%
Wisconsin	1.3%	1.3%	0.0%	0.0%
Arizona	1.3%	1.2%	0.0%	0.1%
Arkansas	1.2%	1.2%	0.0%	0.0%
Michigan	1.2%	1.2%	0.0%	0.0%
Jefferson County, TX	1.1%	1.1%	0.0%	0.0%
Illinois	1.1%	1.0%	0.0%	0.1%
Galveston County, TX	1.0%	0.8%	0.1%	0.1%
Georgia	1.0%	0.9%	0.0%	0.1%
Indiana	0.9%	0.8%	0.0%	0.0%
Minnesota	0.8%	0.7%	0.1%	0.1%
Matagorda County, TX	0.8%	0.3%	0.5%	0.0%
Williamson County, TX	0.8%	0.8%	0.0%	0.0%
Florida	0.8%	0.8%	0.0%	0.0%
Iowa	0.8%	0.7%	0.0%	0.0%
Washington	0.7%	0.6%	0.1%	0.1%
Alabama	0.7%	0.7%	0.0%	0.0%
North Carolina	0.7%	0.7%	0.0%	0.0%
New York	0.7%	0.7%	0.0%	0.0%
Tennessee	0.7%	0.6%	0.0%	0.0%
Ohio	0.7%	0.6%	0.0%	0.0%
Colorado	0.7%	0.6%	0.0%	0.0%
Liberty County, TX	0.6%	0.6%	0.0%	0.0%
Waller County, TX	0.6%	0.6%	0.1%	0.0%
Collin County, TX	0.6%	0.6%	0.0%	0.0%
Kentucky	0.5%	0.5%	0.0%	0.0%
Nueces County, TX	0.5%	0.5%	0.0%	0.0%
South Carolina	0.5%	0.5%	0.0%	0.0%
Nevada	0.5%	0.5%	0.0%	0.0%
Hidalgo County, TX	0.5%	0.5%	0.0%	0.0%
El Paso County, TX	0.5%	0.4%	0.0%	0.0%
McLennan County, TX	0.5%	0.4%	0.0%	0.0%
Mississippi	0.5%	0.5%	0.0%	0.0%
	0% 50% 100% 150%	0% 50% 100% 150%	0% 50% 100% 150%	0% 50% 100% 150%
	% of Tons	% of Tons	% of Tons	% of Tons

Figure 6-17. Origin-Destination Regions for H-GAC Imports Moving Outbound or Internally by Truck (Tons), 2015

Destination Region Name	Origin Region Name: Grand Total	Harris County, TX	Galveston County, TX	Brazoria County, TX
Grand Total	100.0%	90.4%	5.1%	4.5%
Harris County, TX	21.4%	20.2%	0.5%	0.6%
California	7.4%	5.9%	0.9%	0.6%
Louisiana	3.6%	3.2%	0.3%	0.1%
Dallas County, TX	3.3%	3.0%	0.2%	0.1%
Oklahoma	3.0%	2.7%	0.2%	0.1%
Fort Bend County, TX	2.6%	2.5%	0.0%	0.1%
Bexar County, TX	2.5%	2.1%	0.1%	0.2%
Tarrant County, TX	2.4%	2.3%	0.1%	0.1%
Michigan	2.0%	2.0%	0.0%	0.0%
Brazoria County, TX	2.0%	1.1%	0.0%	0.8%
Travis County, TX	1.9%	1.8%	0.1%	0.1%
Montgomery County, TX	1.9%	1.8%	0.1%	0.0%
Arizona	1.7%	1.4%	0.2%	0.0%
Illinois	1.5%	1.3%	0.2%	0.0%
Wisconsin	1.4%	1.3%	0.0%	0.0%
Indiana	1.4%	1.3%	0.1%	0.0%
Arkansas	1.3%	1.2%	0.0%	0.0%
Missouri	1.3%	1.2%	0.1%	0.1%
Florida	1.3%	1.3%	0.0%	0.0%
Ohio	1.3%	1.2%	0.1%	0.0%
Kansas	1.2%	1.1%	0.1%	0.1%
Georgia	1.1%	1.0%	0.1%	0.0%
Tennessee	1.1%	1.0%	0.0%	0.0%
New York	1.1%	1.0%	0.0%	0.0%
Colorado	1.1%	0.9%	0.1%	0.0%
Pennsylvania	0.9%	0.9%	0.0%	0.0%
Minnesota	0.9%	0.8%	0.1%	0.1%
Kentucky	0.9%	0.9%	0.0%	0.0%
Jefferson County, TX	0.8%	0.8%	0.0%	0.0%
Washington	0.8%	0.6%	0.1%	0.1%
Iowa	0.8%	0.7%	0.1%	0.0%
Galveston County, TX	0.8%	0.6%	0.1%	0.0%
Alabama	0.7%	0.7%	0.0%	0.0%
Collin County, TX	0.7%	0.7%	0.0%	0.0%
North Carolina	0.7%	0.7%	0.0%	0.0%
Williamson County, TX	0.7%	0.6%	0.0%	0.0%
Oregon	0.6%	0.4%	0.1%	0.1%
Mississippi	0.5%	0.5%	0.0%	0.0%
South Carolina	0.5%	0.5%	0.0%	0.0%
Hidalgo County, TX	0.5%	0.4%	0.0%	0.0%
Nevada	0.5%	0.4%	0.0%	0.0%
El Paso County, TX	0.5%	0.4%	0.0%	0.1%
Utah	0.5%	0.4%	0.0%	0.0%
	% of Value (0% 50% 100% 150%)	% of Value (0% 50% 100% 150%)	% of Value (0% 50% 100% 150%)	% of Value (0% 50% 100% 150%)

Figure 6-18. Origin-Destination Regions for H-GAC Imports Moving Outbound or Internally by Truck (Value), 2015

6.5 Commodity Analysis - Rail

Railroad commodities originating, terminating, and passing through the Houston region mirror, to a large extent, railroad traffic in Texas as a whole. Data from the Association of American Railroads (AAR) indicate that in 2015, the state of Texas generated 2.1 million carloads of railroad freight traffic, originating from industries, ports, rail-truck intermodal terminals, and other sources of rail traffic; that same year, 3.6 million carloads of railroad freight traffic were delivered to industries, ports, and intermodal and transload terminals within the state of Texas.[126] (One year earlier, the combined volume of originating, terminating, and pass-through railroad freight traffic in the state of Texas totaled 411.5 million tons in 2014, which is the equivalent of approximately 22.9 million additional trucks that were kept off of Texas highways.) Table 6-1 shows the volume of traffic by major commodity originated and terminated in Texas in 2015, according to AAR data.

Table 6-1. Railroad Freight Carloads Originated and Terminated in Texas, 2015

Originated Traffic	Carloads	Percent	Terminated Traffic	Carloads	Percent
Total Carloads	2,119,100	100%	Total Carloads	3,576,900	100%
Intermodal	710,000	34%	Intermodal	983,900	28%
Chemicals	447,300	21%	Nonmetallic Minerals	503,600	14%
Nonmetallic Minerals	277,300	13%	Coal	477,800	13%
Petroleum	119,100	6%	Chemicals	320,000	9%
Transportation Equipment	106,700	5%	Farm Products	183,500	5%
Other/Unknown	458,700	22%	Other/Unknown	1,107,900	31%

Source: AAR/Rail Inc.

The Houston region is an important originator and receiver of freight railroad traffic, owing to its high-volume port operations, its large chemical and industrial manufacturing base, and its large population.

This Chapter presents findings from two separate analyses to place the port-related supply chain findings within the larger context of overall regional rail activity in the PAMS study area. The two separate analyses are:

- Public Waybill-sourced analysis of rail carload for the aggregated Houston-Galveston-Brazoria TX region[127] for years 2001, 2006, 2011, and 2016
- Confidential Waybill-sourced analysis of rail carload shares (not volumes) for HCAC's three port-hosting counties[128] for year 2015

126 https://www.aar.org/Style%20Library/railroads_and_states/dist/data/pdf/Texas-2012.pdf

127 The Houston-Galveston-Brazoria TX region includes 32 counties: Angelina, Austin, Brazoria, Brazos, Burleson, Calhoun, Chambers, Colorado, Fayette, Fort Bend, Freestone, Galveston, Grimes, Harris, Houston, Jackson, Lavaca, Leon, Liberty, Matagorda, Montgomery, Nacogdoches, Polk, Robertson, Sabine, San Augustine, Shelby, Victoria, Walker, Waller, Washington, and Wharton.

128 The three H-GAC port counties are Brazoria, Galveston, and Harris, which contain the ports of Houston, Texas City, Galveston, and Freeport.

Together, these analyses capture both port-related and non-port related data. Information from the Public Waybill Sample is highly aggregated but can be readily analyzed and published. The Confidential Waybill Sample is much more specific, but data or analyses cannot be published unless they are aggregated to a level that ensures confidentiality consistent with STB guidelines. Given these limitations, we can provide general summaries of rail volumes by origin-destination region, commodity type, and rail equipment type, as useful background for the previous discussion of Port-related industry supply chains, although we cannot specify the exact types and amounts of rail freight that are directly related to port facilities and port customers,

To assist the reader, some key definitions are as follows:

- STCC code – the reported commodity type using the Standard Transported Commodity Classification system. STCC codes have different levels of specificity; this analysis uses the 2-digit level groupings, which are fairly general but useful for high-level overview analyses.
- Carloads – the number of railcars of all types carrying revenue traffic. When used alone, the term is a measure of total rail volume.
- Carload and Intermodal – when these terms are used together, they refer to different physical types of railcars. Intermodal railcars carry intermodal shipping containers, which themselves may be loaded or empty. Carload railcars carry all other types of traffic.

6.5.1 Public Waybill Analysis

Trade Type

In 2016, the Houston-Galveston-Brazoria TX waybill analysis region (the “region”) received 1,032,866 carloads of terminating traffic and generated 476,942 carloads of originating traffic, for a total of 1,509,808 carloads originated and terminated. Of this total, 125,972 carloads were both originated and terminated in the region, and is counted as both originating and terminating traffic. The overall profile of traffic by trade type is shown in Table 6-2 below. Roughly two-thirds of rail carloads were inbound receipts from other regions; 9 percent were moves within the region; and 25 percent were outbound shipments to other regions.

Table 6-2. Regional Rail Carloads by Trade Type, 2016

	Carloads	Share
Within Region	125,972	9%
Inbound from Other Regions	906,894	66%
Outbound to Other Regions	350,970	25%
Total by Trade Type	1,383,836	100%

Terminated Traffic Volume

Terminated traffic consists of traffic moving inbound from other regions as well as traffic moving within the region (which is both originated and terminated in the region). In 2016, the leading commodities for rail traffic terminated in the region were: chemical products; coal; nonmetallic minerals; miscellaneous mixed shipments (intermodal containers); transportation equipment; and agricultural produce. Together, these commodity groups represent about 88 percent of terminated rail carloads. Intermodal carloads represented around 17 percent of terminated carloads, and were primarily associated with the miscellaneous mixed shipments (loaded containers) and shipping containers (empty containers) commodity codes. See Figure 6-19 following.

STCC2 Code	STCC2 Name	Carload	Intermodal	Grand Total
28	Chemical Products	215,469	8,080	223,549
11	Coal	167,560		167,560
14	Nonmetallic Minerals	161,725		161,725
46	Misc Mixed Shipments		152,280	152,280
37	Transportation Equipment	96,964	720	97,684
1	Agriculture	93,171		93,171
29	Refined Petroleum Products	58,064	520	58,584
32	Clay, Concrete, Glass	22,511		22,511
20	Food	16,170	280	16,450
33	Metal	15,796	80	15,876
42	Shipping Containers		11,840	11,840
40	Waste	5,716	160	5,876
24	Lumber	4,160		4,160
26	Paper	1,600		1,600
Grand Total		858,906	173,960	1,032,866
		0K 500K 1000K 1500K Carloads	0K 500K 1000K 1500K Carloads	0K 500K 1000K 1500K Carloads

Figure 6-19. Carloads Terminated in the Region by Commodity and Service (2016)

Looking at the origin regions for terminated traffic, and excluding moves of less than 5000 carloads (see Figure 6-20 following), the leading origins in 2016 were:

- Casper WY-ID-UT: coal
- Within-region traffic: chemicals, transportation equipment, and refined petroleum
- San Antonio TX: nonmetallic minerals, clay/concrete/glass, transportation equipment
- Los Angeles-Riverside-Orange County CA: miscellaneous mixed shipments (intermodal containers)
- Wichita KS-OK: agriculture

- Chicago-Gary-Kenosha IL-IN-WI: miscellaneous mixed shipments (intermodal containers), transportation equipment, refined petroleum
- Dallas-Fort Worth TX-AR-OK: nonmetallic minerals, transportation equipment, intermodal containers
- Baton Rouge LA-MA and Lake Charles LA: chemicals
- Austin-San Marcos TX and Oklahoma City OK: nonmetallic minerals

By commodity, the origin regions generally cluster as follows.

- Intermodal: primarily from Southern California, with some from Chicago and a limited amount from Dallas and Oakland; it is interesting to note the absence of east coast origins from this list, which suggests the region is not being served via US east coast intermodal ports. Intermodal traffic is the third-largest rail commodity in Texas by tonnage, but the largest rail commodity by carloads, and for every railroad intermodal unit destined to, from, or within the state of Texas, there are two more railroad intermodal units moving through the state en route to somewhere else. The U.S. West Coast remains the primary origin and destination for intermodal traffic moving to, from, and through Texas. The number of intermodal containers and trailers shipped by U.S. railroads equals the number of all other loaded railcars transported by the industry, although intermodal has a slight lead.
- Coal: from the Powder River Basin in Wyoming
- Chemicals: from within the region itself, and from other gulf coast locations
- Nonmetallic minerals: from outside the region in Texas and Oklahoma
- Agriculture: from Kansas
- Transportation equipment: from a variety of origins

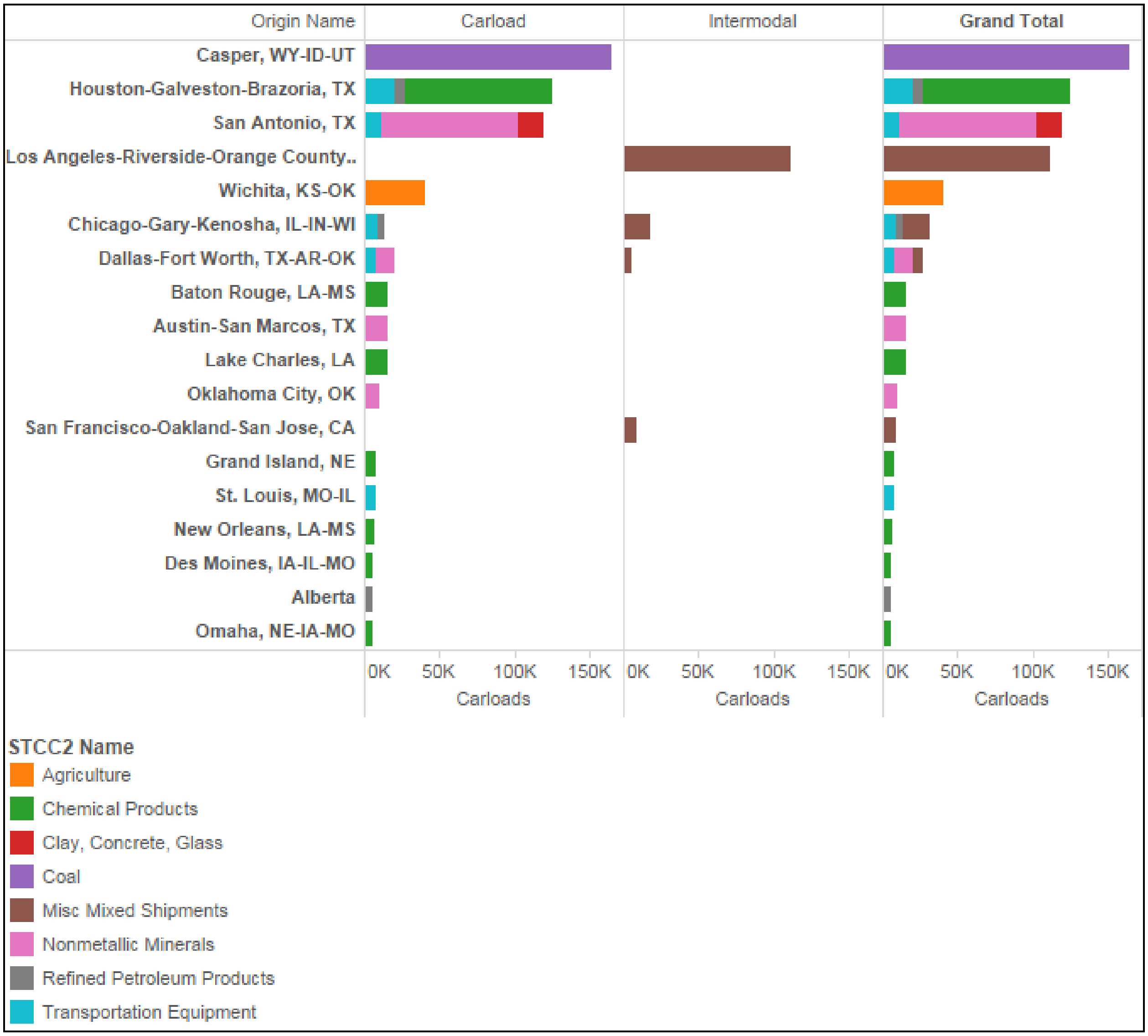


Figure 6-20. Origins and Commodities for Carloads (>5000) Terminated in the Region (2016)

Table 6-3. Commodity Trends for Carloads Terminated in the Region (2001-2016)

STCC2 Code	STCC2 Name	2001	2006	2011	2016
28	Chemical Products	115,731	142,120	175,994	223,549
11	Coal	192,526	252,361	220,000	167,560
14	Nonmetallic Minerals	164,765	196,108	121,125	161,725
46	Misc Mixed Shipments	145,920	234,360	209,760	152,280
37	Transportation Equipment	70,137	83,881	60,206	97,684
1	Agriculture	77,225	109,082	97,994	93,171
29	Refined Petroleum Products	53,657	47,420	58,072	58,584
32	Clay, Concrete, Glass	14,152	15,252	4,372	22,511
20	Food	11,176	13,020	22,524	16,450
33	Metal	30,912	37,672	36,876	15,876
42	Shipping Containers	38,280	14,320	22,560	11,840
40	Waste	10,728	9,176	9,464	5,876
24	Lumber	6,320	7,520	2,920	4,160
26	Paper	2,800	3,200	3,440	1,600
10	Metallic Ores	760	160		
13	Crude Petroleum			7,045	
34	Metal Products	216			
35	Machinery	480			
41	Misc Freight Shipments	960			
44	Freight Forwarder Traffic	2,568			
45	Shipper Association Traffic	480			
48	Hazardous Materials	240			
Grand Total		940,033	1,165,972	1,052,592	1,032,866

Key trends in commodity movements are summarized in Table 6-3 above. Between 2001 and 2016, the data shows:

- Chemical products: strong performance with a near-doubling of traffic. Lower-cost production methods for crude oil and natural gas, as well as low interest rates that have encouraged capital investment in new or retrofitted manufacturing facilities, have opened up new opportunities for increased U.S. petrochemical production, both for domestic and overseas markets. As the center of petrochemical manufacturing in the U.S., Houston has seen an increase in the movement of chemical traffic by rail. Chemical shipments accounted for 12 percent of non-intermodal traffic on U.S. railroads in 2017. Railroads transported 1.61 million carloads of chemicals in 2017, an increase of 1.2 percent, and the highest full-year volume ever handled by the U.S. railroad industry.

- Coal: increasing though 2011 and subsequent decline to below-2001 levels. The decline in coal traffic reflects the decline in the use of coal of electric power in the U.S. Coal's share of U.S. electricity generation has fallen from almost 50 percent in 2011 to 30 percent in 2017, according to the U.S. Energy Information Administration as power plants transition away from coal to other fuels, mainly domestically produced natural gas. U.S. coal exports reached a low level of just over 60.2 million tons in 2016, though coal exports in 2018 were nearly double that at 115.6 million tons, largely driven by exports to Europe due to nuclear power station outages and retirements.
- Nonmetallic minerals: variable but generally unchanged
- Miscellaneous mixed shipments: increasing dramatically between 2001 and 2006, then declining to near 2001 levels; interestingly over the same period the number of empty shipping containers has declined substantially
- Transportation equipment, clay/concrete/glass, and food: generally increasing
- Agriculture also increasing. Agriculture products comprise a variety of commodities, such as wheat, corn, and soybeans, which are moved by rail from locations where crops are harvested to food processing facilities such as flour mills and vegetable oil plants; feedlots and feed mills (about 40 percent of U.S. corn production is used for animal feed); or U.S. ports and border crossings for export to other countries. A sub-category of agriculture products is ethanol, which is moved by rail from production centers in the U.S. Midwest to refineries across the country. Rail transportation of agriculture products can be impacted by volatility associated with weather events, changes in trade policies, and global supply and demand.
- Refined petroleum products: generally unchanged

Key changes in origin regions for terminating traffic – which are primarily driven by changes in demand for the commodities associated with those regions, and secondarily by changes in the location sourcing for those commodities -- are summarized in Table 6-4. Origin Region Trends for Carloads Terminated in the Region (2001-2016). Between 2001 and 2016, the data shows an overall increase from 940,033 carloads to 1,032,866 carloads, with:

- Casper WY-ID-UT: declining to pre-2001 levels
- Null (traffic not associated with a specific origin due to confidentiality): increasing
- Within region: increasing possibly due to increased movements of plastic resins using Storage in Transit rail cars with intra-region transfers between production and packaging facilities
- San Antonio TX: increasing

- Los Angeles-Riverside-Orange County: after increases in 2006 and 2011, has returned to 2001 levels, based on changes in intermodal traffic , which could be associated with an increase in container shipping services from Asia, directly serving the H-GAC region's ports, rather than imports arriving in west coast ports and being transferred to the Houston region by rail
- Chicago-Gary-Kenosha IL-IN-WI and Wichita: increasing
- Dallas-Fort Worth TX-AR-OK: declining
- New Orleans, LA-MS and Baton Rouge LA-MS: increasing

Table 6-4. Origin Region Trends for Carloads Terminated in the Region (2001-2016)

Origin Name	2001	2006	2011	2016
Casper, WY-ID-UT	183,158	243,525	217,221	168,448
Null	131,232	146,385	141,592	145,078
Houston-Galveston-Brazoria, TX	82,702	87,925	83,072	125,972
San Antonio, TX	99,081	108,085	72,514	119,099
Los Angeles-Riverside-Orange County, CA-AZ	114,968	203,896	187,920	118,256
Chicago-Gary-Kenosha, IL-IN-WI	34,830	30,179	48,006	47,503
Wichita, KS-OK	23,441	21,802	23,210	41,613
Dallas-Fort Worth, TX-AR-OK	49,367	53,849	46,133	36,413
Baton Rouge, LA-MS	4,260	4,440	18,272	18,560
Lake Charles, LA	3,640	1,828	2,424	16,576
Austin-San Marcos, TX	26,175	28,335	17,112	15,952
St. Louis, MO-IL	15,744	24,308	18,008	14,514
Grand Island, NE	1,394	8,499	9,681	12,034
Des Moines, IA-IL-MO	4,738	8,601	4,623	11,810
Oklahoma City, OK	24,217	19,761	9,879	10,939
New Orleans, LA-MS	6,288	4,656	5,182	10,848
San Francisco-Oakland-San Jose, CA	15,468	22,956	8,640	10,320
Minneapolis-St. Paul, MN-WI-IA	1,369	5,611	8,610	9,895
Omaha, NE-IA-MO	3,714	8,075	9,564	8,533
Beaumont-Port Arthur, TX	9,392	6,692	7,884	8,240

Originated Traffic Volume

Originated traffic consists of traffic moving to other regions as well as traffic moving within the region (which is both originated and terminated in the region). In 2016, the leading commodities for rail traffic originated in the region were: chemical products; miscellaneous mixed shipments (intermodal containers); transportation equipment; refined petroleum products; and empty shipping containers. Together, these commodity groups represent about 95 percent of originated rail carloads. Intermodal carloads represented around one-third of originated carloads, and were primarily associated with the miscellaneous mixed shipments (loaded containers) and shipping containers (empty containers) commodity codes. See Figure 6-21.

STCC2 Code	STCC2 Name	Carload	Intermodal	Grand Total
28	Chemical Products	248,914	16,240	265,154
46	Misc Mixed Shipments		117,240	117,240
37	Transportation Equipment	34,872		34,872
29	Refined Petroleum Products	30,964	680	31,644
42	Shipping Containers		18,520	18,520
40	Waste	1,640	1,040	2,680
33	Metal	2,144		2,144
20	Food	280	1,760	2,040
13	Crude Petroleum	848		848
24	Lumber	600	240	840
14	Nonmetallic Minerals	560		560
32	Clay, Concrete, Glass	400		400
Grand Total		321,222	155,720	476,942
		0K 200K 400K 600K Carloads	0K 200K 400K 600K Carloads	0K 200K 400K 600K Carloads

Figure 6-21. Carloads Originated in the Region by Commodity and Service (2016)

Looking at the destination regions for originated traffic, and excluding moves of less than 5000 carloads (see Figure 6-22 following), the leading destinations in 2016 were:

- Within-region traffic: chemicals, transportation equipment, and refined petroleum
- Los Angeles-Riverside-Orange County CA: miscellaneous mixed shipments (loaded intermodal containers), empty shipping containers, and chemicals
- Chicago-Gary-Kenosha IL-IN-WI: chemicals and miscellaneous mixed shipments
- Dallas-Fort Worth TX-AR-OK: chemicals
- Mexico: empty shipping containers
- Ontario: chemicals

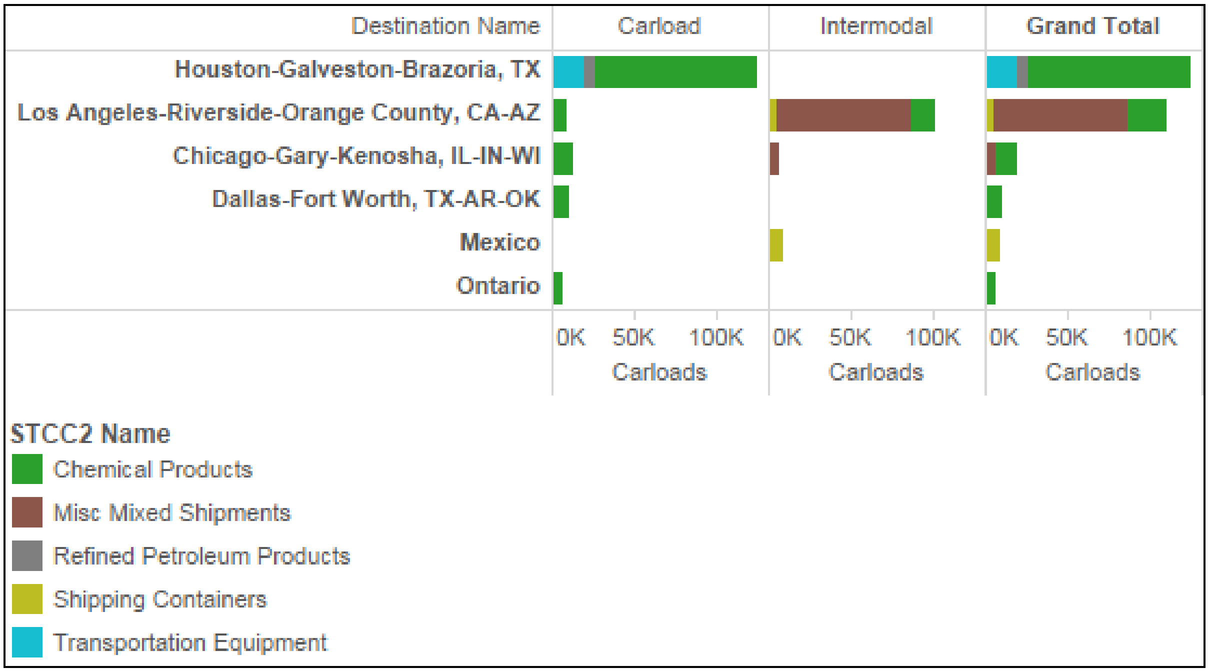


Figure 6-22. Destinations and Commodities for Carloads (>5000) Originated in the Region (2016)

Key trends in commodity movements are summarized in Table 6-5 following. Between 2001 and 2016, the data shows an overall decline from 603,621 carloads to 476,942 carloads, with:

- Chemical products: declining by around 50,000 carloads compared to 2001 volume; this contrasts with the near doubling of inbound chemical traffic
- Miscellaneous mixed shipments: declining by around 40,000 carloads compared to 2001 volume
- Transportation equipment: more than twice the 2001 volume
- Refined petroleum products: less than half the 2001 volume

Table 6-5. Commodity Trends for Carloads Originated in the Region (2001-2016)

STCC2 Code	STCC2 Name	2001	2006	2011	2016
28	Chemical Products	314,125	275,140	237,414	265,154
46	Misc Mixed Shipments	156,880	185,960	152,360	117,240
37	Transportation Equipment	14,499	10,702	12,456	34,872
29	Refined Petroleum Products	65,593	69,764	40,898	31,644
42	Shipping Containers	18,940	36,520	22,320	18,520
40	Waste	7,680	6,208	7,980	2,680
33	Metal	3,208	12,740	7,156	2,144
20	Food	3,796	2,756	3,000	2,040
13	Crude Petroleum	236			848
24	Lumber	3,560	4,240	320	840
14	Nonmetallic Minerals			1,712	560
32	Clay, Concrete, Glass	3,144	884	2,164	400
1	Agriculture	240			
26	Paper	3,160			
30	Rubber/Plastics	320			
44	Freight Forwarder Traffic	8,240			
48	Hazardous Materials		200		
Grand Total		603,621	605,114	487,780	476,942

Key changes in destination regions for originating traffic are summarized in Table 6-6 following. Between 2001 and 2016, the data shows:

- Within region: increasing
- Los Angeles-Riverside-Orange County: declining
- Null (no specified destination): declining
- Chicago-Gary-Kenosha IL-IN-WI: declining
- Dallas-Fort Worth TX-AR-OK: relatively unchanged

Table 6-6. Destination Region Trends for Carloads Originated in the Region (2001-2016)

Destination Name	2001	2006	2011	2016
Houston-Galveston-Brazoria, TX	82,702	87,925	83,072	125,972
Los Angeles-Riverside-Orange County, CA-AZ	171,028	209,124	178,400	117,360
Null	104,316	107,488	89,926	71,083
Chicago-Gary-Kenosha, IL-IN-WI	29,000	21,800	22,924	22,624
Dallas-Fort Worth, TX-AR-OK	14,840	12,900	10,640	15,596
Mexico			2,880	14,320
San Francisco-Oakland-San Jose, CA	14,772	18,220	6,880	7,760
Province of Ontario	16,560	11,120	7,040	7,280
Beaumont-Port Arthur, TX	4,724	3,772	3,991	6,160
Baton Rouge, LA-MS	2,280	3,356	3,028	5,056
New Orleans, LA-MS	12,148	4,880	1,920	4,760
San Antonio, TX	5,084	4,160	3,336	3,960
Salt Lake City-Ogden, UT-ID	3,668	5,584	2,208	3,600
Kansas City, MO-KS	3,108	3,156	2,208	3,440
Little Rock-North Little Rock, AR	1,520	2,929	2,680	3,128
Phoenix-Mesa, AZ-NM	1,840	2,096	2,572	3,060
New York-No. New Jersey-Long Island, NY-NJ-CT-PA-MA-VT	8,680	5,700	3,840	2,920
Seattle-Tacoma-Bremerton, WA	3,360	4,320	2,800	2,440
Indianapolis, IN-IL	2,160	1,360	720	2,400
Wilmington, NC-SC	2,200	2,280	2,480	2,400

Share Analysis by Type of Move

Finally, we can summarize the analysis by examining traffic totals by type of move -- inbound, outbound, or internal – for year 2016. Figure 6-23 shows regional carload shares by commodity and service, while Figure 6-24 shows regional carload shares by commodity and direction of move.

- Carload represents 76 percent of traffic, while intermodal accounts for 24 percent. Chemicals account for 28 percent, miscellaneous mixed shipments for 20 percent, coal and nonmetallic minerals for 12 percent each, transportation equipment for 8 percent, agriculture for 7 percent, and refined petroleum products for 6 percent.
- As previously noted, around 66 percent of carloads are inbound, 25 percent are outbound, and 9 percent are internal. Chemicals are primarily in the outbound (originated) direction, but inbound and internal moves are also very significant; chemicals make up nearly 50 percent of outbound traffic and nearly 80 percent of

internal traffic. Most other commodities are in the inbound direction, with some important commodities – like coal, nonmetallic minerals, and agriculture – being almost exclusively in the inbound direction. These inbound commodities are also exported through the region's ports.

STCC2 Code	STCC2 Name	Carload	Intermodal	Grand Total
28	Chemical Products	26.5%	1.8%	28.3%
46	Misc Mixed Shipments		19.5%	19.5%
11	Coal	12.3%		12.3%
14	Nonmetallic Minerals	11.9%		11.9%
37	Transportation Equipment	7.6%	0.1%	7.6%
1	Agriculture	6.8%		6.8%
29	Refined Petroleum Products	5.9%	0.1%	6.0%
42	Shipping Containers		2.2%	2.2%
32	Clay, Concrete, Glass	1.7%		1.7%
20	Food	1.2%	0.2%	1.3%
33	Metal	1.3%	0.0%	1.3%
40	Waste	0.5%	0.1%	0.6%
24	Lumber	0.3%	0.0%	0.4%
26	Paper	0.1%		0.1%
13	Crude Petroleum	0.1%		0.1%
Grand Total		76.1%	23.9%	100.0%
		0% 50% 100% 150% % of Carloads	0% 50% 100% 150% % of Carloads	0% 50% 100% 150% % of Carloads

Figure 6-23. Shares of Regional Carloads by Commodity and Service (2016)

STCC2 Code	STCC2 Name	Inbound	Outbound	Internal	Grand Total
28	Chemical Products	9.0%	12.0%	7.2%	28.3%
46	Misc Mixed Shipments	11.0%	8.6%		19.5%
11	Coal	12.3%			12.3%
14	Nonmetallic Minerals	11.8%	0.0%		11.9%
37	Transportation Equipment	5.4%	0.9%	1.3%	7.6%
1	Agriculture	6.8%			6.8%
29	Refined Petroleum Products	3.7%	1.8%	0.5%	6.0%
42	Shipping Containers	0.9%	1.3%		2.2%
32	Clay, Concrete, Glass	1.6%	0.0%	0.0%	1.7%
20	Food	1.2%	0.1%	0.0%	1.3%
33	Metal	1.1%	0.2%		1.3%
40	Waste	0.4%	0.2%	0.0%	0.6%
24	Lumber	0.3%	0.1%		0.4%
26	Paper	0.1%			0.1%
13	Crude Petroleum		0.1%		0.1%
Grand Total		65.7%	25.3%	9.0%	100.0%
		50% 100% % of Carloads	50% 100% % of Carloads	50% 100% % of Carloads	50% 100% % of Carloads

Figure 6-24. Shares of Regional Carloads by Commodity and Direction (2016)

6.5.2 Confidential Waybill Analysis

Analysis of the year 2015 Confidential Waybill Sample suggests that the three port H-GAC counties generally account for over four-fifths of the total carloads in the 32-county Houston-Galveston-Freeport TX region. The specific number cannot be reported due to confidentiality requirements, so this analysis focuses on shares, which can be readily compared with the public waybill shares presented in Figure 6-23 and Figure 6-24 previously.

The leading commodities handled by the H-GAC port counties are summarized in Figure 6-25 following. Comparing the regional and H-GAC port county shares:

- Some results are largely similar. Chemicals represent 31.5 percent in the H-GAC port counties, vs. 28.3 percent in the region. Nonmetallic minerals represent 7.8 percent in the H-GAC port counties, vs 11.9 percent in the region. Transportation equipment represents 7.7 percent in the H-GAC port counties, vs 7.6 percent in the region. Agriculture represents 5.6 percent in the port counties, vs. 6.8 percent in the region.
- Other results show meaningful differences. Miscellaneous mixed shipments (loaded containers) represent 26.0 percent in the H-GAC port counties, vs 19.5 percent in the region. Refined petroleum products represent 7.0 percent in the H-GAC port counties, vs. 12.3 percent in the region. Coal represents just 0.5 percent in the H-GAC port counties, vs. 12.3 percent for the region. Overall, 36 percent of carloads in the H-GAC port counties are intermodal, compared to around 24 percent for the larger region; this is likely due to the combined effects

of concentrated intermodal traffic and the absence of coal traffic in the H-GAC port counties.

The leading trade directions for H-GAC port counties rail traffic are summarized in Figure 6-26 following. Most of the results are consistent with distribution patterns in the public waybill analysis, but there are several differences worth noting.

- Chemical products: in the public waybill, a significant share of the traffic (7 percent) is moving within the region. In the confidential waybill, only around 3 percent of traffic is moving between the H-GAC port counties; the other 4 percent is largely shifted to the "outbound" column. The shifted traffic represents moves that are outbound from the H-GAC port counties which terminate within the larger Houston-Galveston-Brazoria region.
- Overall directionality: as previously noted, regional traffic is 66 percent inbound / 25 percent outbound / 9 percent internal. For the H-GAC counties, the figures are 58 percent inbound, 37 percent outbound, and 5 percent internal. This appears to be due primarily to the shift in chemical traffic from the internal to the outbound column and to the loss of coal volume from the inbound column.

STCC Code	STCC Name	Carload	Intermodal	Grand Total
28	Chemical Products	29.2%	2.3%	31.5%
46	Misc Mixed Shipments		26.0%	26.0%
14	Nonmetallic Minerals	7.8%	0.0%	7.8%
37	Transportation Equipment	7.3%	0.3%	7.7%
29	Refined Petroleum Products	6.8%	0.1%	7.0%
1	Agriculture	5.6%	0.1%	5.6%
42	Shipping Containers		3.5%	3.5%
20	Food	1.6%	0.9%	2.5%
32	Clay, Concrete, Glass	1.7%	0.1%	1.8%
33	Metal	1.5%	0.1%	1.5%
13	Crude Petroleum	0.8%		0.8%
40	Waste	0.4%	0.2%	0.6%
11	Coal	0.5%		0.5%
26	Paper	0.2%	0.3%	0.5%
23	Apparel		0.4%	0.4%
24	Lumber	0.4%	0.1%	0.4%
36	Electrical Equipment	0.0%	0.3%	0.3%
30	Rubber/Plastics		0.2%	0.2%
35	Machinery	0.0%	0.2%	0.2%
34	Metal Products	0.0%	0.2%	0.2%
41	Misc Freight Shipments	0.0%	0.2%	0.2%
25	Furniture		0.2%	0.2%
39	Misc Mfg Products		0.2%	0.2%
44	Freight Forwarder Traffic		0.1%	0.1%
10	Metallic Ores	0.0%		0.0%
9	Fish		0.0%	0.0%
48	Hazardous Materials	0.0%	0.0%	0.0%
38	Instruments		0.0%	0.0%
22	Textiles		0.0%	0.0%
27	Printed Goods		0.0%	0.0%
19	Ordnance		0.0%	0.0%
47	Small Packaged Freight		0.0%	0.0%
Grand Total		64.0%	36.0%	100.0%
		0% 50% 100% % of Carloads	0% 50% 100% % of Carloads	0% 50% 100% % of Carloads

Figure 6-25. H-GAC Port County Shares of Carloads by Commodity (2015)

STCC Code	STCC Name	Inbound HGAC Port Counties	Outbound HGAC Port Counties	Within HGAC Port Counties	Grand Total
28	Chemical Products	10.7%	17.9%	2.9%	31.5%
46	Misc Mixed Shipments	16.6%	9.4%		26.0%
14	Nonmetallic Minerals	7.7%	0.1%		7.8%
37	Transportation Equipment	5.8%	1.4%	0.5%	7.7%
29	Refined Petroleum Products	3.1%	2.3%	1.5%	7.0%
1	Agriculture	5.6%	0.1%		5.6%
42	Shipping Containers	0.8%	2.6%		3.5%
20	Food	1.8%	0.7%	0.0%	2.5%
32	Clay, Concrete, Glass	1.6%	0.2%	0.0%	1.8%
33	Metal	1.1%	0.4%	0.0%	1.5%
13	Crude Petroleum	0.8%	0.0%		0.8%
40	Waste	0.2%	0.4%	0.0%	0.6%
11	Coal	0.5%			0.5%
26	Paper	0.3%	0.2%		0.5%
23	Apparel	0.3%	0.2%		0.4%
24	Lumber	0.4%	0.1%		0.4%
36	Electrical Equipment	0.1%	0.2%		0.3%
30	Rubber/Plastics	0.1%	0.1%		0.2%
35	Machinery	0.1%	0.1%		0.2%
34	Metal Products	0.1%	0.1%		0.2%
41	Misc Freight Shipments	0.1%	0.1%		0.2%
25	Furniture	0.2%	0.0%		0.2%
39	Misc Mfg Products	0.2%	0.0%		0.2%
44	Freight Forwarder Traffic	0.1%	0.1%		0.1%
10	Metallic Ores	0.0%	0.0%		0.0%
9	Fish	0.0%			0.0%
48	Hazardous Materials	0.0%	0.0%		0.0%
38	Instruments	0.0%	0.0%		0.0%
22	Textiles	0.0%			0.0%
27	Printed Goods	0.0%	0.0%		0.0%
19	Ordnance	0.0%			0.0%
47	Small Packaged Freight	0.0%			0.0%
Grand Total		58.3%	36.7%	4.9%	100.0%
		0% 50% 100% % of Carloads	0% 50% 100% % of Carloads	0% 50% 100% % of Carloads	0% 50% 100% % of Carloads

Figure 6-26. H-GAC Port County Shares of Carloads by Direction (2015)

Figure 6-27 through Figure 6-30 following describe the leading origins for terminated traffic and the leading destinations for terminated traffic associated with the H-GAC port counties.

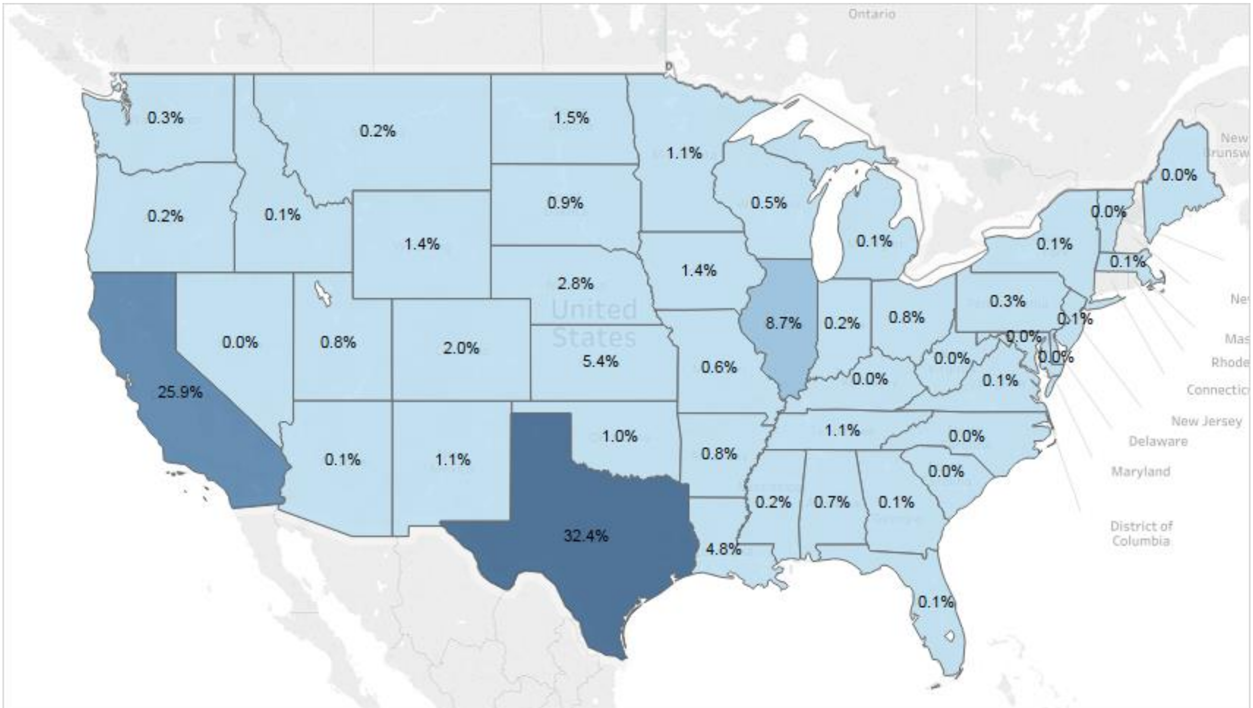


Figure 6-27. Origin State Shares for Carloads Terminated in H-GAC Port Counties (2015)

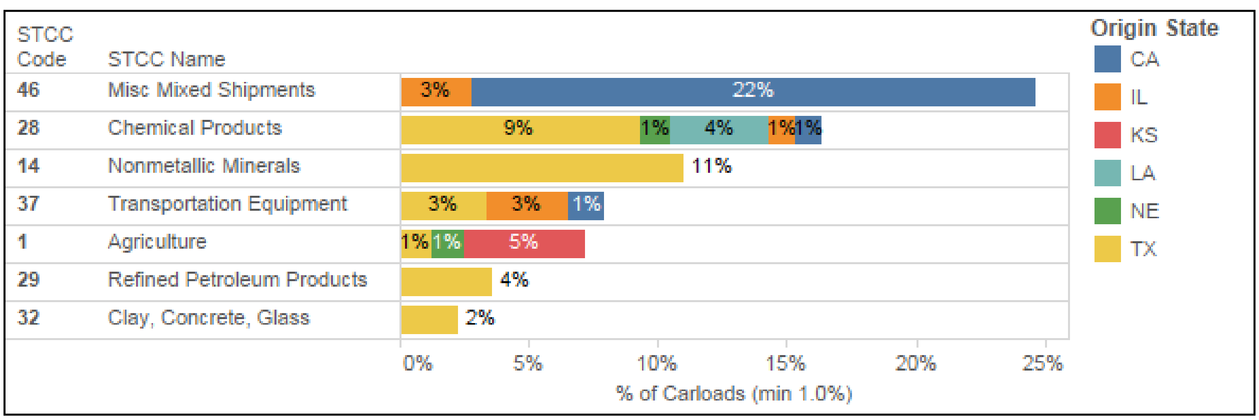


Figure 6-28. Origin State Shares for Carloads Terminated in H-GAC Port Counties, by Commodity (>= 1%) (2015)

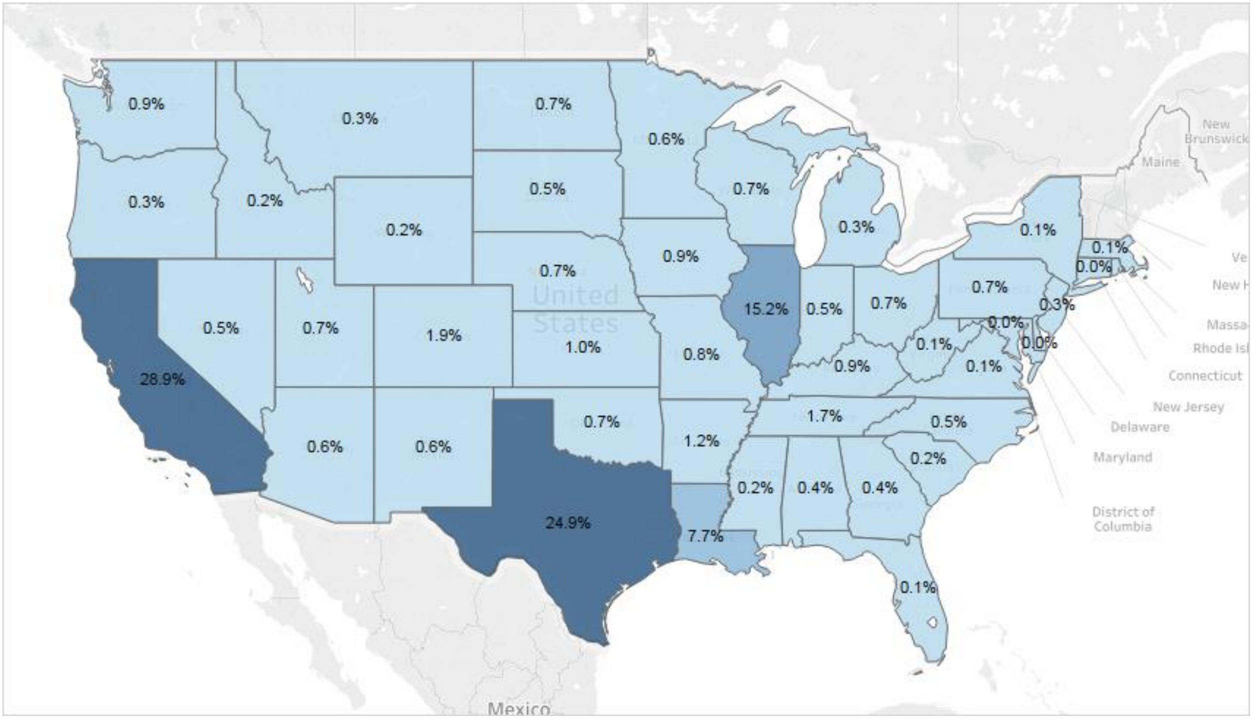


Figure 6-29. Destination State Shares for Carloads Originated in H-GAC Port Counties (2015)

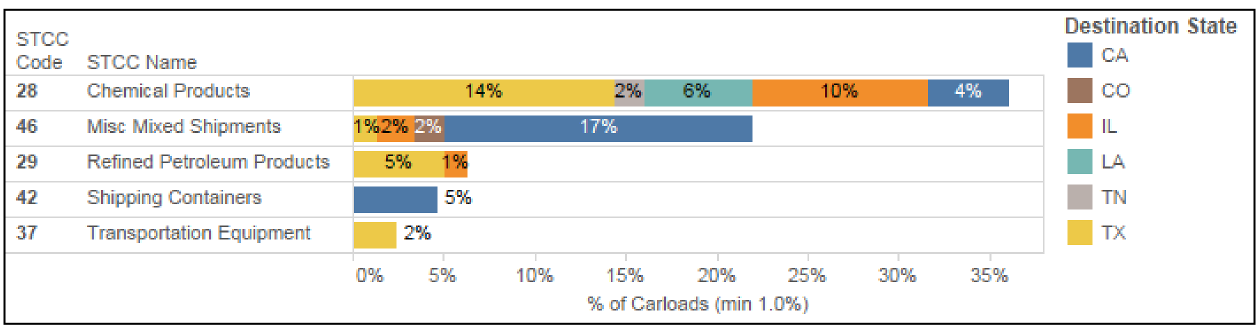


Figure 6-30. Destination State Shares for Carloads Originated in H-GAC Port Counties, by Commodity (>= 1%) (2015)

Overall, the origin and destination results appear generally consistent with the distribution patterns in the public waybill analysis.

- The leading origin state for terminated traffic is Texas (32 percent), followed by California (26 percent), Illinois (9 percent), Kansas (5 percent), and Louisiana (5 percent). Texas traffic is primarily nonmetallic minerals, chemical products, refined petroleum products, transportation equipment, and clay/concrete/glass. Illinois traffic is a combination of miscellaneous mixed shipments, transportation equipment, and chemicals. Kansas traffic is agriculture, and Louisiana traffic is chemicals. With a lower share of inbound coal than the region as a whole, the H-GAC port counties do not have significant traffic from Wyoming's Powder River Basin.

- The leading destination state for originated traffic is California (29 percent) followed by Texas (25 percent), Illinois (15 percent), and Louisiana (8 percent). California traffic consists of miscellaneous mixed shipments, shipping containers, and chemical products. Texas traffic includes chemical products, refined petroleum, and transportation equipment. Illinois traffic is mostly chemical products with some miscellaneous mixed shipments and refined petroleum products. Louisiana traffic is chemical products.

6.6 Commodity Analysis - Short Sea and Inland Waterway Supported Commodity Flow

U.S. Army Corps of Engineers (USACE) Waterborne Commerce Data for 2016 and 2017 has been analyzed to identify the particular commodities that make particular use of intraport movement (cargo transferred within the same port), inland waterways, or was moved by coastwise shipping (defined as a domestic movement but carried over the ocean).

6.6.1 State to State Analysis

Waterborne Commerce Public Domain Data identifies the movement from state to state by waterborne modes and includes tonnages for 14 major commodity groups by origin and destination. Even though the H-GAC region is not specifically identified in this regional analysis, this data gives an indication of the origin and destination of goods moved by domestic waterborne transportation to and from Texas as well as the commodity transported.

As the following tables and figures identify, petroleum related products, crude oil and chemicals dominate the movement of waterborne tonnage to, from and within Texas. There are also relatively sizable volume flows of food, metal products and aggregates Iron and steel waste scrap is one particular flow that passes through the H-GAC region ports for export.

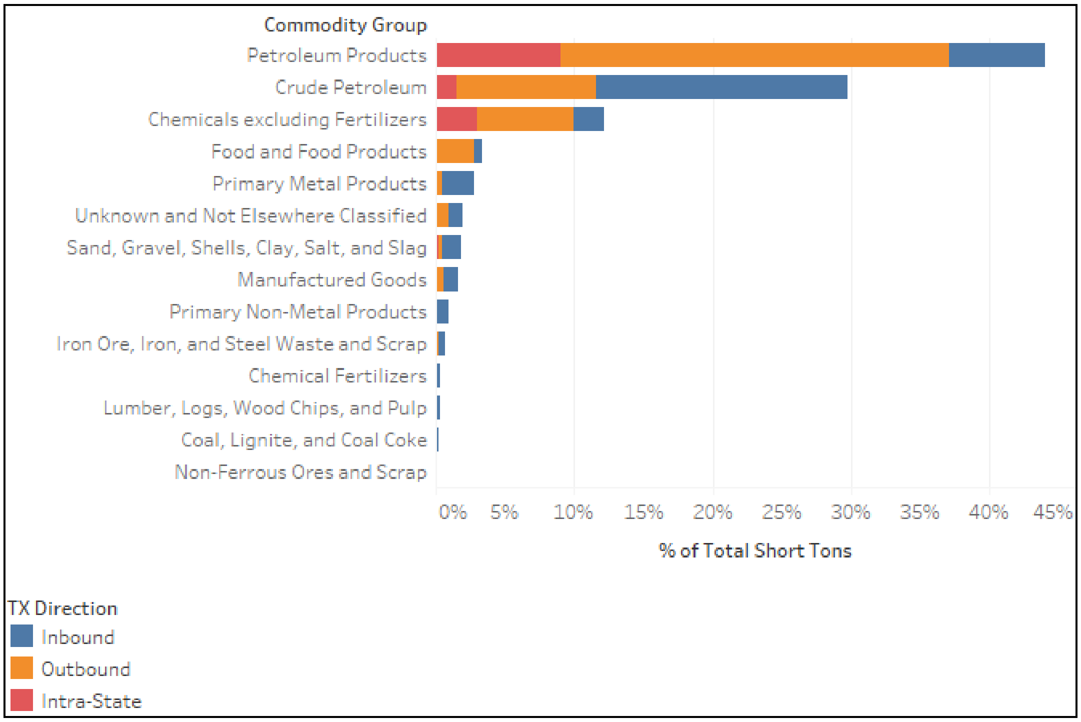


Figure 6-31. Texas Domestic and Canadian Waterborne Tonnage Shares, by Commodity Group and Direction of Trade (2017)

Table 6-7. Texas, Domestic and Canadian Waterborne Tonnage, by Commodity Group and Direction of Trade (2017)

Commodity Group	TX Direction			
	Grand Total	Inbound	Outbound	Intra State
Grand Total	524,583,286	185,917,462	265,897,396	72,768,428
Petroleum Products	230,893,326	36,450,960	146,934,230	47,508,136
Crude Petroleum	156,237,776	95,686,363	52,886,568	7,664,845
Chemicals excluding Fertilizers	63,712,724	11,499,347	36,664,813	15,548,564
Food and Food Products	17,448,427	3,095,449	14,230,408	122,570
Primary Metal Products	14,584,238	12,140,985	2,169,995	273,258
Unknown and Not Elsewhere Classified	10,135,744	5,061,201	5,071,556	2,987
Sand, Gravel, Shells, Clay, Salt, and Slag	9,462,621	6,872,056	1,349,073	1,241,492
Manufactured Goods	8,605,659	5,450,926	3,122,886	31,847
Primary Non-Metal Products	4,997,975	4,482,621	515,354	
Iron Ore, Iron, and Steel Waste and Scrap	3,845,690	2,378,218	1,405,236	62,236
Chemical Fertilizers	1,913,817	1,248,641	516,204	148,972
Lumber, Logs, Wood Chips, and Pulp	1,764,856	1,316,465	448,391	
Coal, Lignite, and Coal Coke	498,711	1,400	333,790	163,521
Non-Ferrous Ores and Scrap	481,722	232,830	248,892	

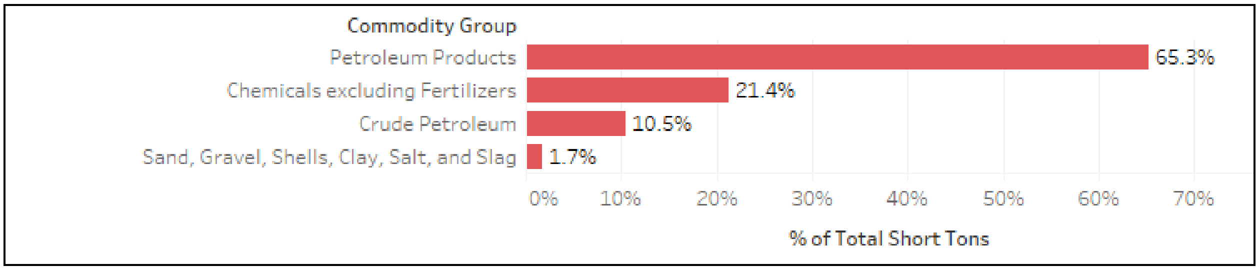


Figure 6-32. Texas Domestic and Canadian Waterborne Tonnage Shares (>= 1%), Intra-State, by Commodity Group (2017)

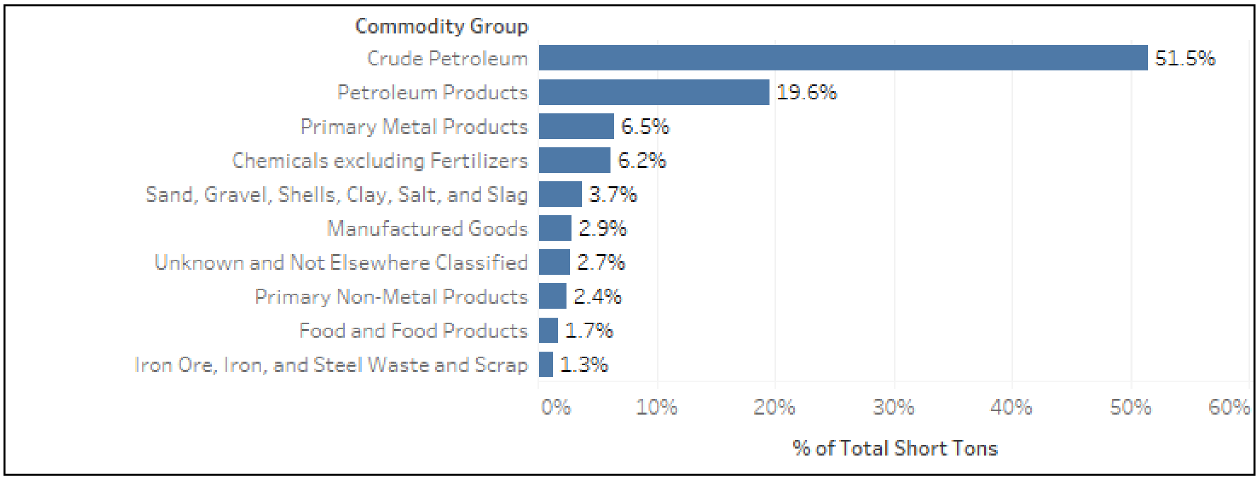


Figure 6-33. Texas Domestic and Canadian Waterborne Tonnage Shares (>= 1%), Inbound, by Commodity (2017)

As shown below, Louisiana is Texas' largest trading partner for both inbound and outbound directions. Unsurprisingly this is again dominated by petroleum and chemical products and crude oil. For outbound products from Texas, we see a very different trading relationship with Florida and Canada being the second and third trading partners for outbound flows. These flows are largely dominated by petroleum products. Florida is not connected by pipeline to the refineries and production centers on the U.S. Gulf coast, so the majority of petroleum products consumed in Florida are delivered by waterborne cargoes.

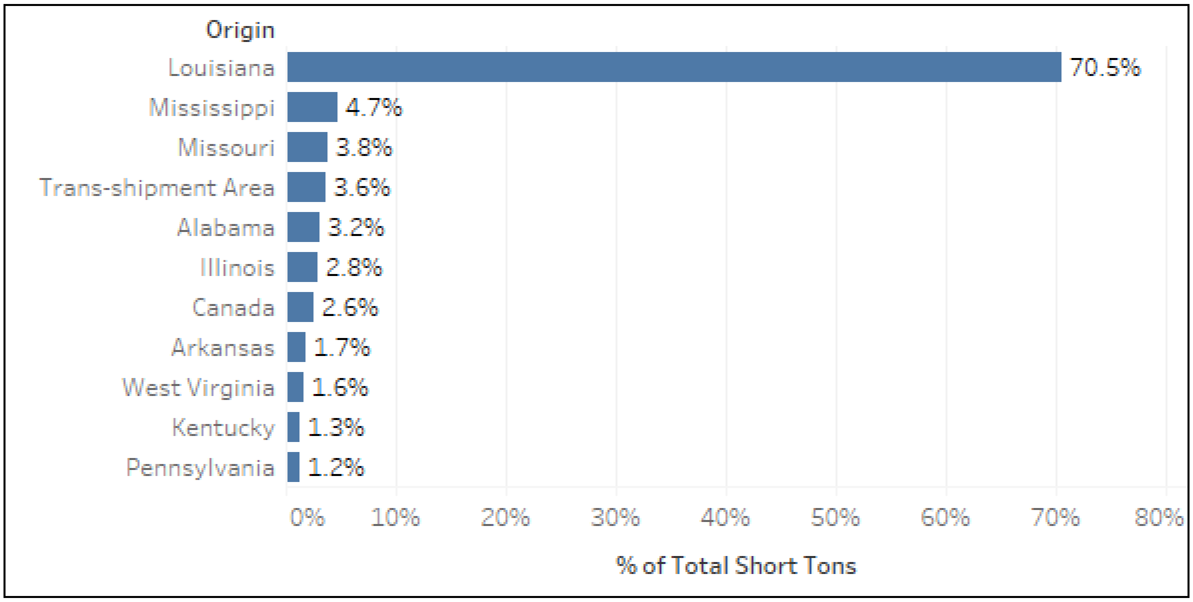


Figure 6-34. Texas Domestic and Canadian Waterborne Tonnage Shares (>= 1%), Inbound, by Trading Partner (2017)

Commodity Group	AL	IL	LA	MO	MS	PA	TS	WV
Chemical Fertilizers			1.4%					
Chemicals excluding Fertilizers			11.2%		1.7%			
Crude Petroleum			2.6%					1.2%
Petroleum Products		2.0%	52.4%		2.8%			
Primary Metal Products	1.4%							
Primary Non-Metal Products				2.4%				
Sand, Gravel, Shells, Clay, Salt, and Slag				1.2%				
Unknown and Not Elsewhere Classified			1.5%			1.2%	3.6%	

Figure 6-35. Texas Domestic and Canadian Waterborne Tonnage Shares (>= 1%), Inbound, by Commodity and Trading Partner (2017)

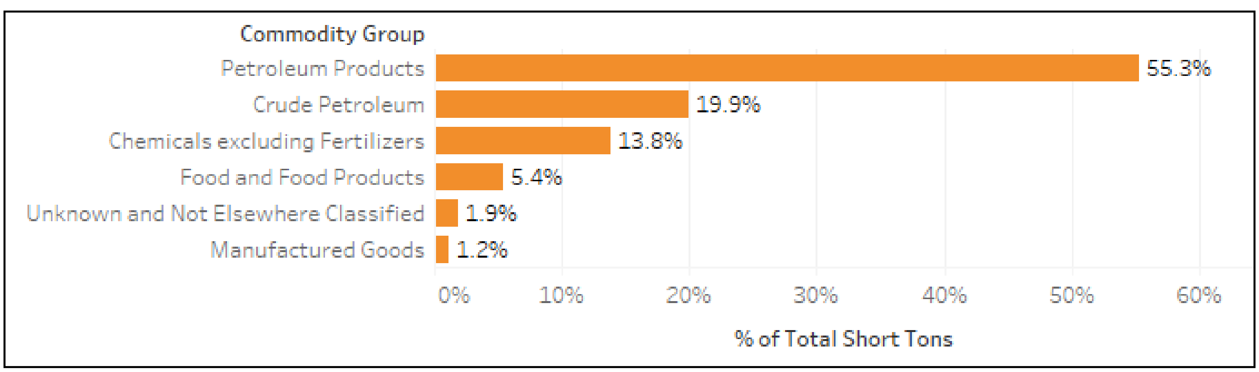


Figure 6-36. Texas Domestic and Canadian Waterborne Tonnage Shares (>= 1%), Outbound, by Commodity (2017)

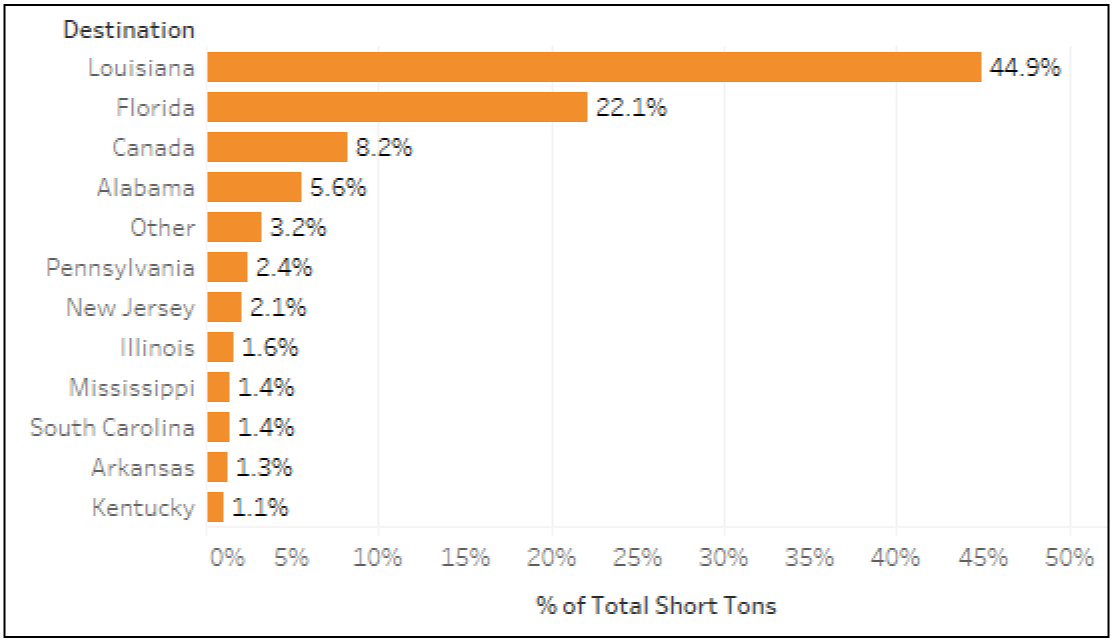


Figure 6-37. Texas Domestic and Canadian Waterborne Tonnage Shares (>= 1%), Outbound, by Trading Partner (2017)

6.6.2 H-GAC Region Port Analysis

Mirroring the Texas State analysis, the majority of the cargoes moved between the region's port and the inland waterways and within each port (intraport movement) consist of bulk petroleum or chemical products.

The tables below illustrate that each of the region's ports and have different tonnage associated with inland waterways and intraport movements. In 2016, Galveston had the highest share amongst the region's ports of cargoes carried to and from inland waterways and intraport shipping of 34.3 percent of its cargoes. This was followed by the Houston Ship Channel at 29.9 percent, Texas City at 27.3 percent and Freeport at 22.4 percent.

Table 6-8. Houston Ship Channel Tonnage by Movement Type (2016)

Movement Type	Direction	Tons (2016)	Percentage
Foreign Imports & Exports	Import	68,734,000	27.72
	Export	93,565,000	37.73
Domestic & Canada Coastal Shipping	Receipts	3,440,000	1.39
	Shipments	8,026,000	3.24
Inland Waterways	Receipts	33,353,000	13.45
	Shipments	19,920,000	8.03
Intraport	-	20,945,000	8.45
Total		247,983,000	

Table 6-9. Houston Ship Channel Inland and Intraport Petroleum and Chemical Tonnages (2016)

Shipment Type	Country	Total Tons (2016)	Petroleum and Chemical Tonnage (2016)	Petroleum & Chemical Percentage of Total Tonnage
Inland Waterways	Receipts	33,353,000	31,228,000	93.63
	Shipments	19,920,000	18,722,000	93.99
Intraport	-	20,945,000	20,838,000	99.49
Total		74,218,000	70,788,000	95.38

Other commodities moved to, from and within the Port of Houston by inland waterway include:

- Coal coke
- Iron and Steel scrap, in 2017 957,000 tons were moved by inland waterways
- Other iron and steel products including plates, bars and pipe
- Grain including corn and wheat
- Oilseeds such as soybeans
- Sand and gravel, in 2017 153,000 tons were moved by inland waterways

More recent commodity movements include the transportation of containerized plastic resins for export.

Table 6-10. Texas City Tonnage by Movement Type (2016)

Movement Type	Direction	Tons (2016)	Percentage
Foreign Imports & Exports	Import	13,169,000	31.20
	Export	13,453,000	31.87
Domestic & Canada Coastal Shipping	Receipts	1,068,000	2.53
	Shipments	2,976,000	7.05
Inland Waterways	Receipts	4,239,000	10.04
	Shipments	7,059,000	16.73
Intraport	-	242,000	0.57
Total		42,206,000	

Table 6-11. Texas City Inland and Intraport Petroleum and Chemical Tonnages (2016)

Shipment Type	Country	Total Tons (2016)	Petroleum and Chemical Tonnage (2016)	Petroleum & Chemical Percentage of Total Tonnage
Inland Waterways	Receipts	4,239,000	4,218,000	99.50
	Shipments	7,059,000	7,057,000	100.00
Intraport	-	242,000	242,000	100.00
Total		11,540,000	11,517,000	99.80

Table 6-12. Galveston Tonnage by Movement Type (2016)

Movement Type	Direction	Tons (2016)	Percentage
Foreign Imports & Exports	Import	1,640,000	16.60
	Export	3,247,000	32.86
Domestic & Canada Coastal Shipping	Receipts	62,000	0.63
	Shipments	1,544,000	15.63
Inland Waterways	Receipts	2,366,000	23.94
	Shipments	954,000	9.65
Intraport	-	68,000	0.69
Total		9,881,000	

Table 6-13. Galveston Inland and Intraport Petroleum and Chemical Tonnages (2016)

Shipment Type	Country	Total Tons (2016)	Petroleum and Chemical Tonnage (2016)	Petroleum & Chemical Percentage of Total Tonnage
Inland Waterways	Receipts	2,366,000	2,124,000	89.77
	Shipments	954,000	825,000	86.48
Intraport	-	68,000	68,000	100.00
Total		3,388,000	3,017,000	89.05

Table 6-14. Freeport Tonnage by Movement Type (2016)

Movement Type	Direction	Tons (2016)	Percentage
Foreign Imports & Exports	Import	10,230,000	52.10
	Export	4,549,000	23.17
Domestic & Canada Coastal Shipping	Receipts	220,000	1.12
	Shipments	235,000	1.20
Inland Waterways	Receipts	2,680,000	13.65
	Shipments	1,715,000	8.73
Intraport	-	8,000	0.04
Total		9,881,000	

Table 6-15. Freeport Inland and Intraport Petroleum and Chemical Tonnages (2016)

Shipment Type	Country	Total Tons (2016)	Petroleum and Chemical Tonnage (2016)	Petroleum & Chemical Percentage of Total Tonnage
Inland Waterways	Receipts	2,680,000	2,055,000	76.68
	Shipments	1,715,000	1,704,000	99.36
Intraport	-	8,000	8,000	100.00
Total		4,403,000	3,767,000	85.56

Nonchemical petroleum commodities moved by inland waterway to and from the Port of Freeport include:

- Sand and gravel
- Rice

6.7 Summary

The analysis of the different data sets including Transearch, both confidential and public rail waybill data and US Army Corps Waterborne Statistics illustrate the dominance of petroleum and chemical commodities carried by the different modes and for product destined to and originating from, the region’s port counties. The data also identifies key trading patterns. For example, Louisiana is a major trading partner with the H-GAC region and features heavily in trucking, rail and short sea shipping chemical and petroleum products. Florida is a large trading partner with the H-GAC region for petroleum products transported by short sea shipping/barge, though unlike Louisiana, there is minimal commodities being transported back from Florida to the H-GAC region.

The data also highlights some high volumes of commodity flow that are transported within the H-GAC region, particularly in the petroleum and chemical commodity sectors. This highlights the interdependency of these sectors, whose facilities produce, process and refine feedstocks and other materials, which are then used by others to produce or repackage those products for distribution. An example of this is the use of rail cars supporting Storage in Transit for plastic resins which are subsequently dispatched to packaging facilities who bag and load the resins into containers for export from the region’s container ports. The region’s multimodal freight transportation network facilitates that interdependency and also provides links into the market place, be it domestic or global destinations.

The data also highlights the variability of commodities and tonnages moved in response to trading, economic and market conditions. The number of shipping containers transported by rail into the region has reduced, which could be associated with an increase in container shipping services from Asia, directly serving the H-GAC region’s ports, rather than imports arriving in west coast ports and being transferred to the Houston region by rail.

7 Supply Chain Analysis

7.1 Key Findings

Bulk commodities such as crude oil and petroleum products dominate total waterborne tonnage, but crude oil is largely transported by pipeline or rail rather than truck and therefore not included as a top supply chain commodity. Top commodity groups (excluding crude oil and petroleum products) and their respective supply chain characteristics are:

- Perishable Foods include significant imports as well as exports. Largest volume imports include bananas, meat, and fish and crustaceans. Data indicates HGAC region ports' importance as a national supply chain gateway for these products. Both Port of Galveston and Port of Freeport have established produce import facilities located within their ports.
- Other Foods and Beverages includes a broad range of edible products and beverages. These products are almost entirely containerized and imported through the Port of Houston. HGAC region ports largely serve markets within the state. The Port of Houston in is an import gateway for beer to regions beyond the state while wine and spirits for most destinations of imports are located within the state.
- Other Agricultural Products are largely exported and include wheat, corn, rice and sorghum as well as cotton. The Port of Houston is the leading HGAC port for grain exports followed by Galveston although there has historically been a significant variation by type of grain.
- Chemicals includes organic, inorganic and miscellaneous chemical products. Volumes through HGAC ports are quite large in both directions, with export tonnage about double that of imports. Chemicals are moved through all four HGAC ports, but most volumes are through Houston.
- Plastics in Primary Forms includes a range of plastics materials. These products are imported as well as exported, but export volumes are much greater than imports. The forecast of plastic materials volumes transported by truck shows significant growth, with exports quadrupling from 2015 to 2045.
- Building Materials includes wood products; stone and cement; and stone, cement and ceramic products. These products are largely imported, with the exception of pebbles, gravel, etc. imported through Freeport, these products are almost entirely imported through Houston.
- Iron and Steel and Articles of Iron and Steel These commodities are largely non-containerized and mostly imported, almost entirely though Houston. HGAC ports' imports of iron and steel products represent a very large share of U.S. imports, 19% of non-containerized and 12% of containerized imports in 2018.
- Machinery imports represent the primary flow of trade and have been highly cyclical, dipping sharply during the Great Recession and rebounding strongly from 2010 through 2018. Over 70% of HGAC port's import tonnage was

containerized in 2018 with Houston the primary port of entry followed by Galveston and Freeport.

- Motor Vehicles includes motor cars and vehicles for transporting persons. Motor vehicles are imported as well as exported through HGAC ports and are largely non-containerized Imports are mainly transported through the Port of Houston, and volume has grown from 2009 through 2018. Exports are also largely transported through the Port of Houston, but exports have grown at Freeport beginning in 2015.
- Other Consumer Goods include apparel and footwear; home furnishing textiles; furniture; and toys, games and sporting equipment. Imports are almost entirely containerized and almost all come through the Port of Houston. Imports and have grown rapidly across all product categories

7.2 Introduction

This chapter provides an overview of the key port related supply chains and logistical concepts within the Houston-Galveston Area Council's (H-GAC) region and how they shape the transportation characteristics and needs of the infrastructure in the region.

The objectives of the H-GAC supply chain analysis are:

- Identify and define supply chains that have significant impacts on truck traffic in the H-GAC region that are related to international trade through the region's four major ports.
- Examine these flows in terms of historic and projected volumes and the geographic characteristics of these flows.
- Understand modal choice and how different transportation modes are used to move commodities to and from the region's ports.

Insights into the challenges and opportunities of the region's supply chains can help support the area's economic growth while being considerate of the constraints of the transportation system and the environment.

The measures used for this study to evaluate commodity flow and supply chain volumes are 1) total waterborne tonnage and 2) containerized tonnage from U.S. Census Bureau trade data for the Ports of Houston, Galveston, Freeport and Texas City.

Bulk commodities such as crude oil, petroleum and chemical products dominate total waterborne tonnage. However, crude oil is largely transported by pipeline, rail or marine transportation rather than truck and is therefore not included as a top supply chain commodity.

Many of the commodity groups identified in this analysis are either import or export oriented. For most consumer goods imports are the predominant direction of trade flow.

This document includes profiles of 10 H-GAC supply chains for commodity groups defined by Harmonized System (HS) commodity codes including:

1. Perishable Foods
2. Other Foods and Beverages

3. Other Agricultural Products
4. Chemicals
5. Plastics in Primary Forms
6. Building Materials
7. Iron and Steel and Articles of Iron and Steel
8. Machinery
9. Motor Vehicles
10. Other Consumer Goods

Sections which follow include information for each supply chain listed above:

1. Supply chain description including commodity components, and whether these commodities are primary imported, exported or both, and the relative importance of the commodity to overall port volumes. This is focused on the predominant direction of trade, imports or exports, and mode of water transport, and whether goods are moved in containers or non-container.
2. Historic and projected volumes for H-GAC ports. This provides a view of which ports handle the commodity group and how these volumes have changed over time. The data source for the graphs illustrating historical trade is U.S. Census Bureau Foreign Trade Statistics, unless otherwise stated. Forecasts of future volumes are from IHS Markit Transearch and show how truck volumes are likely to change in the future.
3. Measures that represent the reach of supply chains served by H-GAC ports
    a. The share of total U.S. volumes represented by H-GAC volumes.
    b. The share of total Texas trade represented by H-GAC volumes
4. Geographic information on where exports originate and where imports are destined. This includes the origin of exported volumes and the destination of imports. The source of data to produce the maps contained in this report is IHS Markit Transearch.
5. A listing of top importing and exporting companies derived from detailed shipment data from Datamyne data for a full year, from August 2017 to August 2018. This data includes total tonnage and Twenty-foot equivalent unit shipping containers (TEUs). This data is summarized in tabulated form.

Measures included in the third listed point are informative because they show the geographic extent of the supply chain relative to the H-GAC region. The Houston region represents about 2 percent of total U.S. population. For commodity groups such as containerized consumer goods for which volumes are closely related to population, an H-GAC port share much greater than 2 percent may indicate that H-GAC region ports act as a gateway to other parts of Texas and the U.S., and that distribution to other U.S. regions is an important characteristic of H-GAC supply chains. Conversely, a share much less than 2 percent may indicate that H-GAC regional consumption may be supplied from other ports, and that H-GAC supply chains may have much different characteristics for these commodities.

The H-GAC ports' share of Texas trade provides a similar measure of the reach of H-GAC's supply chains, but directly related to Texas economic activity. If H-GAC port volumes are close to those of the state, this indicates that on average the ports serve Texas origins and destinations. However, if H-GAC port volumes are much less than the state's trade, this indicates that trade volumes are more closely related to the H-GAC region.

7.3 Perishable Foods

The perishable foods category includes fruits and vegetables, and meat and seafood (fish and crustaceans). For imports by vessel the largest commodity categories include bananas (HS 0803), meat (HS02) and fish and crustaceans (HS 03). For exports the principal commodity is poultry (HS 0207).

Containerized imports of perishable foods through H-GAC ports represented 7 percent of total containerized U.S. tonnage within this product category in 2018. For non-containerized tons the H-GAC share of the U.S. total was 9 percent in 2018. These import volumes also exceeded imports into Texas in 2018, 112 percent of state containerized imports and 115 percent of non-containerized imports. These large shares indicate that, for perishable foods, H-GAC region ports act as a supply chain gateway well beyond the H-GAC region and, on average, beyond the state.

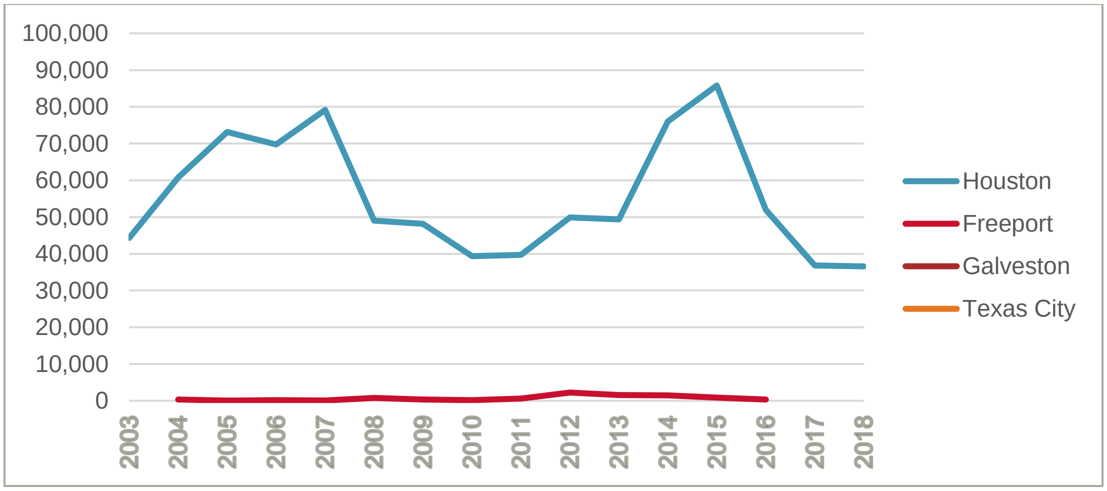
Containerized exports of perishable foods through H-GAC ports in 2018 represented 5 percent of the U.S. total volume of the overall category, with very high shares for edible vegetables (13 percent) and meat (6 percent). As is the case for imports, the high share for vegetables indicates that the ports support a supply chain extending significantly beyond the state.

7.3.1 Meat Imports

Imports of meat are comprised mainly of beef and pork which are usually frozen and transported in refrigerated containers. The U.S. is the largest producer of beef, but also the largest importer. Top country origins of these imports include New Zealand, Australia and Nicaragua. These imports are shipped almost entirely through the Port of Houston as shown in Figure 2-1 below. In 2014, imports of beef surpassed exports when U.S. domestic production declined nearly six percent. Falling production was triggered by severe drought in the Southern Plains states, as well as high feed prices that caused farmers to reduce their herds between 2009 and 2014[129]. These volumes declined from a peak in 2015 to a low point in 2017 and 2018, suggesting that the expansion in the domestic cattle sector that began in 2014 was offsetting beef imports.

From the port these containers are carried by truck to a variety of distributors, manufacturers and distribution centers serving retail stores, restaurants and other consumers.

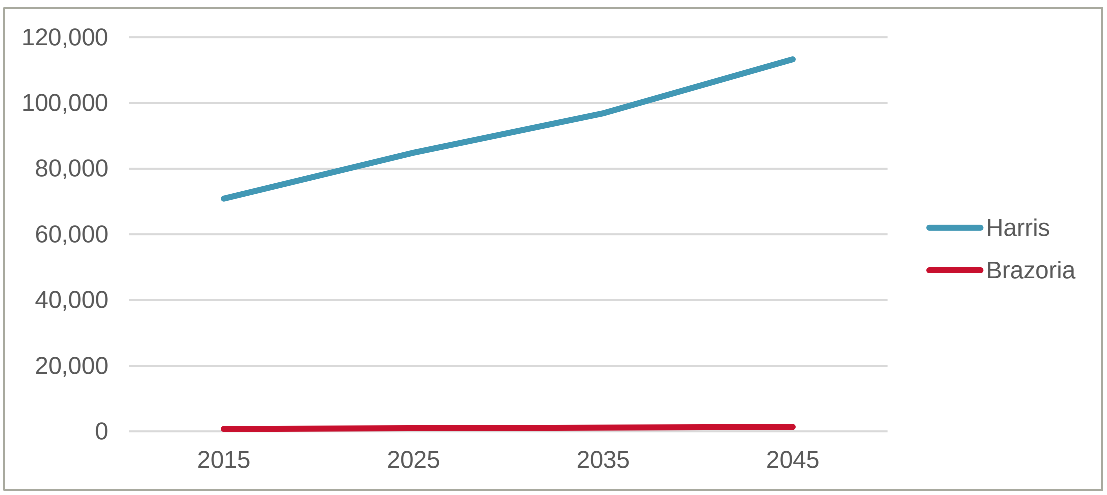
[129] https://www.fas.usda.gov/data/review-us-tariff-rate-quotas-beef-imports



Data Source: U.S. Census Bureau Foreign Trade Statistics

Figure 7-1. Imports of Meat by Port in Metric Tons

The forecast for meat imports transported by truck is for growth of nearly 50 percent from 2015 to 2045.

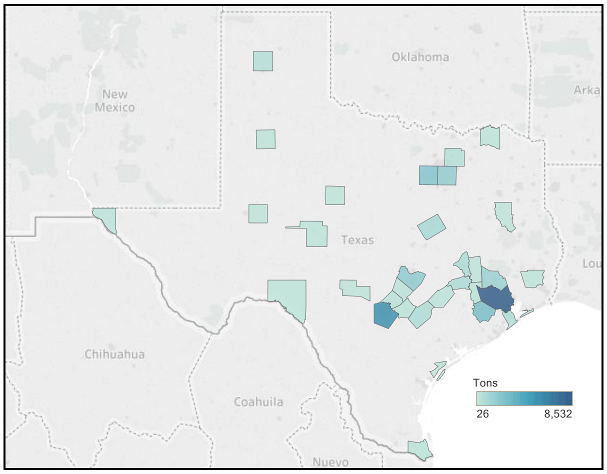


Data Source: IHS Markit Transearch

Figure 7-2. Forecasts of Meat Imports Transported by Truck by Destination County in Tons

H-GAC ports' containerized meat imports in 2018 represented nearly 50 percent more than estimated state imports, indicating that the ports support a supply chain extending well beyond Texas.

Within the state, imports of meat through the Port of Houston go principally to large population centers including Harris County, the top county destination, and Bexar County (San Antonio), the second largest county destination.



Data Source: IHS Markit Transearch

Figure 7-3. Destination Counties of Meat Imports through Houston

The top importing company is Oceania Meat Processors, a supplier of New Zealand meats to the pet food industry. The second largest top importing company over the past year has been AgriFoods, an Australian company owned by the five North American McDonald's beef patty manufacturers.

Table 7-1. Top Importers of Meat through the Port of Houston

Consignee (Unified)	Metric Tons	TEUs Quantity
OCEANIA MEAT PROCESSORS (AZ)	5,668	311
VIA CATTLE CORPORATION (CA)	3,725	394
PURR FERRED PET FOOD IN (MN)	3,693	293
AGRIFOODS GLOBAL PTY LTD (NJ)	3,589	186
COLORADO FOOD PRODUCTS INC (CO)	3,526	249
ASC MEYNERS (FL)	2,634	242
ALL AMERICAN PET PROTEINS LLC (CO)	2,131	211
JBS SWIFT COMPANY (CO)	1,985	141
TAURUS FOOD PRODUCTS INC (AZ)	1,562	81
TEYS USA INC (IL)	1,124	64
PRAIRIE PETFOOD INGREDIENTS (TX)	1,121	61
LAMEX FOODS INC (MN)	1,064	85

Data Source: Datamyne

7.3.2 Imports of Fish and Crustaceans

Like meat, imports of fish and crustaceans (largely shrimp) are generally frozen and transported in refrigerated containers. Top originating countries include China, Vietnam and India. These imports are almost all transported through the Port of Houston as shown in Figure 2-4 below. From the Port these containers are carried by truck to a variety of distributors, distribution centers serving retail stores, restaurants and other consumers.

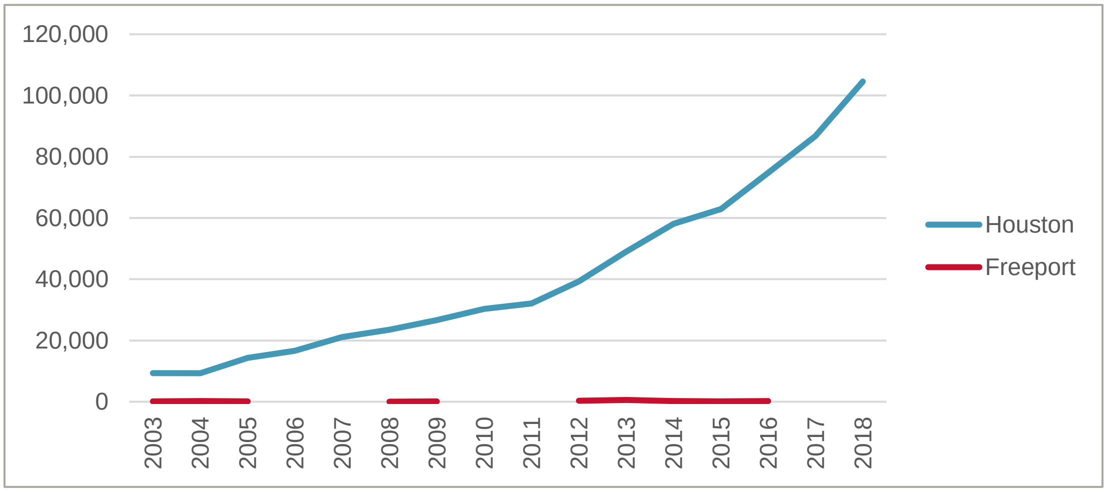


Figure 7-4. Imports of Fish and Crustaceans by Port

The forecast for fish imports transported by truck is for continued growth, tripling in volume from 2015 to 2045.

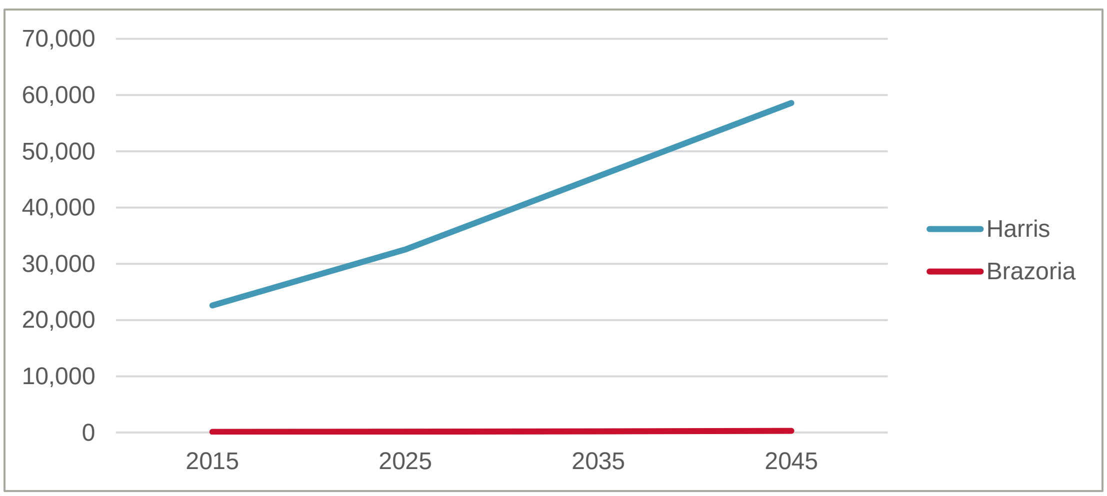


Figure 7-5. Forecast of Fish Imports Transported by Truck by Origin County

Port Imports of fish in 2018 exceeded state imports by about 25 percent, indicating that the ports serve regions beyond the state. Within Texas, the destination of fish and crustacean imports through Houston is concentrated in Harris County.

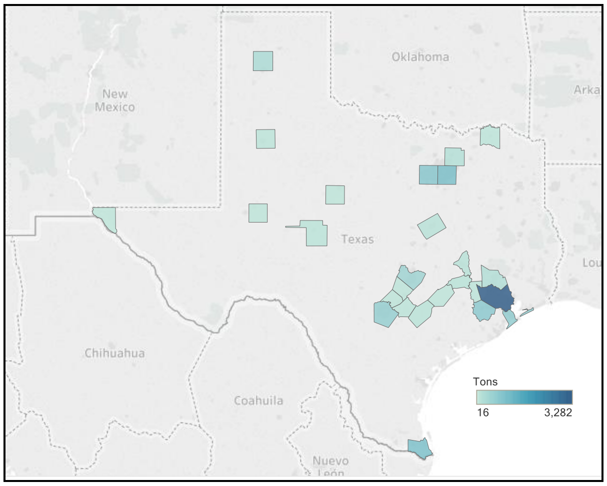


Figure 7-6. County Destinations of Fish Imports through Houston

The Fishin' Company was the largest importer of seafood through the Port of Houston in 2017-2018. According to its website, the company is the largest importer of tilapia in the world and one of the largest importers of frozen fish.

Table 7-2. Top Importers of Fish and Seafood through the Port of Houston

Consignee (Unified)	Metric Tons	TEUs Quantity
THE FISHIN COMPANY (PA)	7,871	687
B & D SEAFOODS INC (CA)	6,221	562
ALL HARVEST TRADING LLC (TX)	5,076	472
BAILEYS SEAFOOD INC (FL)	5,003	425
VINH HOAN USA INC (CA)	4,162	423
GROBEST USA INC (CA)	3,973	430
COAST BEACON (CA)	3,091	306
OCEAN WORLD VENTURES (IL)	2,016	212
EMPACADORA LITORAL USA (FL)	1,831	189
MV AND SONS TEXAS LP (TX)	1,683	144

7.3.3 Banana Imports

Banana imports represented about half of the total tons of fruits and edible nuts imported into the U.S. in 2018. Imported bananas are shipped in temperature and climate-controlled shipping containers as well as in conventional dedicated refrigerated ships. H-GAC imports are split between three ports, with Freeport and Galveston importing nearly equal volumes from 2014 to 2018 and Houston handling smaller volumes. Imports into Houston and Freeport are almost all containerized, while Galveston's volumes are primarily transported in refrigerated vessels. In 2016, Galveston handled 17,712 reefer containers and 230,221 short tons of breakbulk refrigerated cargo.[130] Principal originating countries include Guatemala, Honduras, and Costa Rica.

The forecast for imports of tropical fruits (detail specifically for bananas is not available) is for Galveston and Freeport volumes to continue to be equal based on historic shares, with Harris County/Houston volumes growing more slowly.

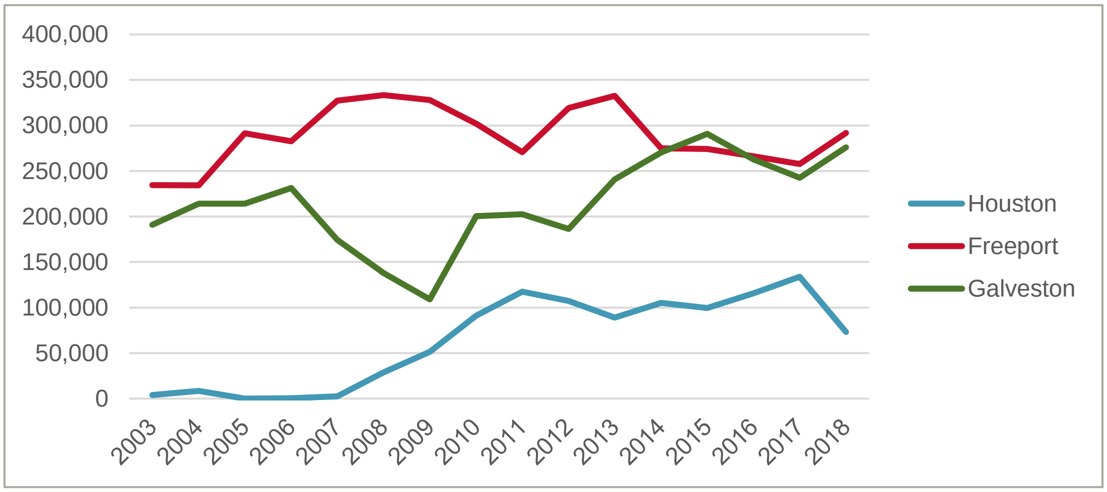


Figure 7-7. Imports of Bananas, including Plantains, Fresh or Dried by Port

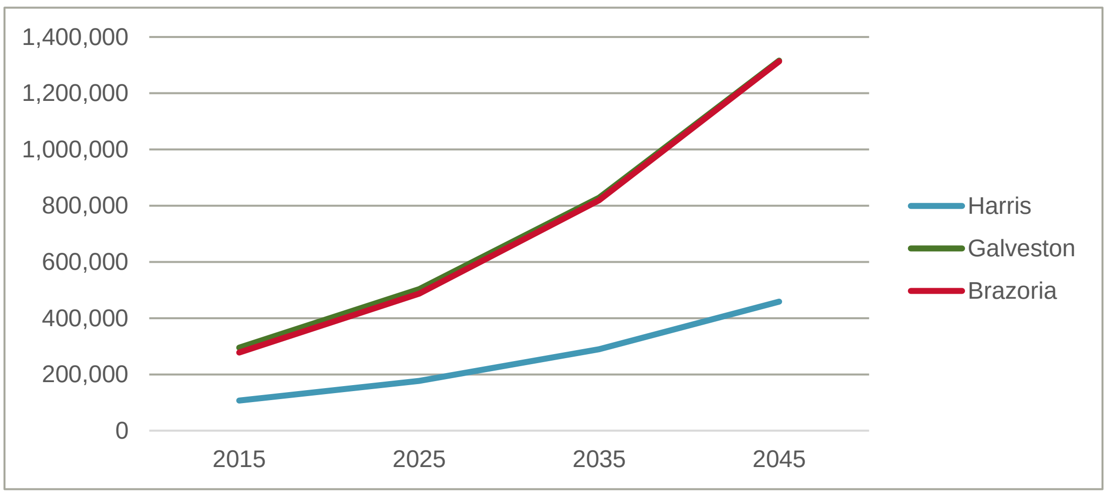


Figure 7-8. Forecasts of Tropical Fruit Transported by Truck from Origin Counties

As noted earlier, bananas comprised about half the total tonnage of edible fruits and nuts imported into the U.S. in 2018. H-GAC ports accounted for about 12 percent of this national total and the ports together represent one of the principal U.S. gateways for banana imports.

The destination counties for banana imports are very dependent on the origin port. For example, Bananas destined to Dallas and Tarrant Counties are primarily imported

130 https://www.maritime-executive.com/magazine/cool-ports

through Brazoria/Freeport and Galveston, and all volumes going to El Paso originate from Brazoria/Freeport.

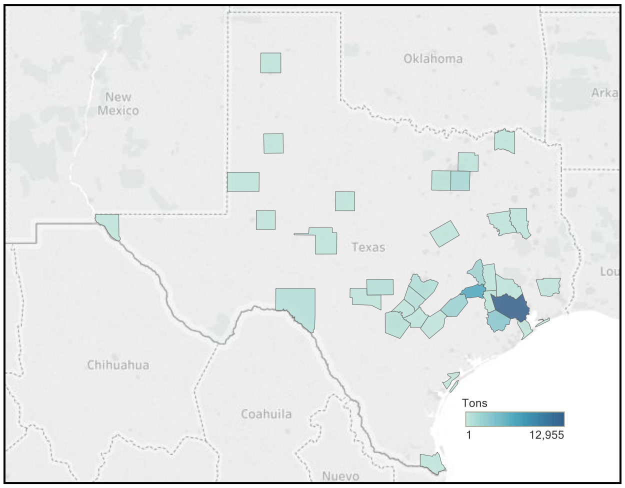


Figure 7-9. County Destinations of Tropical Fruit Imports from Harris County

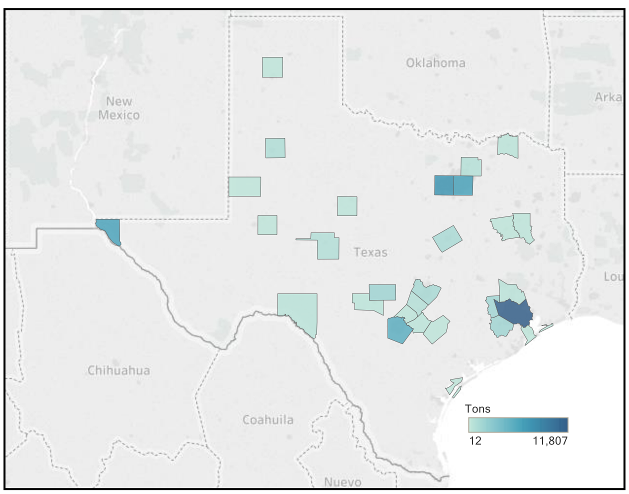


Figure 7-10. County Destinations of Tropical Fruit Imports from Brazoria County

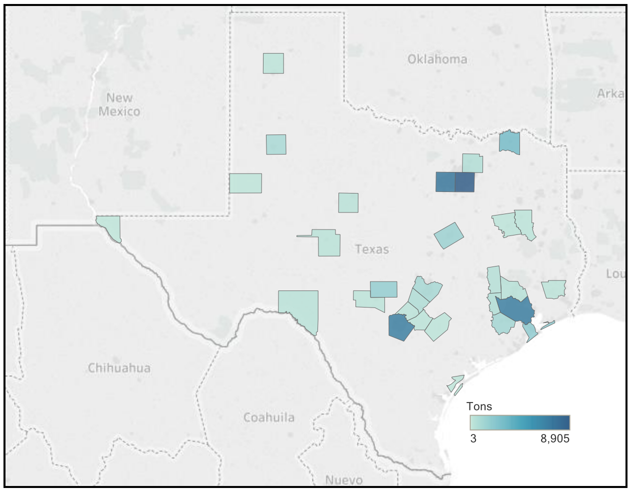


Figure 7-11. County Destinations of Tropical Fruit Imports from Galveston County

Top banana importers include Del Monte (through Galveston), Dole (Freeport) and Chiquita (Freeport and Houston). There is also a significant volume through the Port of Houston, where the import data set is populated with Consignee "Not Available."

DelMonte and Dole have their own port operations at Galveston and Freeport respectively. DelMonte operates four port facilities in the U.S. (Galveston; Gloucester, NJ; Hueneme, CA; and Manatee, FL) while Dole operates five port facilities (Freeport; Wilmington, DE; Port Everglades, FL; Gulport, MS; and San Diego, CA). These port facilities are typically dedicated to serving the produce importer's own shipping lines such as Dole Ocean Cargo Express and Del Monte's Ocean Carrier Services, who are wholly owned subsidiaries of their respective produce companies and operate their own fleet of containerized and refrigerated vessels in addition to chartering vessels. However, there is a general shift towards containerization for produce transportation. According to the U.K based shipping consultants Drewery, they estimate that 79 percent of perishable cargo moved in refrigerated containers in 2016 and only 21 percent on reefer ships. Drewery predicts that by 2021 reefer containers will carry 85 percent of perishable seaborne products.

Table 7-3. Top Banana Importers - Houston

Consignee (Unified)	Metric Tons	TEUs Quantity
NOT AVAILABLE (WO)	55,083	5,691
FYFFES NORTH AMERICA INC (FL)	14,386	1,410
ONE BANANA NORTH AMERICA CORP (FL)	7,245	720
CHIQUITA FRESH NORTH AMERICA LLC (FL)	2,089	216
WAL MART BENTONVILLE (AR)	1,348	142

Table 7-4. Banana Importers - Galveston

Consignee (Unified)	Metric Tons	TEUs Quantity
DEL MONTE FRESH PRODUCE NA INC (TX)	265,743	6,207

Table 7-5. Banana Importers – Freeport

Consignee (Unified)	Metric Tons	TEUs Quantity
DOLE FOOD COMPANY INC (TX)	216,266	22,747
CHIQUITA FRESH NORTH AMERICA LLC (FL)	51,171	5,306

7.3.4 Meat Exports

Meat exports are primarily comprised of poultry (HS 0207). Poultry is produced on farms and transported to processing plants that produce the meat products that are then frozen and shipped by truck in refrigerated containers to the ports for export. In 2018, Japan was the world's leading importer of chicken meat, importing just over 1 million metric tons, followed by Mexico at 820,000 tons. The U.S. was the second largest exporter of chicken meat at 3.2 million tons[131]. Nearly all H-GAC volumes are exported out of the Port of Houston.

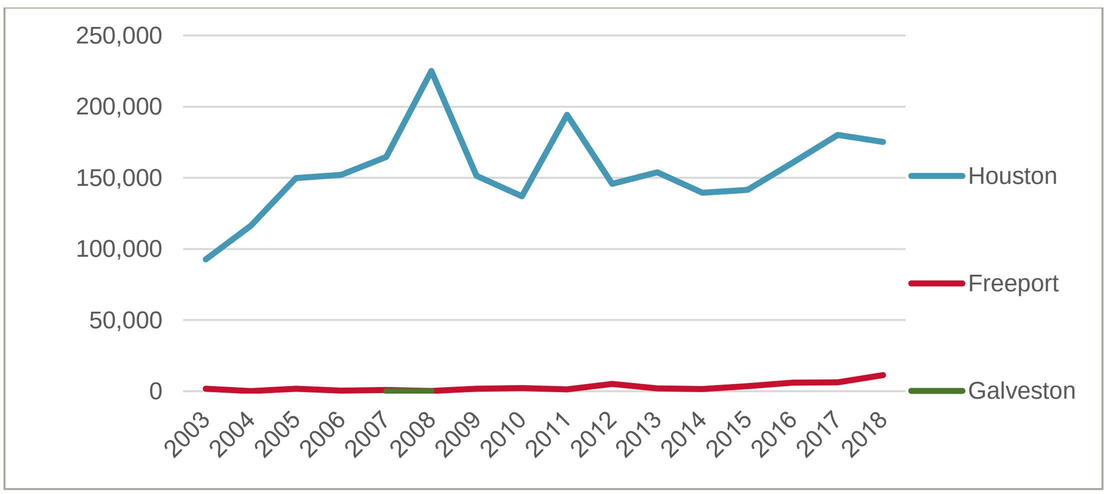


Figure 7-12. Exports of Poultry, Fresh, Chilled or Frozen by Port in Metric Tons

[131] https://apps.fas.usda.gov/psdonline/circulars/livestock_poultry.pdf

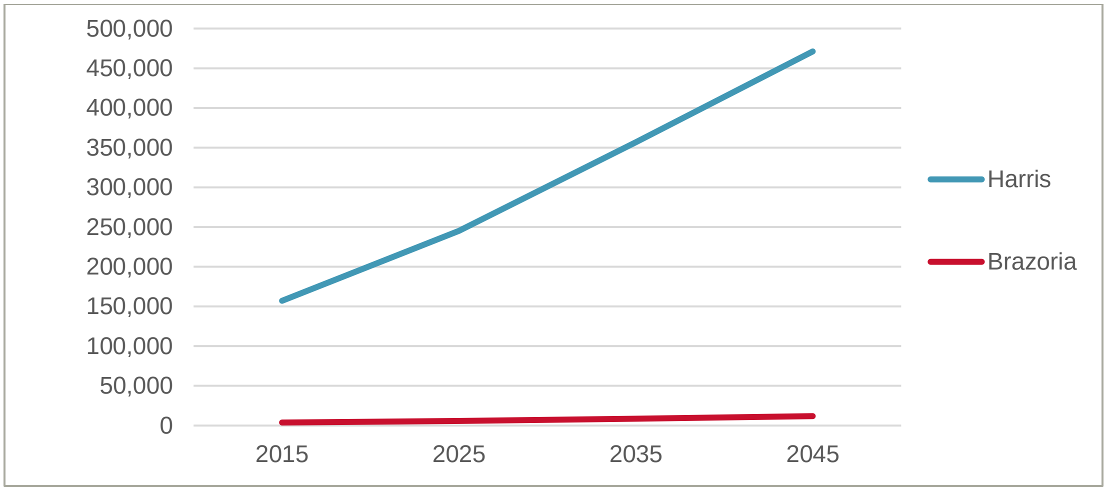


Figure 7-13. Forecast of Meat Exports by Truck by Destination County

As noted earlier, exports of meat through H-GAC ports represent a relatively high 6 percent of total U.S exports. This reflects the concentration of production in Texas. However, these exports represented about 85 percent of total state exports, indicating that most exports through the region's ports originate within the state.

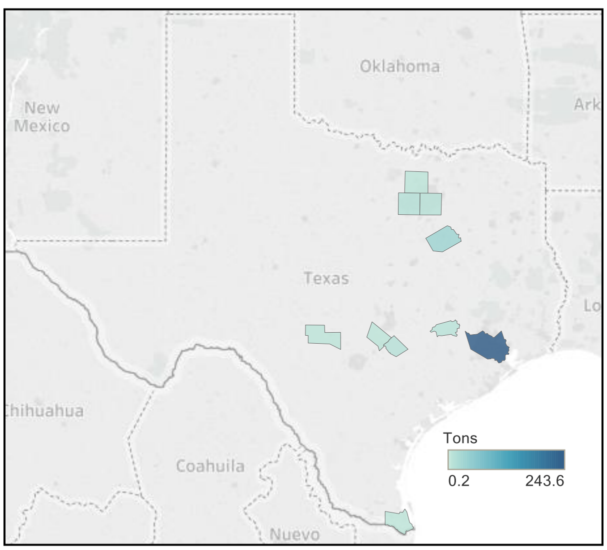


Figure 7-14. Origin Counties of Meat Exports through Houston

The top exporters of poultry through Houston include Pilgrim's Pride, Grove Services and Simmons Prepared Foods. Pilgrim's is the second-largest chicken producer in the world (see http://www.pilgrims.com/our-company/about-us.aspx) and has four locations in Northeast Texas. Grove Services is a supplier and distributor of frozen meats including poultry, beef and pork. Simmons is an Arkansas-based supplier of chicken products primarily for the food service industry.

Table 7-6. Top Exporters of Poultry through Houston

Exporter (Declared)	Metric Tons	TEUs Quantity
GROVE SERVICES, INC.	24,401	1,764
PILGRIMS PRIDE CORPORATION	12,274	885
SIMMONS PREPARED FOODS INC	11,118	792
INTERVISION FOODS	6,685	472
HAKAN USA INC	3,244	252
AJC INTERNATIONAL, INC.	2,712	201
E & E GLOBAL, INC.	2,707	194

7.4 Other Food and Beverages

The Other Food and Beverages commodity group includes a broad range of edible products and beverages. Most of these commodities are containerized imports. Commodity subgroups include prepared foods; soft drinks/mineral waters; and alcoholic beverages.

Containerized imports of other food and beverages through H-GAC ports represented 6 percent of total containerized U.S. tonnage within the product category in 2018. These imports were about equal to state imports, suggesting that H-GAC region ports, on average, serve markets within the state.

7.4.1 Imports of Prepared Foods

This product group includes Preparations of Cereal, Flour, Starch or Milk; Bakers Wares (HS 19), Preparations of Vegetables, Fruit, Nuts or Other Plant Parts (HS 20) and Miscellaneous Edible Preparations (HS 21). These products are almost entirely containerized and imported through the Port of Houston. These products come from many countries with top origins including China, Italy and Spain. From the Port these containers are carried by truck to a variety of distribution centers serving retail stores, restaurants and other consumers.

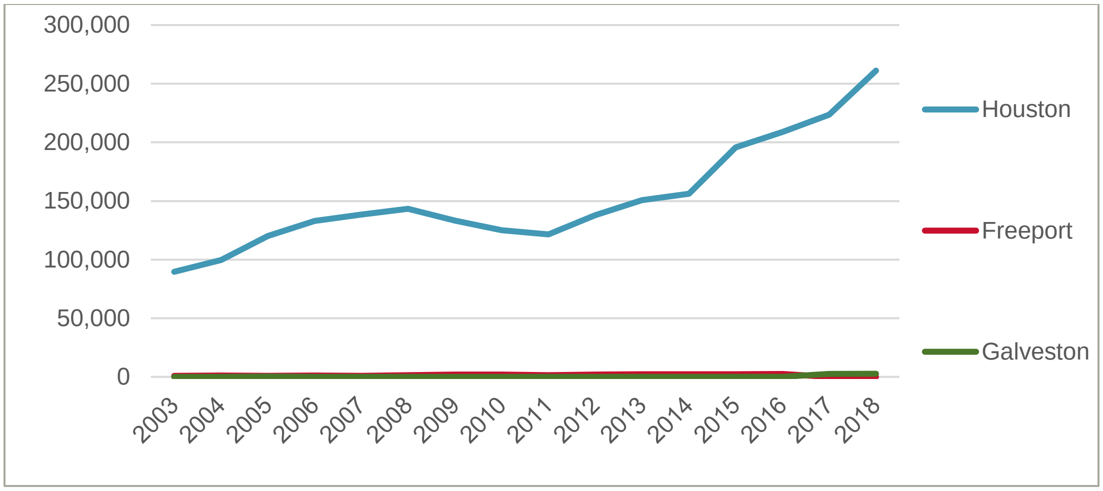


Figure 7-15. Imports of Prepared Foods by Port in Tons

Imports have exhibited strong growth since 2011, nearly doubling through 2018, and the forecast also shows strong growth, doubling from 2025 to 2045.

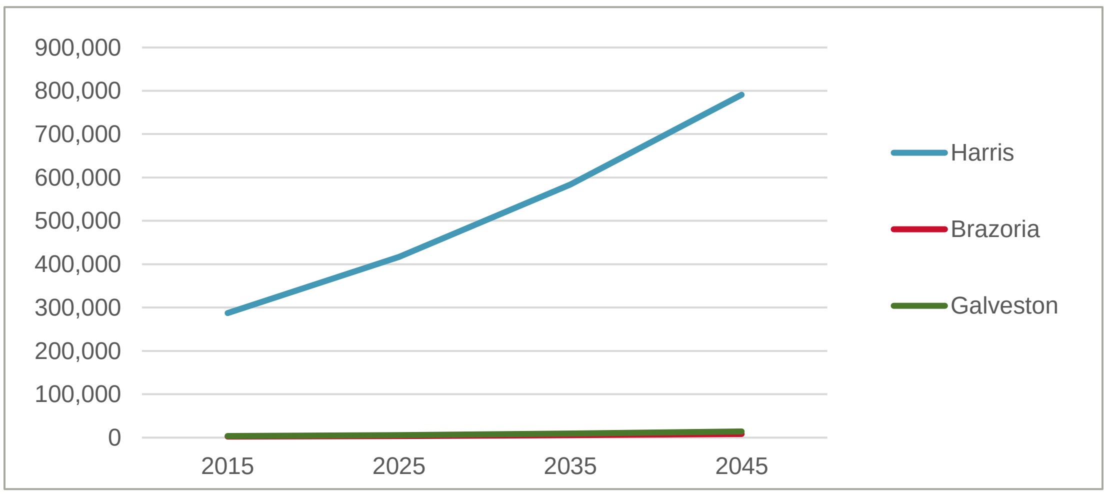


Figure 7-16. Forecast of Import Volumes of Prepared Foods by Origin County in Tons

Imports of prepared foods in 2018 totaled about 85 percent of the state total indicating that most import destinations are located within the state. Harris County is by far the principal destination for prepared food imports through the Port of Houston

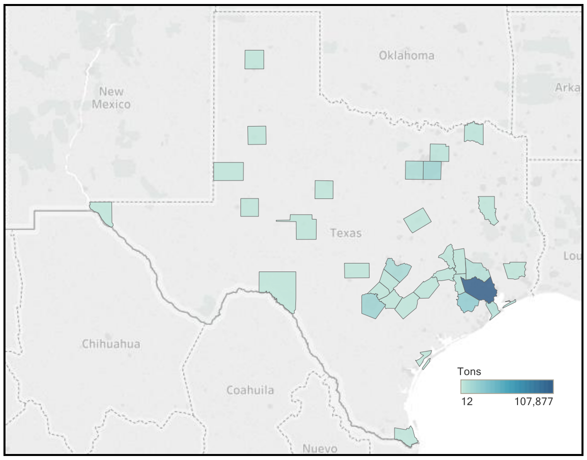


Figure 7-17. Destination Counties of Prepared Food Imports through the Port of Houston

Across the three prepared food commodity groups, the top importing companies in 2017-2018 were Family Delight Foods, Transmed Foods, and Mario Camacho Foods. Transmed is part of Crespo Olives, a Mediterranean company with locations in Morocco, Spain, and France.

Table 7-7. Top Importing Companies of Preparations of Cereals, etc. Bakers Wares (HS 19)

Consignee (Unified)	Metric Tons	TEUs Quantity
AJINOMOTO WINDSOR INC (OR)	2,989	366
ABBOTT NUTRITION (WO)	2,910	263
EL TERRIFICO LLC (TN)	2,014	276
SINCO INC (MA)	1,386	264

Table 7-8. Top Importing Companies of Prepared Vegetables, Fruits, (HS 20)

Consignee (Unified)	Metric Tons	TEUs Quantity
FAMILY DELIGHT FOODS INC (NY)	7,688	542
TRANSMED FOODS INC (MD)	4,790	486
MARIO CAMACHO FOODS (FL)	4,503	501
SAMBAZON INC (CA)	3,989	320
MCLANE GLOBAL (TX)	3,772	189
AGRO SEVILLA USA INC (VA)	3,286	256
GOYA FOODS OF TEXAS (TX)	2,669	266
BELL CARTER FOODS INC (CA)	2,650	278
GREAT GIANT FOODS USA INC (CA)	2,161	106
SHAVER FOODS LLC (AR)	2,033	102

Table 7-9. Top Importing Companies of Misc. Food Preparations (HS 21)

Consignee (Unified)	Metric Tons	TEUs Quantity
CACIQUE INTERNATIONAL USA INC (NY)	3,836	342
SOUTHERN WORLDWIDE LOG (TX)	1,267	104
INTEPLAST GROUP LTD (NJ)	986	105
AJINOMOTO WINDSOR INC (OR)	744	91
GOYA FOODS OF TEXAS (TX)	627	53

7.4.2 Imports of Soft Drinks/Mineral Waters

This product group includes natural waters (HS 2201) and sweetened waters and other nonalcoholic beverages (HS 2202). Like prepared foods, these products are all containerized. The top origins for these products are all European countries, including Austria, Switzerland, France and Italy. In 2016, France was the world's leading exporting country with exports of bottled water valued at $906.5 million.[132]

Volume increases for soft drinks and mineral waters are similar to those of prepared foods, growing strongly from 2011 through 2018. The forecast shows volumes growing five-fold from 2015 to 2045.

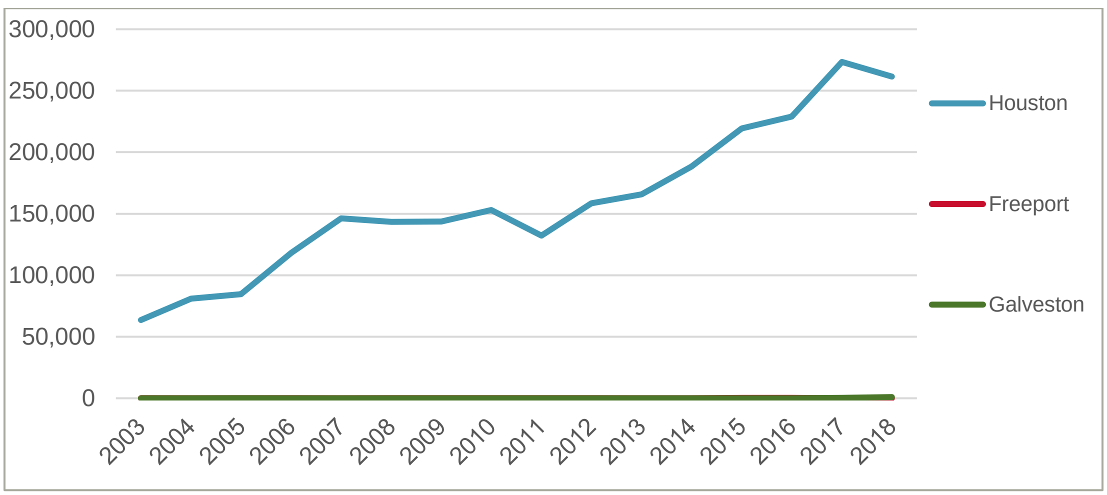


Figure 7-18. Imports of Waters by Port in Tons

[132] Fooddive.com

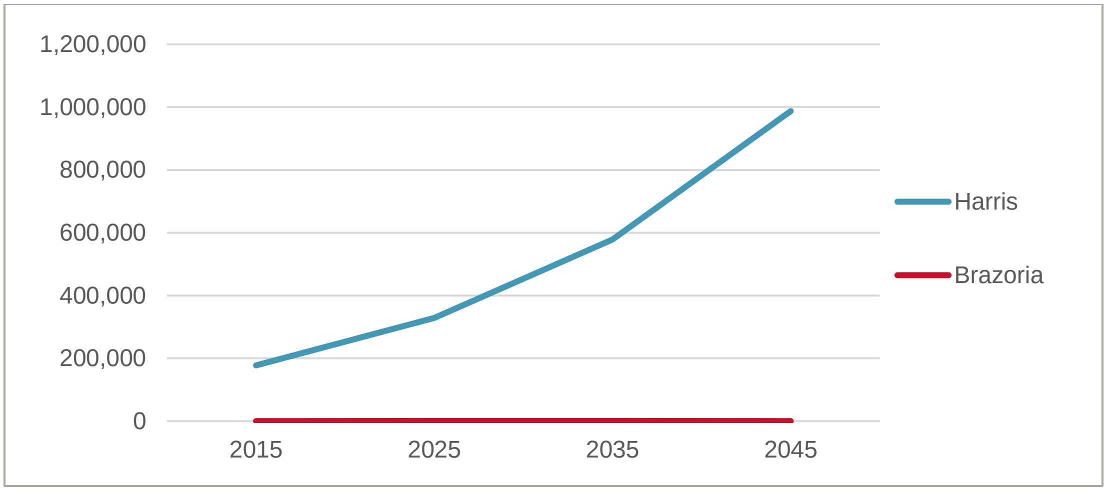


Figure 7-19. Forecast of Waters Imports Transported by Truck in Tons

Imports of soft drinks/mineral waters in 2018 were about equal to the state total indicating that, on average, most destinations of imports are located within the state. Harris County is the primary destination of imports of waters through the Port of Houston.

By far, the top importing consignee of natural waters imported through Houston is "Not Available" (this may include companies such as WalMart and other importers whose names are not disclosed within this data source), followed by Danone Waters (whose brands include Evian and many others) and Nestle Waters (who supplies European brands such as Perrier, San Pellegrino and Acqua Panna). For sweetened waters and other non-alcoholic beverages, Red Bull is the predominant importer with shipments through the Port of Houston typically originating in Europe.

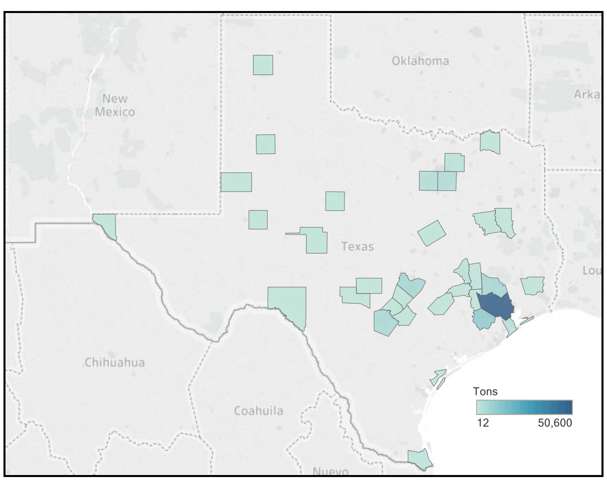


Figure 7-20. Destination Counties of Waters Imports through the Port of Houston

Table 7-10. Top Importers of Natural Waters - Houston

Consignee (Unified)	Metric Tons	TEUs Quantity
NOT AVAILABLE (WO)	38,824	3,084
DANONE WATERS OF AMERICA INC (NY)	14,846	1,108
NESTLE WATERS NORTH AMERICA (CT)	2,214	195
UNITED NATURAL FOOD INC	1,051	106

Table 7-11. Top Importers of Sweetened Waters and Other Non-Alcoholic Beverages - Houston

Consignee (Unified)	Metric Tons	TEUs Quantity
RED BULL NORTH AMERICA INC (CA)	96,944	9,734
NOT AVAILABLE (WO)	17,178	1,421
GOYA FOODS OF TEXAS (TX)	6,236	323
JJ MARTIN GROUP LLC (NJ)	2,825	288
ANHEUSER BUSCH INC (MO)	1,319	134
UNFI (RI)	1,121	114
NESTLE WATERS NORTH AMERICA (CT)	699	63
SAM'S F&B INC (CA)	577	58
ELEGANT TRADING (TX)	489	44
DANONE WATERS OF AMERICA INC (NY)	374	31

7.4.3 Imports of Alcoholic Beverages

Alcoholic beverages include beer, wine, and distilled spirits. Almost all imports are through the Port of Houston and are entirely containerized. Most import volume is represented by beer, for which the top originating countries are Netherlands, Mexico, Ireland, Belgium and Germany. Wine represents the second largest commodity with Italy, France and Australia the top originating countries. Top originating countries for distilled spirits include the United Kingdom, France and Ireland.

Imported beer accounts for 18 percent of all beer consumed in the U.S. In 2018, Mexico was the largest importer with 773 million gallons, followed by the Netherlands at 135 million gallons and Belgium at 60 million gallons[133]. Regarding distilled spirits, U.S. imports have risen from 184 million gallons in 2014 to 208 million gallons in 2018. [134]

Containers are moved by truck to liquor wholesalers and distributors.

Imports remained relatively steady, peaked in 2015, and have declined to around 400 thousand tons in 2019. Volumes are projected to grow to over 5 million tons in 2045.

[133] Beerinstitute.org

[134] https://www.distilledspirits.org/trends-data/

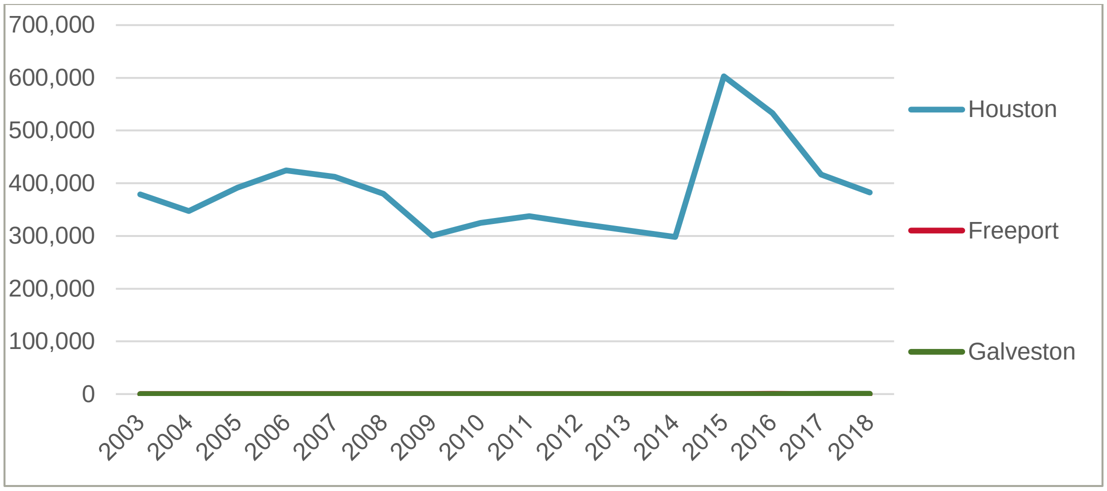


Figure 7-21. Imports of Alcoholic Beverages by Port in Metric Tons

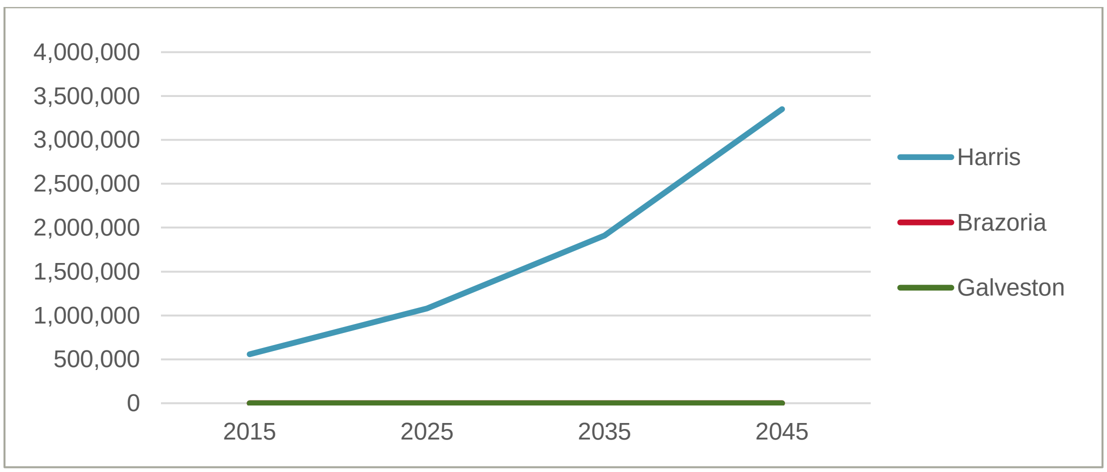


Figure 7-22. Forecast of Alcoholic Beverage Import Volumes by Port in Tons

Imports of beer through the Port of Houston in 2018 represented 11 percent of U.S. total volume and 114 percent of the Texas state total indicating that the port is a significant import gateway and that the region's supply chain extends beyond the state. Imports through the Port of Houston of wine and spirits both represented about 5 percent of U.S. total imports in 2018 and were about equal to state imports indicating that, on average, most destinations of imports for these products are typically located within the state. Harris County is the largest destination for alcoholic beverage imports.

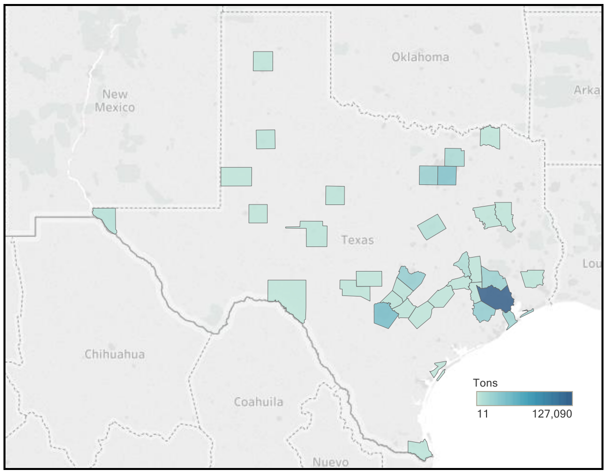


Figure 7-23. Destination Counties of Alcoholic Beverage Imports through the Port of Houston

The top importer of alcoholic beverages through Houston is Heineken, with over 120 thousand metric tons and nearly ten thousand TEUs imported in 2017-2018. Anheuser-Busch is also a large importer of foreign produced beer through Houston. It is also the leading global brewer with approximately 27 percent of global volumes.[135]

The other major importer of beer through Houston is Gulf Winds International, a Houston-based warehousing and logistics company that operates large facilities in close proximity to the Port of Houston.

Republic National Distributing Company (RNDC) is a large national distributor of wines and spirits. Under the spirits category a top importer is UETA which includes Duty Free Americas, Inc (DFA) stores on the US/Mexican border.

Table 7-12. Top Importing Companies of Beer - Houston

Consignee (Unified)	Metric Tons	TEUs Quantity
HEINEKEN USA INC (NY)	120,915	9,635
GULF WINDS INTERNATIONAL INC (TX)	40,765	3,236
ANHEUSER BUSCH INC (MO)	33,192	3,372
SATELLITE LOGISTICS GROUP (WO)	2,977	232
MILLER COORS LLC (WI)	2,725	294

[135] https://www.jpmorgan.com/global/research/beer-market

Table 7-13. Top Importing Companies of Wine - Houston

Consignee (Unified)	Metric Tons	TEUs Quantity
REPUBLIC NATIONAL DISTRIBUTING (TX)	14,769	1,554
SOUTHERN GLAZERS W&S OF TEXAS (TX)	11,112	981
PALMBAY LIMITED (NY)	5,372	561
MISA IMPORT INC (TX)	4,305	471
ECCO DOMANI USA INC (CA)	3,942	414
REPUBLIC SALES AND MANUFACTURING (TX)	3,575	358
FAVORITE BRANDS (TX)	3,504	367
CARDINAL WINE GROUP LLC (CA)	3,284	346
CONSTELLATION WINES US INC (NY)	3,238	287
UNITED WINE SPIRITS LLC (TX)	2,475	270

Table 7-14. Top Importing Companies Spirits - Houston

Consignee (Unified)	Metric Tons	TEUs Quantity
SOUTHERN GLAZER S W&S OF NY (TX)	11,586	1,195
REPUBLIC SALES AND MANUFACTURING (TX)	6,163	659
REPUBLIC NATIONAL DISTRIBUTING (TX)	3,523	378
PERNOD RICARD USA (FL)	3,366	379
PR USAFORT SMITH (AR)	3,053	152
BREAKTHRU BEVERAGE COLORADO (CO)	2,841	303
SOUTHERN WINE & SPIRITS OF AMERICA INC (CO)	1,919	196
GLAZER WHOLESALE DRUG COMPANY OF SHREVEPORT INC (TX)	1,894	215
CHIVAS BROTHERS LTD (AR)	1,546	78

7.5 Other Agricultural Products

Other agricultural products include large volume commodities that are principally exported. They include wheat, corn, rice and sorghum as well as cotton. Grain once it is harvested from fields is then transported to regional grain elevators. From these grain elevators, products may be moved by rail or truck to storage at port grain elevators where they are transferred to bulk vessels or loaded into containers that are subsequently loaded on board container vessels. The majority of grain volumes are transported in bulk vessels while most cotton exports are containerized. According to the U.S. Agricultural Marketing Service, in 2017, containers were used to transport seven percent of total U.S. waterborne grain exports. Approximately 62 percent of U.S. waterborne grain exports in 2017 went to Asia, of which 10 percent were moved in containers. Approximately 93 percent of U.S. waterborne containerized grain exports were destined for Asia. The H-GAC region's ports also compete with other Gulf coast ports for agricultural exports, including the New Orleans Port region, which in 2015 handled 76 percent of U.S. exports of grain products, 59 percent of Soybeans, 38 percent of animal feed, 23 percent of bulk grains and 64 percent of rice.[136]

7.5.1 Grain Exports

The Port of Houston is the leading H-GAC port for grain exports followed by Galveston, although there has historically been a significant variation by type of grain.

Figure 7-24. Grain Vessel Loaded at the Port of Houston

Wheat

Global wheat production for 2019/2020 is forecast at a record 777 million tons. The U.S. competes with other exporters as shown in Figure 7-25. Food, Seed and Industrial (FSI) consumption makes up the largest use of wheat. The USDA reports that FSI growth is particularly significant in South Asia and East Asia as consumers in those markets move towards a more wheat-based diet with rising incomes. Countries across Africa are also increasing import volumes. The USDA also notes

- Continued strong competition from Russia, Ukraine, and the European Union inhibit U.S. export growth, primarily due to relatively high transportation costs associated with greater distance from several markets.
- The U.S. share of the global wheat market has also been declining over the past two decades as the European Union and Russia have risen in prominence. Between 2001 and 2005, the U.S. share of global wheat exports averaged 25 percent; by 2016/17, the U.S. share slipped to about 15 percent.

[136] https://www.ams.usda.gov/sites/default/files/media/PortProfiles2017.pdf

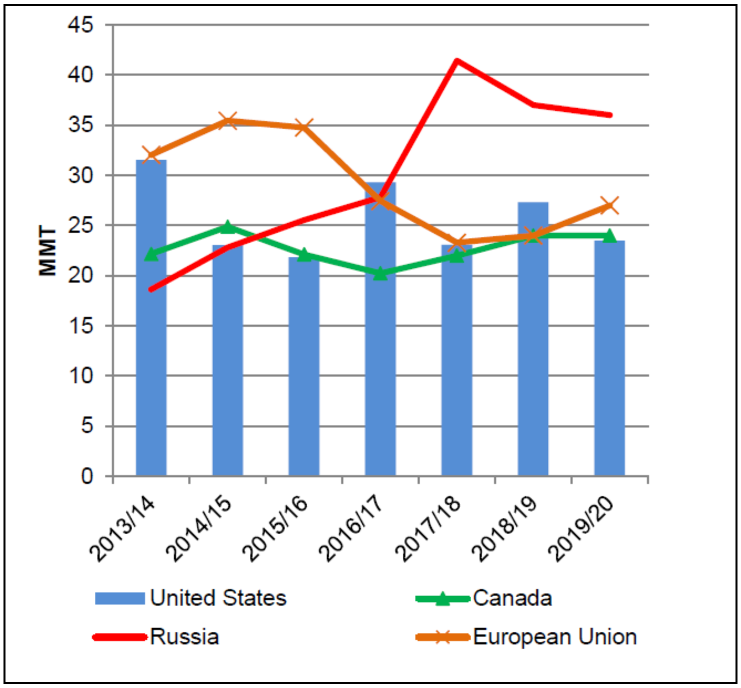


Figure 7-25. Leading Wheat Exporters
Source: Foreign Agricultural Service/USDA

Figure 7-26 illustrates the variable nature of wheat exports through the region's ports. Weather can significantly impact harvest yields and product quality. Also, the amount of land available for wheat production changes as farmer's change the types of crops they produce according to market conditions. With the change in soybean imports into China shifting from the U.S. to Brazil due to trade tensions, U.S. producers are expected to shift to wheat or corn production. According to the USDA Long-term agricultural projections – "*Exports are expected to remain flat as the U.S. share of global wheat trade continues to decline, particularly due to growing competition from the Black Sea region."*

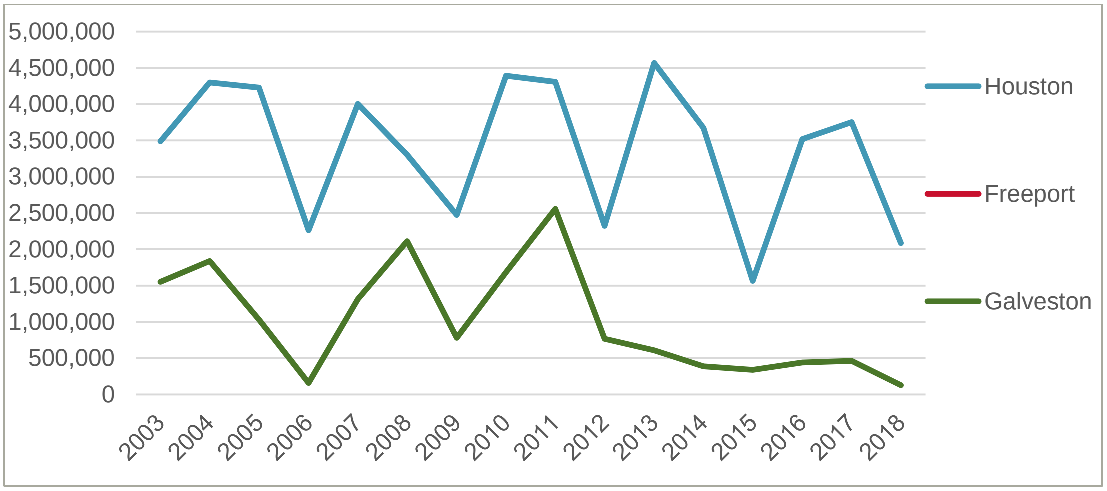


Figure 7-26. Exports of Wheat and Meslin by H-GAC Port in Metric Tons

Corn

Though corn is grown in most U.S. states, production is centered on the U.S. Corn Belt in the northern and Midwestern states. According to the U.S. Grains Council, roughly 17 percent of domestic production was exported to more than 80 different countries. Mexico (25 percent), Japan (21 percent) and South Korea (9 percent) were the top three U.S. corn export destinations. Corn can be used for food production, animal feeding and ethanol production.

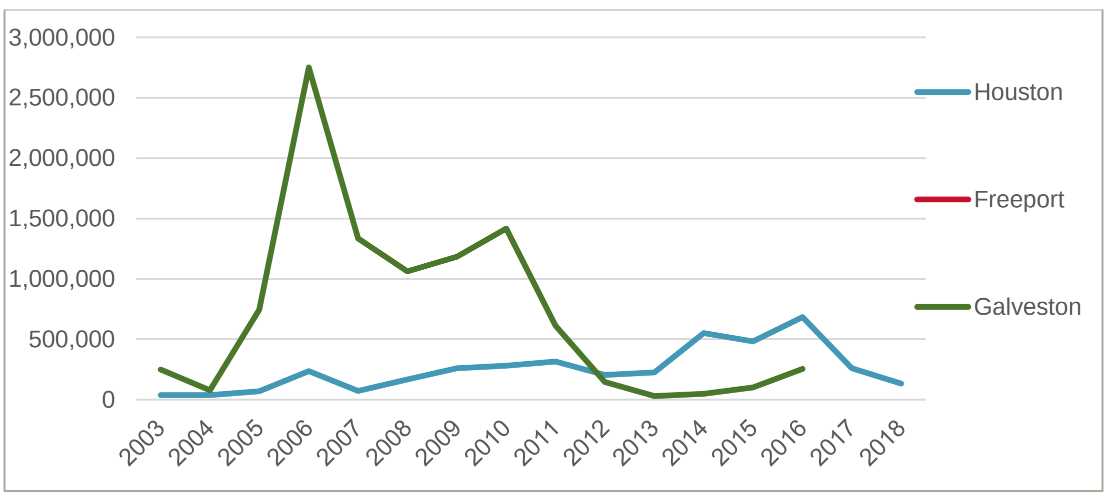


Figure 7-27. Exports of Corn by H-GAC Port in Metric Tons

Rice

Domestic production of rice is centered in Arkansas, California, Louisiana, Mississippi, Missouri and Texas. Arkansas ranks as the leading producer growing rice on 1.2 million acres, while Texas has seen a decrease in rice acres in recent years and now produces rice on about 140,000 acres. According to U.S. Rice, nearly 50 percent of the U.S. rice crop is exported to more than 120 countries worldwide. Mexico is the largest importer of U.S rice, followed by Canada and Central America represents the third largest market.

While U.S. exports of rice are expected to grow slightly, the U.S. share of global exports is projected to drop below six percent by 2020.

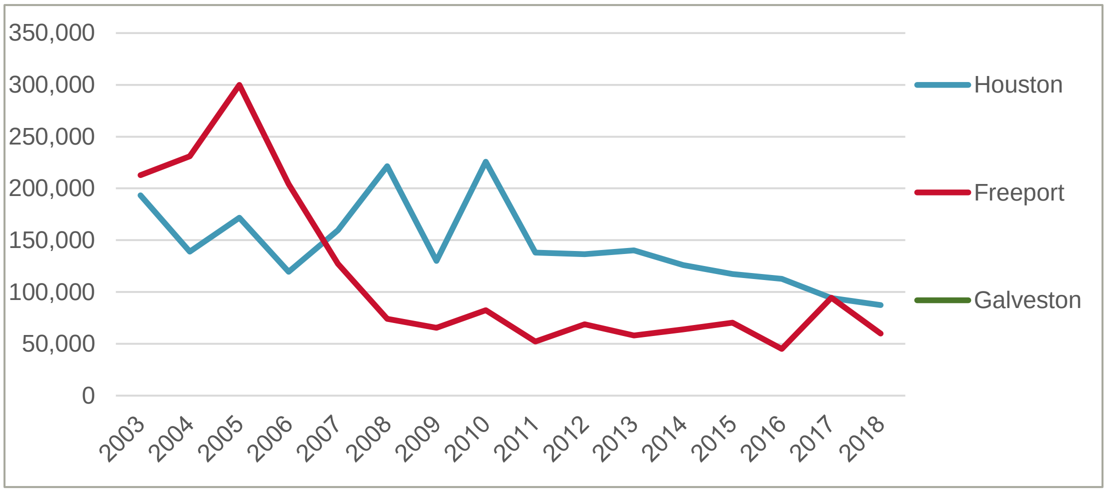


Figure 7-28. Exports of Rice by H-GAC Port in Metric Tons

Sorghum

Sorghum is a grain that is used for animal feed, ethanol production, food and industrial uses. Produced in 21 states, the majority of production is centered on the Sorghum Belt running from South Dakota to South Texas. In 2017, the top five producing states were Kansas, Texas, Colorado, Oklahoma and South Dakota. Approximately 40 percent of domestic sorghum is used for ethanol production. The U.S. is the world's largest sorghum exporter. Mexico and Japan are the second and third largest importers after China.

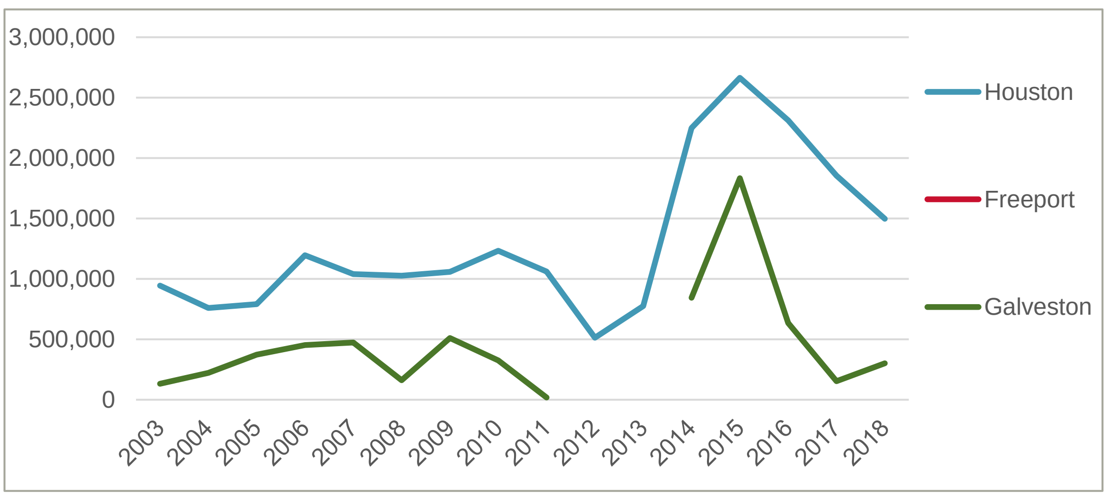


Figure 7-29. Exports of Grain Sorghum by H-GAC Port in Metric Tons

The increase in sorghum exports from 2013/14 to 2016/17 was largely a result of feed mills in southern China seeking cheaper substitutes for expensive domestically produced corn. When China imposed higher trade tariffs in April 2018, the demand for U.S. imports reduced.

Summary of Grain Exports

Non-containerized grain exports through H-GAC ports represented about five percent of the U.S. total in 2018 but only 90 percent of total state exports, indicating that most exports originate within the state.

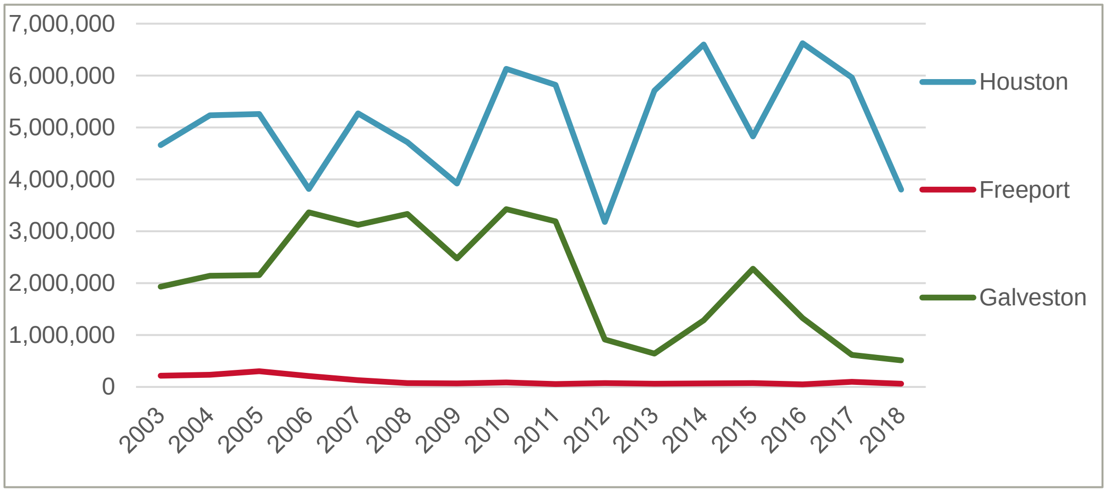


Figure 7-30. Exports for Total of Four Grains by H-GAC Port in Metric Tons

The forecast for grain exports transported by truck shows volumes growing from under 2.0 million tons in 2015 to nearly 3 million tons in 2045.

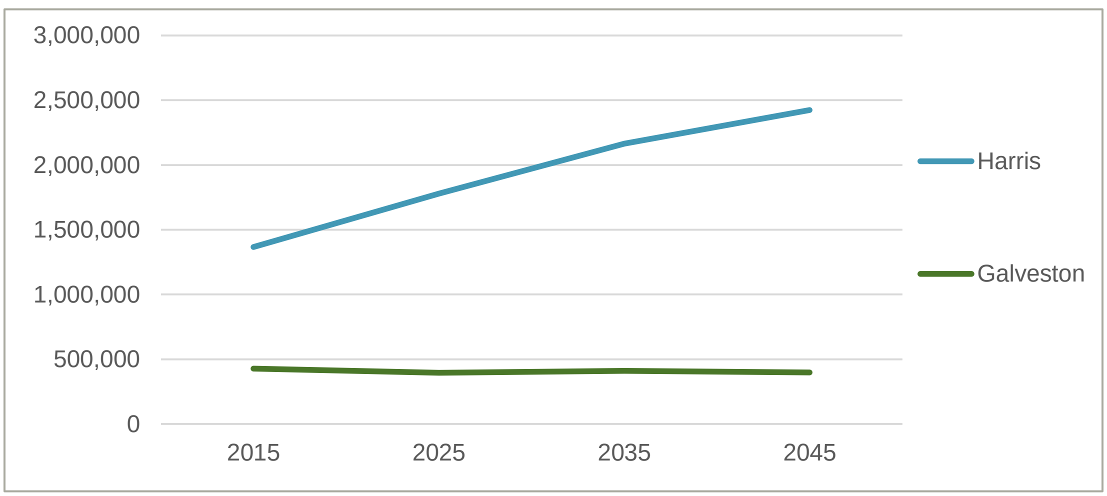


Figure 7-31. Forecast of Grain Exports Transported by Truck in Tons

Figure 2-32 below shows that grain exports originate in many counties throughout Texas. Harris County is the top originating county for exports out of the Port of Houston while Nueces County to the south is the top origin county for exports out of Galveston.

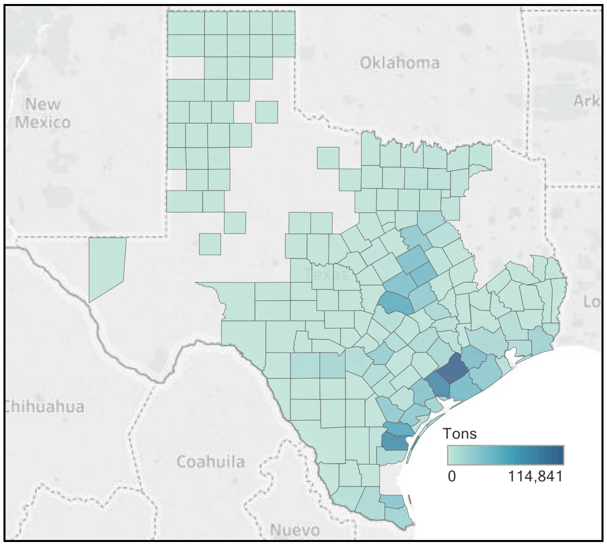


Figure 7-32. County Origins of Grain Exports to Harris County (Port of Houston) in 2015

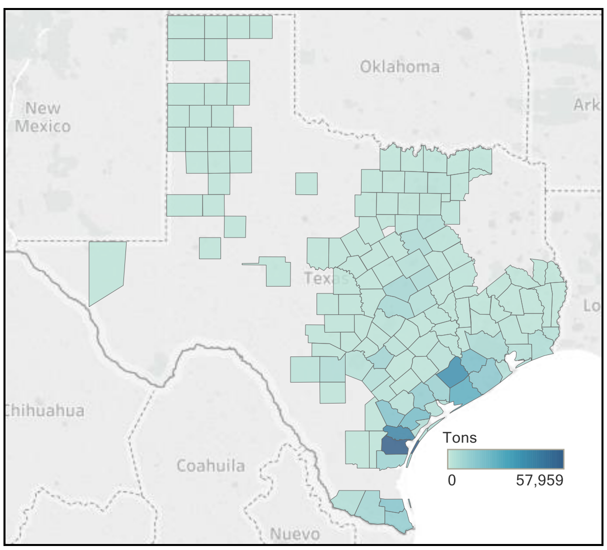


Figure 7-33. County Origins of Grain Exports through Galveston in 2015

The largest exporters of grains out of the Port of Houston include food aid organizations: United Nations World Food Program, Catholic Relief Services and US AID.

Milgram is a customs brokerage and international freight forwarder. Archer Daniels Midland (ADM) is a major international supplier of rice.

Table 7-15. Top Exporters of Grains through the Port of Houston

Exporter (Declared)	Metric Tons	TEUs Quantity
WORLD FOOD PROGRAMME	18,305	1,372
CATHOLIC RELIEF	7,275	302
USAID / M / OAA / T	2,990	262
MILGRAM & COMPANY LTD	5,182	275
ADM RICE INC.	2,486	124
GEODIS USA INC FOOD AID	2,135	212
RIVIANA FOODS INC.	2,123	87
INTERRA INTERNATIONAL, LLC	1,918	112

7.5.2 Cotton Exports

Cotton is grown on farms and then milled in ginning facilities where it is baled and transported to warehouses. Exports are almost entirely containerized and are principally shipped out of the Port of Houston. Cotton exports have been highly cyclical over recent years dropping to a low in 2011 but rebounding strongly to a peak in 2018.

The forecast for cotton exports by truck shows relatively slow growth through 2045.

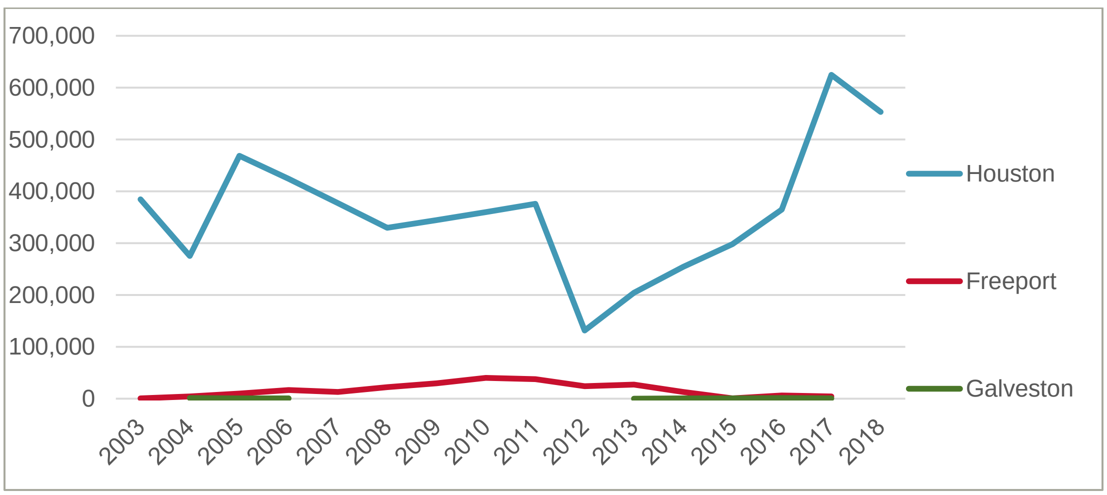


Figure 7-34. Exports of Raw Cotton (HS 5201 Cotton, Not Carded or Combed) by Port in Metric Tons

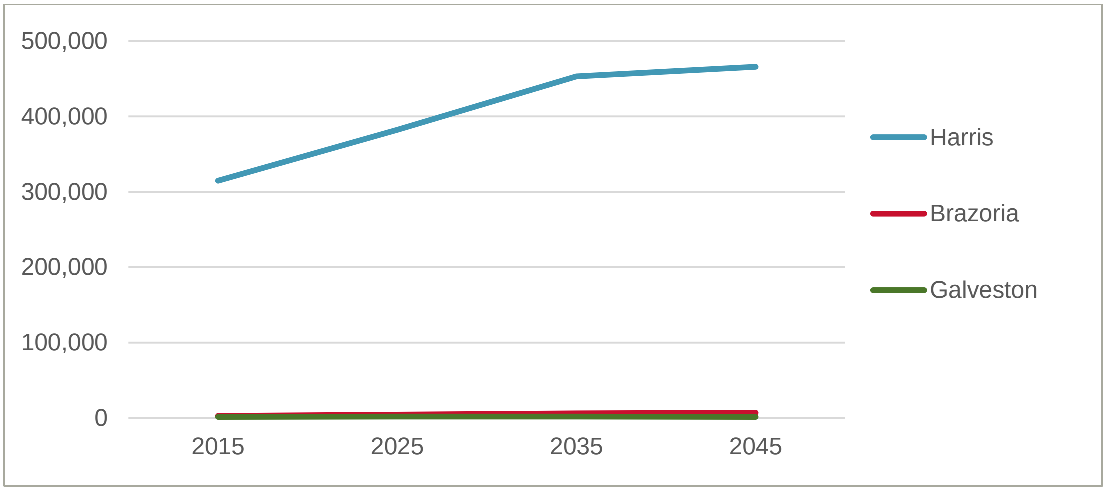


Figure 7-35. Forecast of Cotton Exports Transported by Truck by Port in Tons

According to the USDA Long-Term projections "*With growing international demand and strong growth expected in both Brazil and India, as well as from West African countries, the U.S. trade share is expected to decline. India, Brazil, and the West African countries exported roughly 11 million bales in 2017/18 and are expected to more than double their exports, with almost 27 million bales projected in 2028/29. The U.S. trade share is expected to drop from 39 percent in 2019/20 to under 30 percent by the end of the decade, despite an expected increase in exports of over 1 million bales.*"

Cotton exports through H-GAC ports represented about 16 percent of the U.S. total in 2018 but only about a third of total state exports, indicating that most exports originate within the state.

Cotton exports originate from many counties in Texas with the highest volumes coming from Northwest Texas. Texas is the largest producing state of upland cotton in the country with 9.2 million bales produced in 2017.

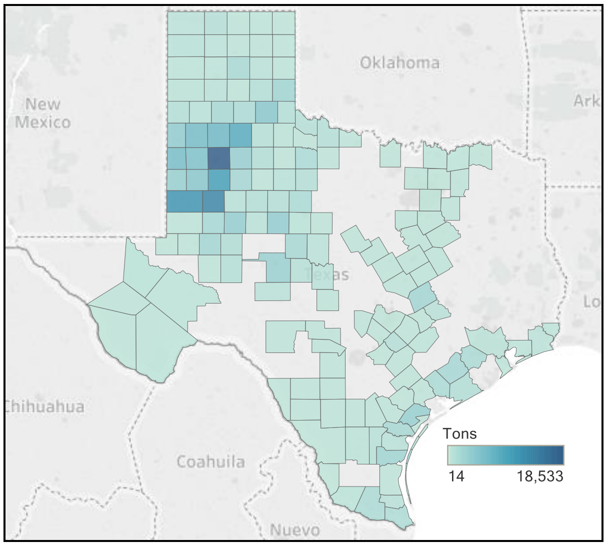


Figure 7-36. County Origins of Cotton Exports through Houston

The top exporter of cotton in 2017-2018 was Allenberg Cotton, a Louis Dreyfus Company. Other top exporters include Olam Cotton and Cargill Cotton. According to the U.S. Cotton Council, Vietnam was the largest importer of U.S. cotton in 2018 receiving 23 percent of U.S. exports, followed by China, Turkey, Pakistan and Indonesia.

Table 7-16. Exporters of Cotton through Houston

Exporter (Declared)	Metric Tons	TEUs Quantity
ALLENBERG COTTON CO	67,943	6,870
OLAM COTTON	44,786	4,541
ENGELHART CTP (US) LLC	32,075	3,225
CARGILL COTTON, A BUSINESS UNIT OF	26,499	2,829
ECOM USA LLC	14,242	1,417
BRIGHANN MARKETING INC.	13,192	1,299
PLAINS COTTON COOPERATIVE	12,729	1,281
COFCO AMERICAS RESOURCES CORP.	12,632	1,194
OMNICOTTON INC	8,626	876

7.6 Chemicals

7.6.1 Chemical Commodities

The chemicals commodity group includes organic, inorganic and miscellaneous chemical products. Volumes through H-GAC ports are substantial in both directions with export tonnage about double that of imports. Chemicals are moved through all four H-GAC ports but most volumes are through Houston. Imports volumes have been relatively stable over the past 15 years but have declined from 2014 to 2018. Export volumes have continued to rise steadily over the past 15 years.

Imports of organic and inorganic chemicals are largely non-containerized (about 80 percent of tonnage in 2018) while half of the volume of miscellaneous chemicals is containerized.

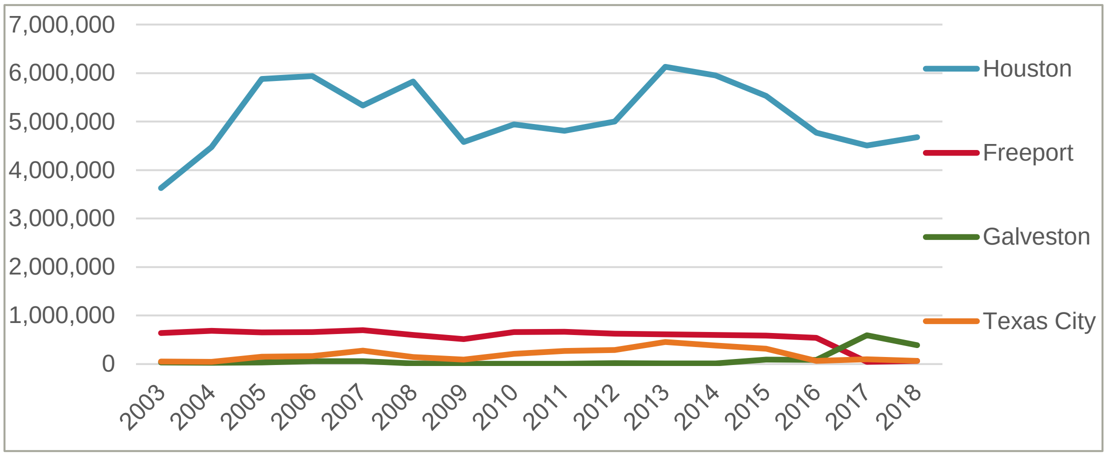


Figure 7-37. Imports of Chemicals by Port in Metric Tons

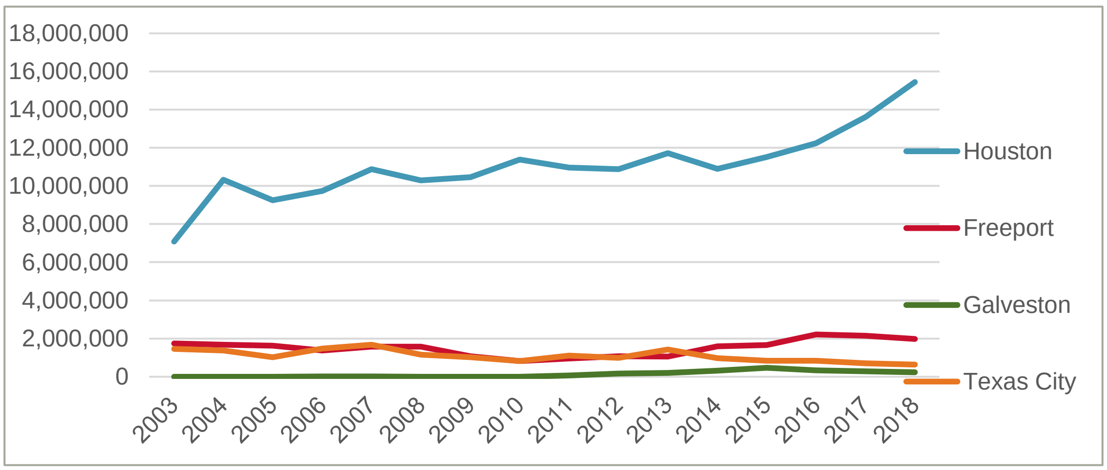


Figure 7-38. Exports of Chemicals by Port in Metric Tons

Forecasts of Chemicals imports show a quadrupling of volumes from 2015 to 2045, faster than the projected growth in exports.

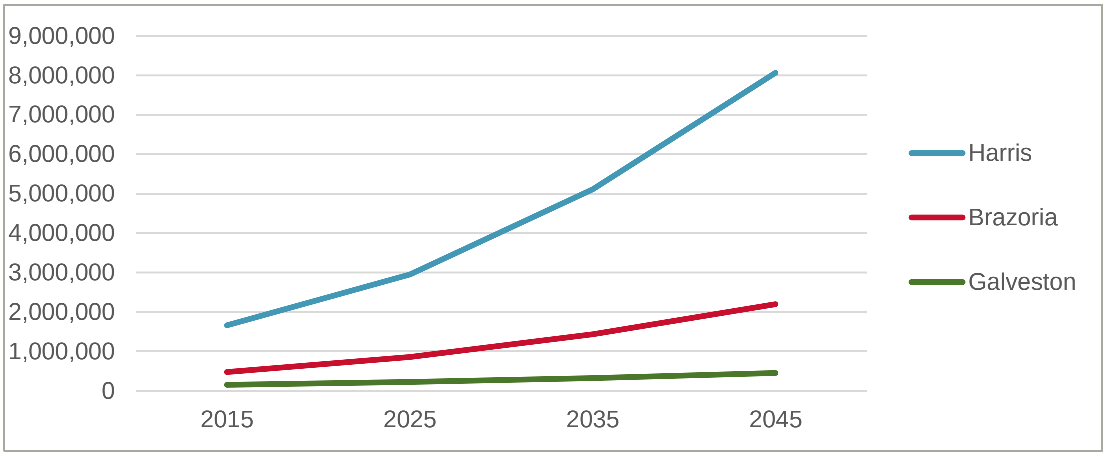


Figure 7-39. Forecast of Chemicals Imports Transported by Truck by County in Tons

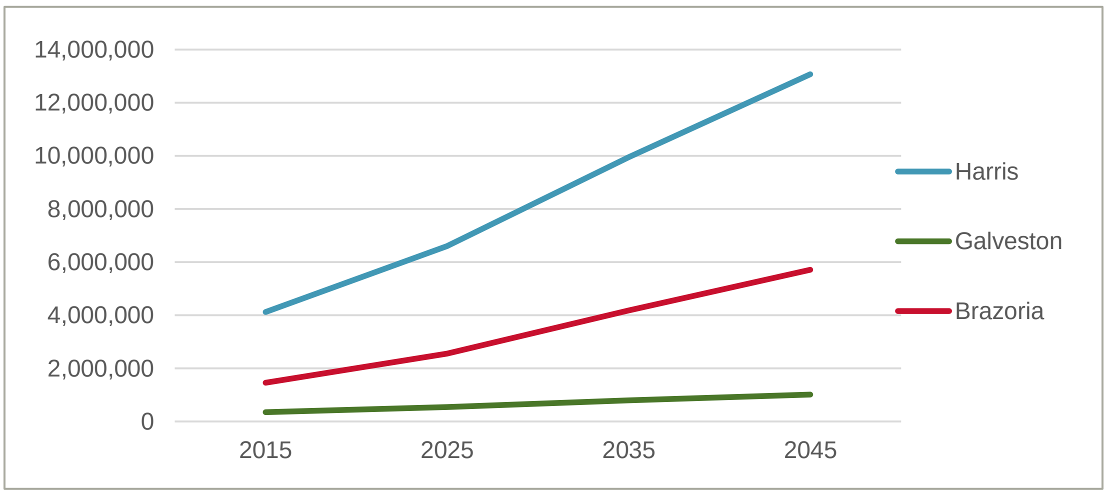


Figure 7-40. Forecast of Chemicals Exports Transported by Truck by County in Tons

Imports of chemicals through H-GAC ports comprise a large share of U.S. imports, 15 percent of containerized volumes and 30 percent of non-containerized volumes. However, these volumes represent only 75 percent of total state imports indicating that, on average, supply chains for these imports do not extend beyond the state.

Harris County is the primary destination of imports and the primary origin of exports for volumes through the Port of Houston. Brazoria County is the largest origin of exports out of Freeport.

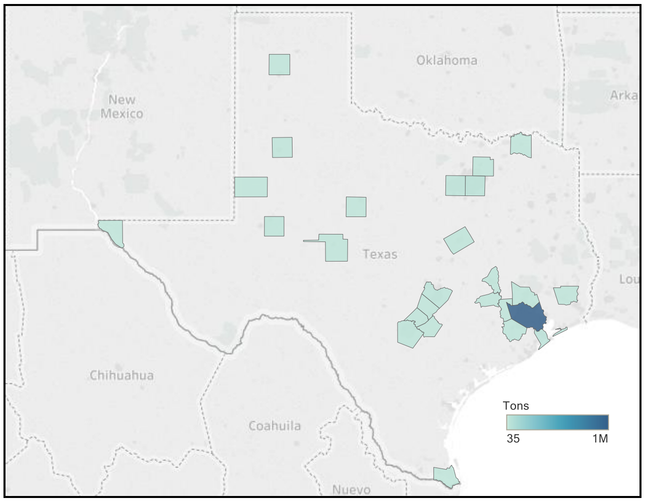


Figure 7-41. County Destinations of Chemicals Imported through Houston Transported by Truck

The bulk of chemical exports through H-GAC ports are non-containerized, about 75 percent of volume in 2018. Reflecting the large concentration of chemical products manufactured in Texas, these exports comprise a very large share of U.S. exports, 45 percent of non-containerized volumes and nearly 40 percent of containerized volumes in 2018. However, these volumes represent only 73 percent of total non-containerized state exports and 93 percent of containerized exports indicating that, on average, supply chains for these exports do not extend beyond the state.

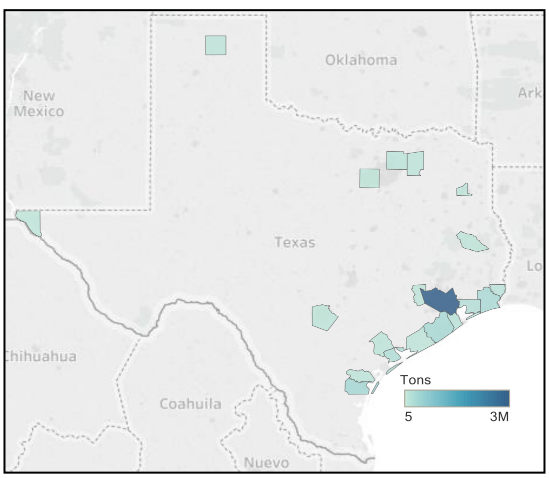


Figure 7-42. County Origins of Chemicals Exported through Houston Transported by Truck

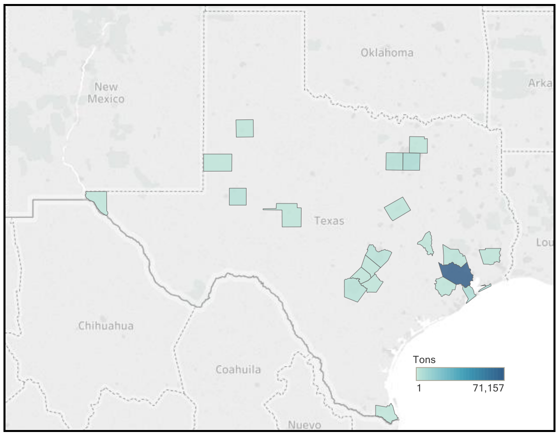


Figure 7-43. County Destinations of Chemicals Imported through Freeport Transported by Truck

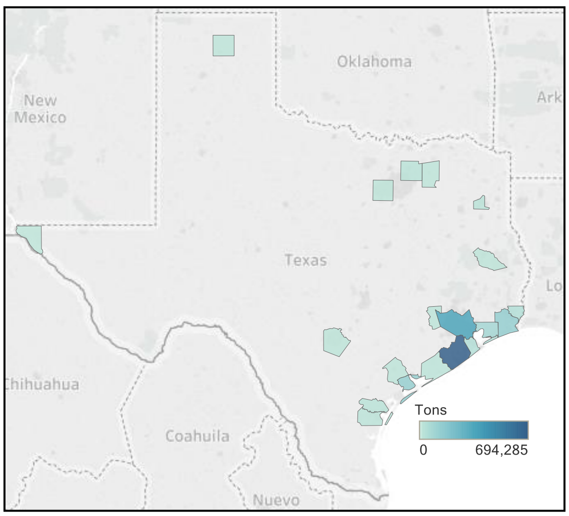


Figure 7-44. County Destinations of Chemicals Exported through Freeport Transported by Truck

Importing Companies

Sintex Minerals is the top importer of organic chemicals through Houston. It is part of The Curimbaba Group, a Brazilian company that produces bauxite proppant which is marketed and distributed by Sintex Minerals for use in the hydraulic fracture stimulation treatments of oil and gas wells.

Table 7-17. Importing Companies of Inorganic Chemicals - Houston

Consignee (Unified)	Metric Tons	TEUs Quantity
SINTEX MINERALS & SERVICES INC (TX)	62,939	2,269
MERICHEM COMPANY (TX)	17,882	0
ETIMINE USA INC (PA)	13,563	36
HALDOR TOPSOE INC (TX)	7,572	991
ICL IP AMERICA INC (MO)	5,568	249
LANXESS CORP (PA)	4,567	352
ALTEO NA LLC (OH)	3,604	208
KRONOS INC (TX)	3,454	327

Table 7-18. Importing Companies of Organic Chemicals - Houston

Consignee (Unified)	Metric Tons	TEUs Quantity
SOUTHERN CHEMICAL CORP (TX)	188,653	97
MITSUI USA (TX)	60,638	73
EXXONMOBIL OIL CORPORATION (TX)	39,333	12
COVESTRO (PA)	32,094	440
KAO SPECIALTIES AMERICAS LLC (NC)	30,858	129
TAUBER PETROCHEMICALS CO (TX)	25,585	53
LANXESS CORP (PA)	24,122	489
HUNTSMAN INC (TX)	15,261	745
ARKEMA CHEMICALS INC (TX)	13,307	6
DEXCO POLYMERS LP (TX)	13,016	90
BASF CORPORATION (NJ)	11,834	541

Exporting Companies

Most exports of chemicals are organic (HS 29). While a few top exporters are manufacturing companies, such as ExxonMobil, many are 3rd party logistics companies specializing in transportation of chemicals in tank containers. Top exporter companies include Newport Tank Containers, Den Hartogh, Stolt Tank Containers and Hoyer Global.

Table 7-19. Top Exporters of Inorganic Chemicals - Houston

Exporter (Declared)	Metric Tons	TEUs Quantity
OCCIDENTAL CHEMICAL EXPORT SALES LL	36,699	6

Table 7-20. Top Exporters of Organic Chemicals - Houston

Exporter (Declared)	Metric Tons	TEUs Quantity
NEWPORT TANK CONTAINERS, INC.	44,827	2,248
HOYER GLOBAL (USA) INC	37,412	2,222
DEN HARTOGH AMERICAS INC.	29,493	1,487
INTERMODAL TANK TRANSPORT (USA)	23,691	1,207
VTG TANKTAINER NORTH AMERICA, INC.	22,027	1,116
STOLT TANK CONTAINERS B.V.	21,791	1,095
CELANESE LTD ON BEHALF OF	20,237	696
EXXONMOBIL CHEMICAL	16,594	884
LESCHACO, INC.-TANK CONTAINER	14,307	731
BERTSCHI NORTH AMERICA INC	13,234	669
GTM INTERNATIONAL, LLC	10,173	188
M&S LOGISTICS	8,271	424
ASCEND PERFORMANCE MATERIALS	7,606	677
NOVUS INTERNATIONAL INC	7,578	376
TAMINCO US LLC	5,900	449
ROHM & HAAS CHEMICALS LLC	5,562	371
EVONIK CORPORATION	4,412	409
KATOEN NATIE TANK OPERATIONS INC.	4,264	205
LUCITE INTL INC	4,210	247

Table 7-21. Top Exporters of Misc. Chemicals - Houston

Exporter (Declared)	Metric Tons	TEUs Quantity
WORLD FOOD PROGRAMME	26,498	1,742
STOLT TANK CONTAINERS B.V.	25,025	1,238
ALBEMARLE CORP	17,450	962
EXXON MOBIL CORPORATION	13,758	1,141
INTERMODAL TANK TRANSPORT (USA) INC	15,205	785
NEWPORT TANK CONTAINERS, INC.	7,730	388
HOYER GLOBAL (USA) INC	7,308	401

Table 7-22. Top Exporters of Inorganic Chemicals - Freeport

Exporter (Unified)	Metric Tons	TEUs Quantity
GTM INTERNATIONAL LLC (WO)	17,223	108
TRICON ENERGY LTD (TX)	17,116	2

Table 7-23. Top Exporters of Organic Chemicals - Freeport

Exporter (Unified)	Metric Tons	TEUs Quantity
MITSUI & CO USA INC (WO)	60,470	0

7.6.2 Plastics in Primary Forms

Plastics in primary forms includes a range of plastics materials (in HS 3901 to 3914). The definition of 'primary forms' is:

- liquids and pastes, including dispersions (i.e. emulsions and suspensions) and solutions
- blocks or irregular shape, lumps, powders (including molding powders), granules, flakes and similar bulk forms

These products are imported as well as exported but export volumes are much greater than imports. Most volumes in both directions are transported through Houston.

These products are almost entirely containerized for ocean transport.

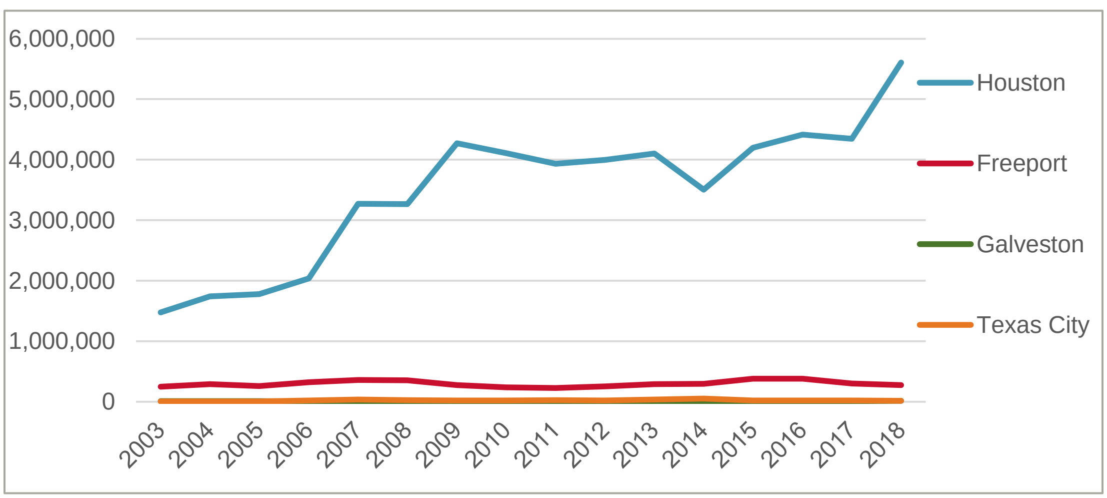


Figure 7-45. Exports of Plastics in Primary Forms by Port in Metric Tons

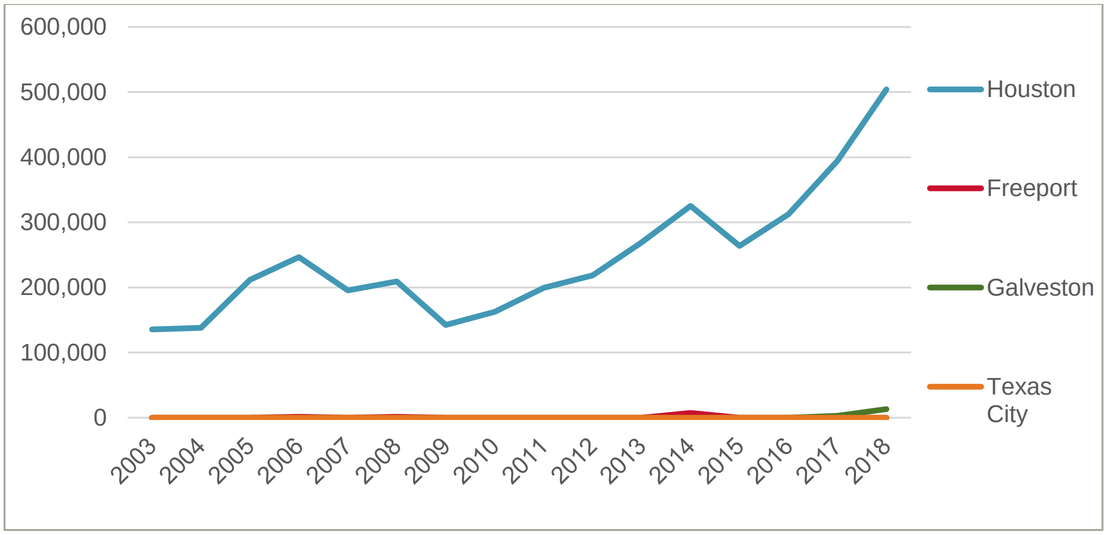


Figure 7-46. Imports of Plastics in Primary Forms by Port in Metric Tons

Forecasts of Plastic Materials Volumes

The forecasts of plastic materials volumes transported by truck show significant growth, with export volumes quadrupling from 2015 to 2045.

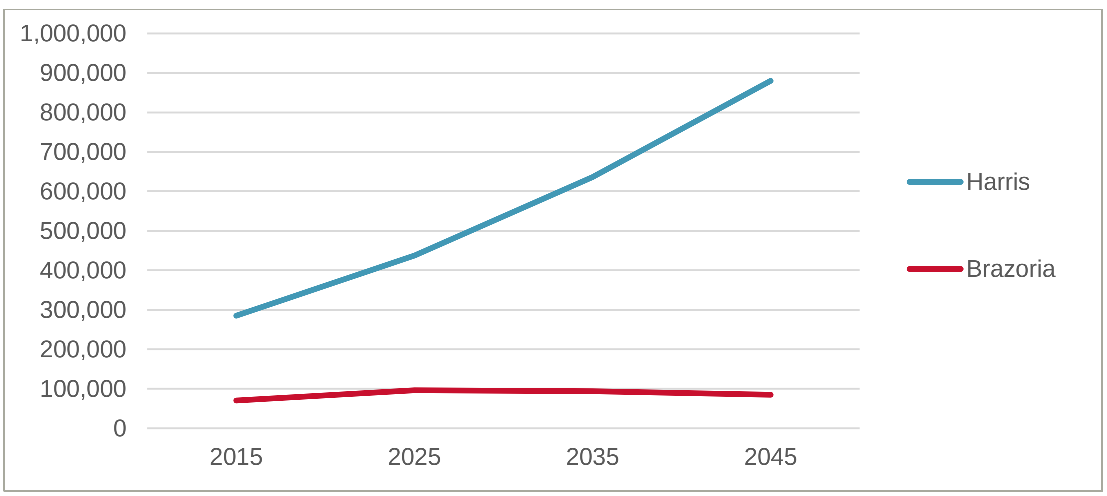


Figure 7-47. Forecast of Imports of Plastics Materials Transported by Truck in Tons

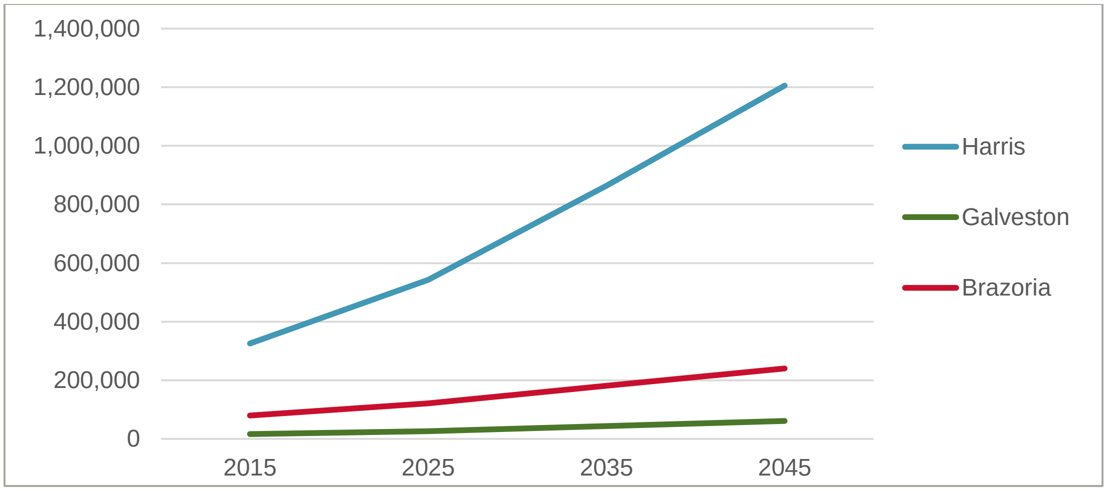


Figure 7-48. Forecast of Exports of Plastics Materials Transported by Truck in Tons

Imports through H-GAC ports comprise a significant share of U.S. imports, 15 percent of containerized volumes and 30 percent of non-containerized volumes. However, these volumes represent only 75 percent of total state imports indicating that, on average, supply chains for these imports do not extend beyond the state.

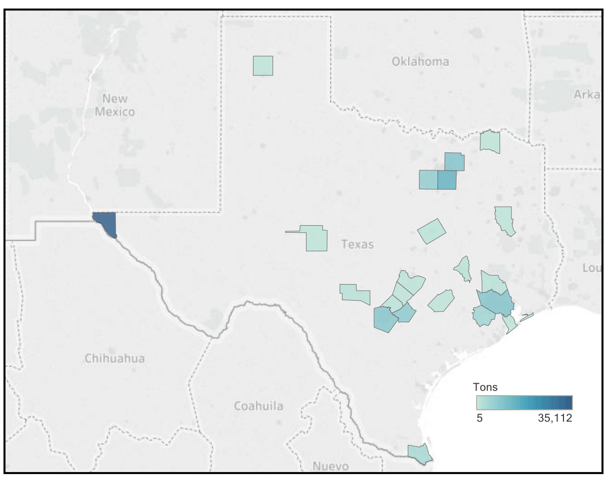


Figure 7-49. County Destinations of Plastic Materials Imported through Houston Transported by Truck

Reflecting the H-GAC region's large and growing concentration of plastics manufacturing capacity, exports through H-GAC region ports in 2018 represented more than half of total U.S. exports of these products even though these volumes were less than total exports from Texas. Origins of these exports are heavily concentrated in Harris County and other counties along the Gulf Coast.

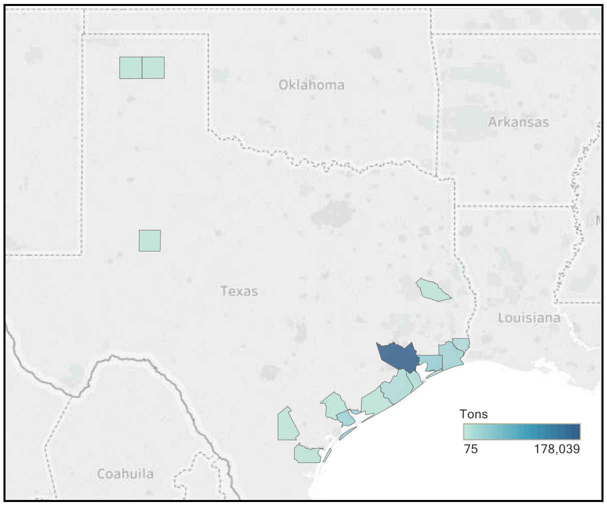


Figure 7-50. County Origins of Plastic Materials Exported through Houston Transported by Truck

ExxonMobil is the top importer of polyethylene polymers in primary forms, followed by Dow Chemical (with multiple consignees not included in Table 2-24 below).

Table 7-24. Top Importers of Polyethylene Polymers in Primary Forms (HS 3901) - Houston

Consignee (Unified)	Metric Tons	TEUs Quantity
EXXONMOBIL OIL CORPORATION (TX)	20,382	1,527
THE DOW CHEMICAL COMPANY (TX)	3,755	222

Table 7-25. Top Importers of Propylene or other Olefins Polymers in Primary Forms (HS 3902) - Houston

Consignee (Unified)	Metric Tons	TEUs Quantity
BRASKEM AMERICA INC (TX)	14,941	1,182
EQUISTAR CHEMICAL LP (TX)	7,816	740
VOPAK TERMINAL DEER PARK INC (TX)	5,878	313
THE DOW CHEMICAL COMPANY (TX)	3,744	356

Table 7-26. Top Importers of Polyethers, Epoxides and Polyesters in Primary Forms (HS 3907)

Consignee (Unified)	Metric Tons	TEUs Quantity
THE DOW CHEMICAL COMPANY (TX)	10,307	831
COVESTRO (PA)	2,956	182
HEXION INC (TX)	2,757	251
VINMAR OVERSEAS LTD (TX)	2,265	99
THE DOW CHEMICAL COMPANY (GA)	2,165	118

Top exporters of plastics in primary forms include identified manufacturers, with ExxonMobil the top company, and transportation companies such as Unitcargo Container Line, a Non-Vessel Operating Common Carrier (NVOCC).

Table 7-27. Top Exporters of Polymers of Ethylene in Primary Forms (HS 3901) - Houston

Exporter (Declared)	Metric Tons	TEUs Quantity
UNITCARGO CONTAINER LINE,	219,202	18,775
EXXON MOBIL	218,012	17,990
MONTACHEM INTERNATIONAL INC	52,377	4,094
MTS LOGISTICS, INC.	47,351	4,130
RAVAGO GLOBAL TRADING	41,985	3,691
TOTAL PETROCHEMICALS & REFINING	37,375	3,153
EQUISTAR CHEMICALS, LP	30,035	2,538
VINMAR OVERSEAS LTD	28,067	2,361
BAMBERGER POLYMERS	25,635	2,132
CHEVRON PHILLIPS CHEMICAL CO. LP.,	22,528	1,814
EMERAUDE INTERNATIONAL	16,254	1,271
FLEUR DE LIS WORLDWIDE LLC	13,782	1,172
FMS LINES AS AGENT FOR	12,831	1,080
DISTRIBUIDORA PORTLAND S.A.	10,770	893
SHIPPER NAME/ADDRESS NOT DISCLOSED	10,622	946
M HOLLAND EXPORT SERVICES LLC	9,104	776
GEOCHEM INTERNATIONAL	7,613	607
CHEVRON PHILLIPS CHEMICAL	7,571	809

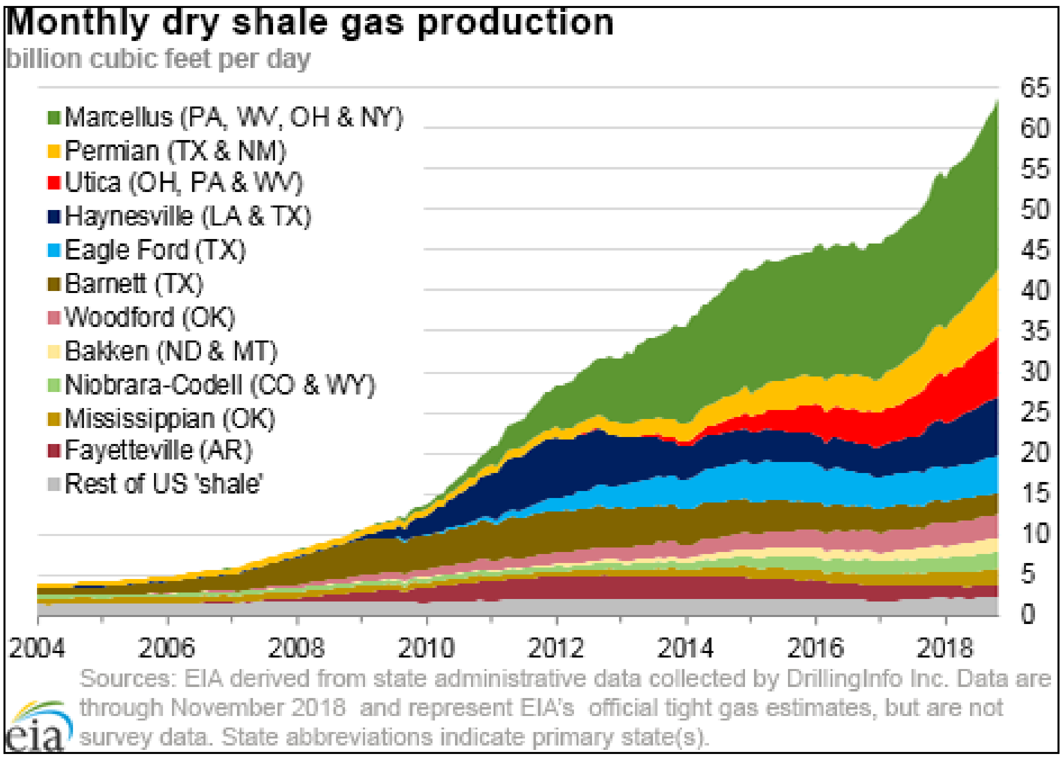
Table 7-28. Top Exporters of Polymers of Propylene or of Other Olefins in Primary Forms (HS 3902) – Houston

Exporter (Declared)	Metric Tons	TEUs Quantity
EQUISTAR CHEMICALS, LP	10,800	842
EXXONMOBIL	8,575	708
TOTAL PETROCHEMICALS & REFINING	7,962	584
UNITCARGO CONTAINER LINE, INC. ON	6,989	601
MONTACHEM INTERNATIONAL INC	6,061	490
HOYER GLOBAL (USA) INC	5,054	269

7.6.3 Plastic Resin Supply Chain

The plastic resin supply chain deserves a particular mention and in-depth analysis, as part of this study, largely because the H-GAC region and surrounding area has grown in the number of new plastic resin production facilities and significant volumes of products from these facilities are directed to export markets via the region's ports. This growth is a relatively new phenomena, driven largely by the domestic production of natural gas, a key feedstock for plastic resin production in the USA, whereas resin producers in Europe and Asia primarily use Naptha – a refinery byproduct.

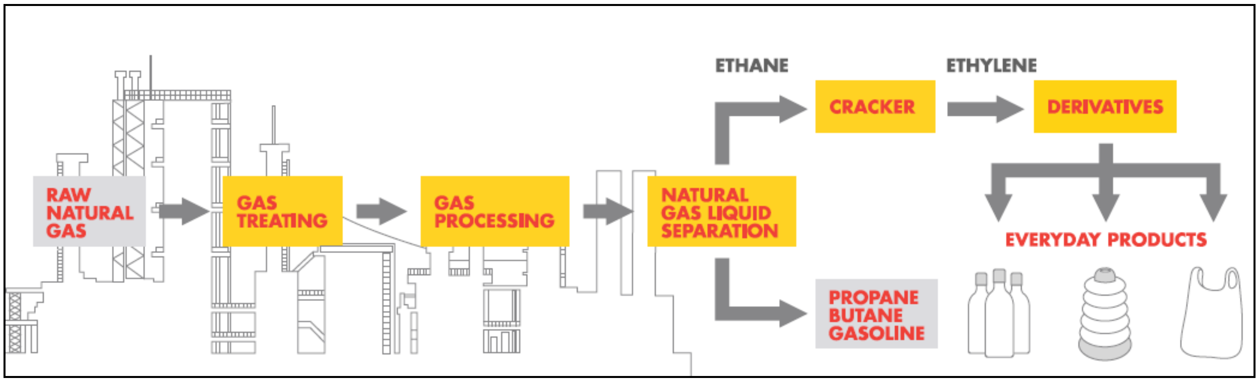
The growth in domestic natural gas production is shown in Figure 2-51.



Data Source: EIA

Figure 7-51. Monthly Dry Shale Gas Production

A 'cracker' is a large petrochemical plant that breaks down natural gas liquids and rearranges molecules to create ethylene, a building block in the formation of plastics. Ethylene is then converted into other materials such as polyethylene which is then hardened into plastic resin, typically pellets. The end to end production process is shown below.



Data Source: Shell

Figure 7-52. Process for Plastic Resin Production

Recent cracker developments include locations in Freeport (Dow), Mont Belvieu (Exxon Mobil) and Baytown (Chevron Phillips), in addition to locations in Louisiana at St. Charles and Placquemine. A development by Shell in Beaver County, PA is the first major cracker development outside of the Gulf region in the last 20 years and is expected to use products from the Marcellus shale as a feedstock for ethylene production.

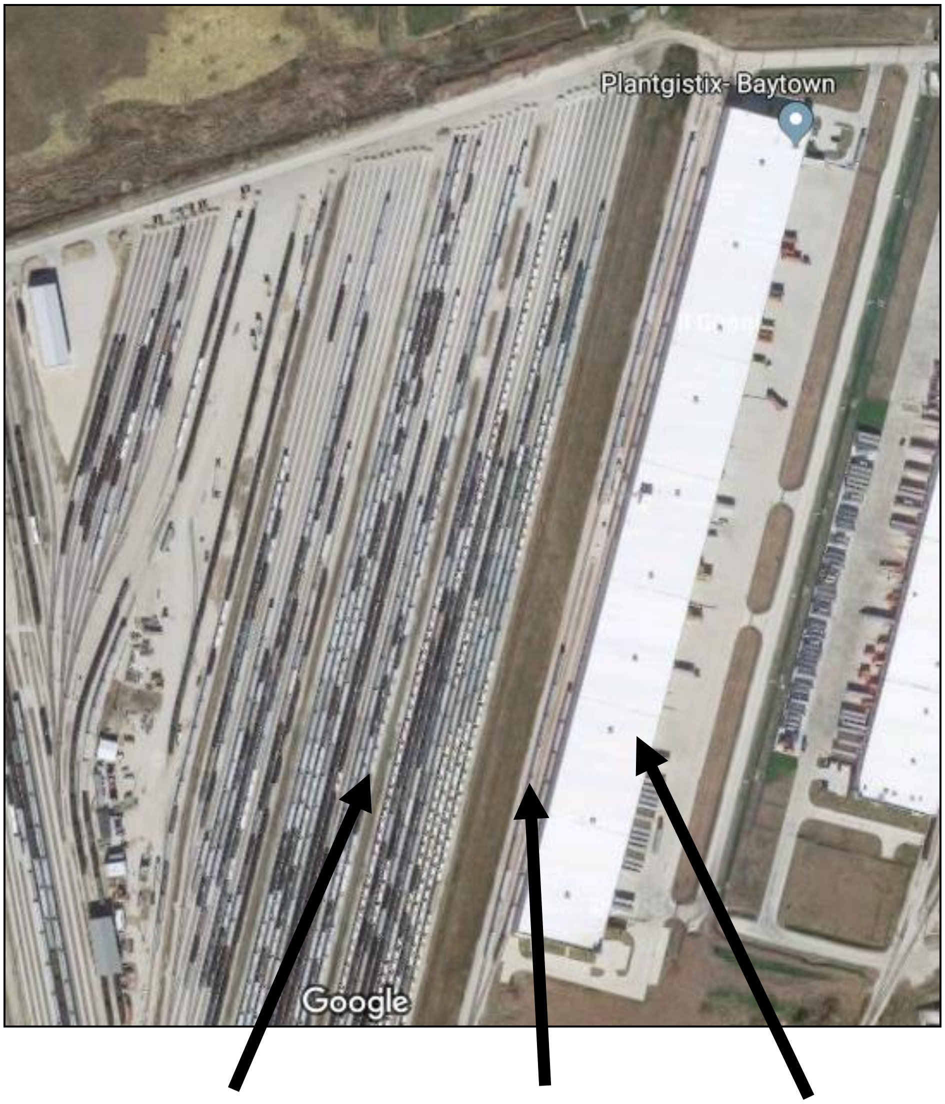
Once plastic resin is produced, the resin in powder or pellet form needs to be transported to a manufacturing facility where it can be melted and formed into end user products, such as plastic film, pipes, bottles, molds etc. Large, domestic users of plastics pellets may receive their product in rail hopper cars, which are directly loaded at the plastic production facilities. While some customers who receive exported plastic resin may be able to accommodate a bulk loaded shipping container or 1-ton bulk bags, the majority of plastic product producers prefer to receive pellets in 55-pound bags. This bagging of plastic resins for the export market has led to a number of different supply chain configurations.

Off-site packaging. This operation relies upon rail to move hopper cars of plastic pellets from the production facility to the packaging plant. In recent years a number of packaging sites have been established in the Ameriport and Cedar Port Industrial areas located to the east of Baytown, while older packaging plants were located within Houston or close to the Houston container terminals (see Figure 2-53). All are rail-served facilities. Other packaging facilities have also been located adjacent to the Port of Freeport.

Source: 2019 Google, Landsat/Copernicus, Datas SIO, NOAA, U.S. Navy, NGA, GEBCO, Map Data

Figure 7-53. Location of Plastic Resin Packaging Facilities in Houston

The plastics industry uses rail cars for storage in transit. Typically, to reduce cost, plastic manufacturers will produce large batches of plastic pellets which must then be stored until the product is purchased by a customer. Using rail, relieves the manufacturer of on-site storage requirements. Once the hopper car is loaded with pellets, it is placed in a storage in transit location until needed. When that plastic is required, the rail car is transported to to the export packaging facility or domestic user. An example of an off-site packaging facility in Baytown is shown below.



Source: 2019 Google, Map Data

Figure 7-54. Plastic Packaging Facility Baytown

Not all plastic pellets produced in the Houston area and destined for export markets, will be packaged in the Houston region. To reduce risk, diversify and exploit other opportunities, plastic packaging facilities are also emerging in close proximity to other ports outside the region. Examples include New Orleans, Charleston and Savannah. These ports are those which have not traditionally supported plastic resin exports. A further variation on the off-site packaging configuration is the development of “Dallas to Dock” operations. Both UP and BNSF are partnering with plastic packaging companies to develop packaging facilities in the Dallas area and make use of shipping containers that carried imports into the region from West coast ports that would otherwise return empty to those ports. Once loaded with plastic resins, the shipping containers are transported by rail to West coast ports.

On-site packaging. Research suggests that the ExxonMobil Mont Belvieu Plant is the only on-site packager in the Houston region. Figure 2-55 is an overview image of the Mont Belvieu plant

Source: 2019 Google, Map Data

Figure 7-55. ExxonMobil Mont Belvieu

A closer examination of the packaging and finished product staging area identifies shipping containers being loaded.

Source: 2019 Google, Map Data

Figure 7-56. ExxonMobil Mont Belvieu Plastic Resin Distribution Facility

7.7 Building Materials

The Building Materials product group includes Wood Products (HS 44), Stone and Cement (HS 2517 and 2523), and Stone, Cement and Ceramic Products (HS 68 & 69). These products are largely imported and are very heavy commodities with significant cyclicality. Stone and cement are bulk products while wood products and stone and ceramic products are largely containerized. With the exception of pebbles, gravel, etc. (HS 2517) imported through Freeport, these products are almost entirely imported through Houston. Historic volumes of building materials imports transported by truck are much smaller than total imports.

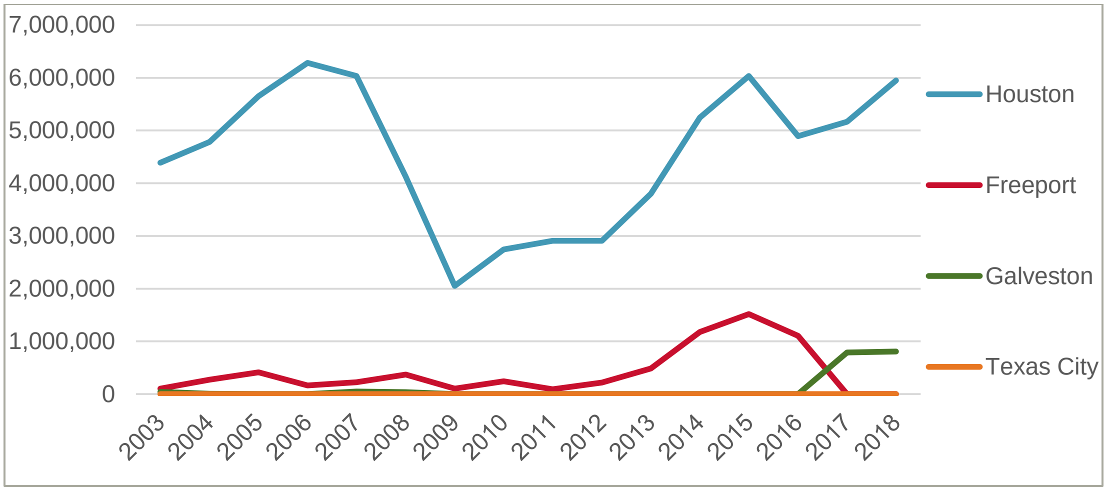


Figure 7-57. Imports of Building Materials by Port in Metric Tons

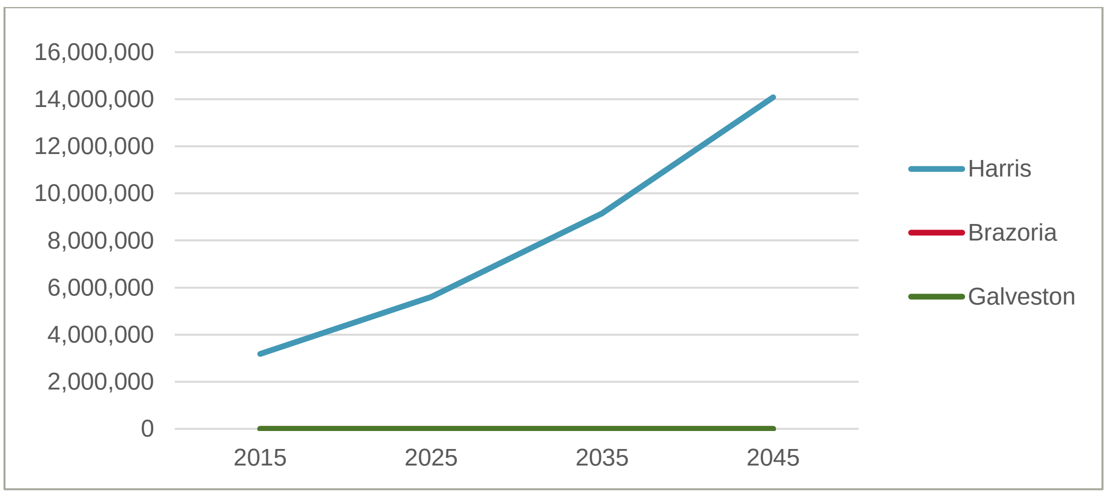


Figure 7-58. Forecast of Building Materials Imports Transported by Truck in Tons

Reflecting Texas' economic growth and large share of construction, imports of building materials comprise a large share of U.S. imports, 14 percent of non-containerized and 12 percent of containerized imports in 2018. Containerized imports through H-GAC ports were just less than state imports in 2018 and non-containerized imports through H-GAC ports were less than 60 percent of state volumes. This suggests that, on average, H-GAC ports supply chains for non-containerized imports are limited to regions within the state.

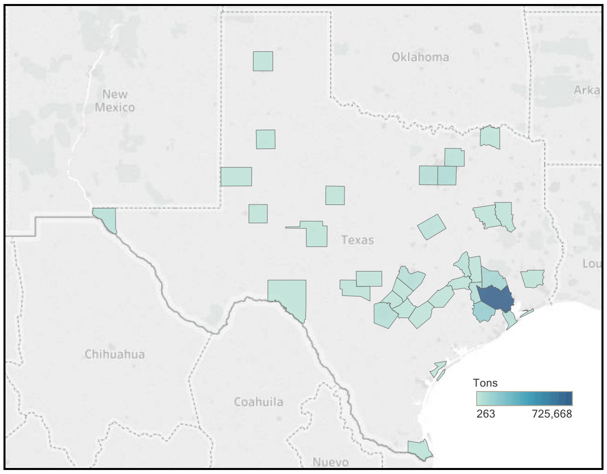


Figure 7-59. Destination Counties for Imports of Building Materials through Houston

UFP International is the top importing company for wood products through Houston and is part of Universal Forest Products, Inc. that manufactures and distributes products to construction, retail and industrial markets.

ARAUCO is the second largest imported or wood products. It supplies fiberboard, particleboard, hardboard, premium plywood, millwork, lumber, and wood pulp to the construction, casework/fixture fabrication, and papermaking industries.

Houston Cement and CEMEX are the top importers of cement through Houston. Houston Cement owns and operates two Portland cement import terminals located along the Houston Ship Channel. FD Sales Company is the top importer of ceramic products and M S International Inc. (MSI) is the second largest importer and is a large supplier of surfacing products, with a Houston distribution center.

Table 7-29. Top Importers of Wood Products - Houston

Consignee (Unified)	Metric Tons	TEUs Quantity
UFP INTERNATIONAL LLC (GA)	34,237	2,960
ARAUCO WOOD PRODUCTS (GA)	27,705	2,653
GLOBAL PRIME WOOD LLC (FL)	17,829	1,572
HOLLAND SOUTHWEST CORP (TX)	16,663	1,343
EUCATEX OF NORTH AMERICA INC (GA)	15,127	1,500
WOODGRAIN DISTRIBUTION (TX)	14,164	1,436
CMPC USA INC (GA)	13,434	1,396
BMC WEST BUILDING MATERIALS (ID)	12,639	1,405

Table 7-30. Top Importers of Cement

Consignee (Unified)	Metric Tons	TEUs Quantity
HOUSTON CEMENT COMPANY (TX)	1,011,512	0
CEMEX INC (TX)	350,061	0

Table 7-31. Top Importers of Stone and Cement Articles

Consignee (Unified)	Metric Tons	TEUs Quantity
GRANITE IMPORT LLC (CO)	80,765	100
C&C NORTH AMERICA INC (FL)	16,647	906
CONSENTINO NORTH AMERICA (FL)	12,269	650
PLYCEM USA LLC (TX)	11,495	1,099
ALLIED STONE INC (OK)	11,227	458

Table 7-32. Top Importers of Ceramic Products

Consignee (Unified)	Metric Tons	TEUs Quantity
FD SALES COMPANY LLC (GA)	36,707	1,498
ELIANE CERAMIC TILES USA INC (TX)	16,976	693
EMSER TILE LLC (CA)	14,002	550
RHI US LTD (IN)	9,583	441
ARIZONA TILE SUPPLY INC (AZ)	8,210	354

7.8 Iron and Steel and Articles of Iron and Steel

This commodity group includes iron and steel (HS 72) and articles of iron or steel (HS 73). Iron and steel principally include flat-rolled products; bars and rods; and angles, shapes and sections of iron and steel. Articles of iron or steel are largely comprised of tubes, pipes and hollow profiles of iron and steel. These materials may either be for end-use applications such as pipe or received as rolls or slabs to be processed into other metal products. Texas crude oil and natural gas fields are a significant consumer of pipe products that pass through the region's ports. The commodity group is largely non-containerized and arrives in bulk vessels.

Figure 7-60. Steel Pipe Offloaded in the Port of Houston

These products are mostly imported, and almost entirely though Houston. Research and feedback during the study identified that imported pipe is often staged at the port and then dispatched directly by truck to individual oil drill sites.

Volumes have been variable averaging about 6 million tons per year as shown in Figure 2-61. Volumes are projected to grow from the 6 million to level in 2015 to nearly 12 million tons in 2045.

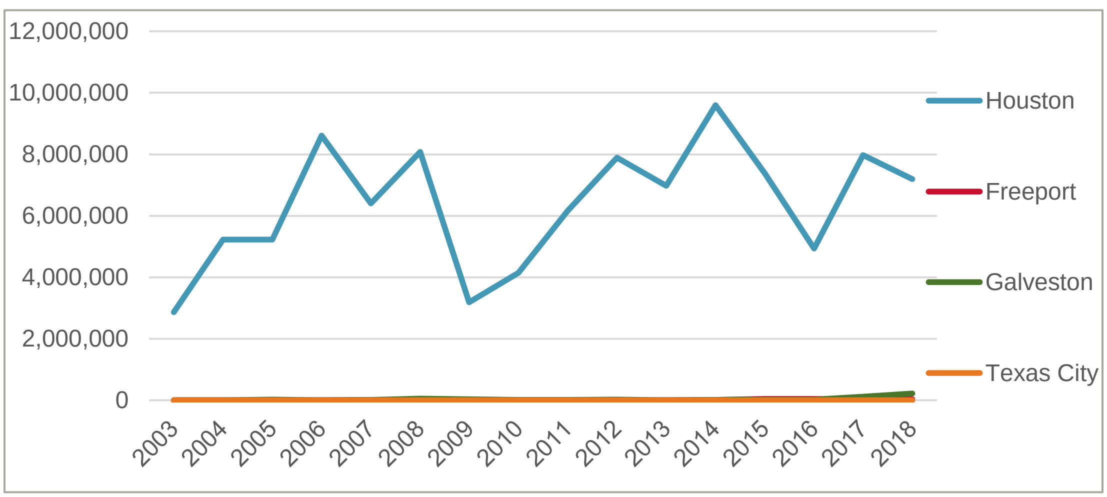


Figure 7-61. Iron and Steel Imports by Port in Metric Tons

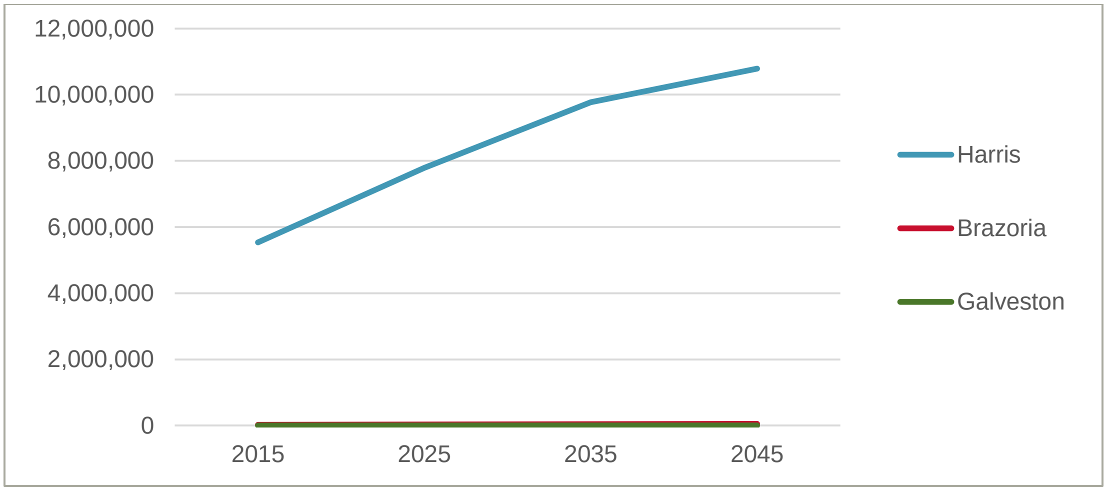


Figure 7-62. Forecast of Iron and Steel Imports Transported by Truck in Tons

H-GAC ports' imports of iron and steel products represent a very large share of U.S. imports, 19 percent of non-containerized and 12 percent of containerized imports in 2018. Both containerized and non-containerized imports through H-GAC ports were about equal to state imports in 2018 indicating that, on average, H-GAC ports supply chains for imports are limited to regions within the state.

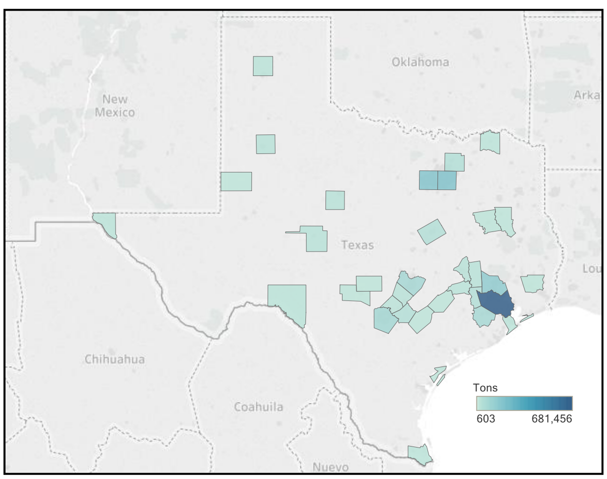


Figure 7-63. Destination Counties for Iron and Steel Imports Transported by Truck

The growth in domestic drilling and pipeline operations associated with the oil and gas sector has spurred a revival in regional production facilities. Arcelor is the top importing company of iron and steel as well as iron or steel products. ArcelorMittal is one of the largest steelmakers in North America. Tenaris is a global manufacturer and supplier of tubular products and in 2017, it started producing piping at its BayCity, TX location. Tenaris also imports products through the Port of Freeport, while other importers also use the Port of Houston. Borusan Mannesman a Turkish steel producer also invested in a Baytown production facility.

Table 7-33. Importing Companies: Iron or Steel

Consignee (Unified)	Metric Tons	TEUs Quantity
ARCELOR INTERNATIONAL AMERICA LLC (IL)	209,695	46

Table 7-34. Importing Companies: Iron or Steel Products

Consignee (Unified)	Metric Tons	TEUs Quantity
ARCELOR INTERNATIONAL AMERICA LLC (IL)	601,868	42
PUSAN PIPE AMERICA INC (CA)	573,881	175
TENARIS GLOBAL SERVICES CORPORATION (TX)	542,405	1,551
BORUSAN MANNESMANN PIPE US INC (TX)	500,005	42
NORTH AMERICAN INTERPIPE INC (TX)	328,357	2
HUSTEEL USA INC (TX)	246,736	0
HYUNDAI HYSCO USA (TX)	181,595	0
VALLOUREC MANNESMANN USA CORP (TX)	142,516	15
TMK IPSCO INTERNATIONAL LLC (TX)	125,035	0
TUBOS REUNIDOS AMERICA INC (TX)	112,471	24
SUMITOMO CORP OF AMERICA (TX)	109,770	0

7.9 Machinery

The machinery commodity group includes HS 84 Machinery. Imports are the primary flow of trade and have been highly cyclical, dipping sharply during the Great Recession and rebounding strongly from 2010 through 2018. Over 70 percent of H-GAC port's import tonnage was containerized in 2018.Houston is the primary port of entry followed by Galveston and Freeport.

Figure 7-64. Machinery waiting on the quayside at Port of Houston

As shown in Figure 2-65 below total import volume has roughly tripled from 2003 to 2018 with a significant downturn during the Great Recession.

Forecasts show volumes growing four-fold from 2015 to 2045 for the Port of Houston.

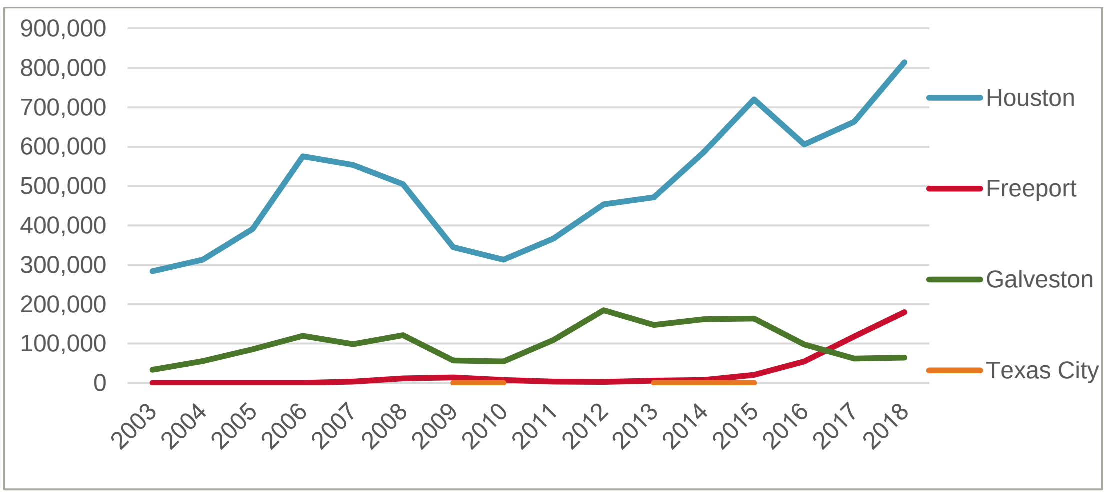


Figure 7-65. Machinery Imports by Port in Metric Tons

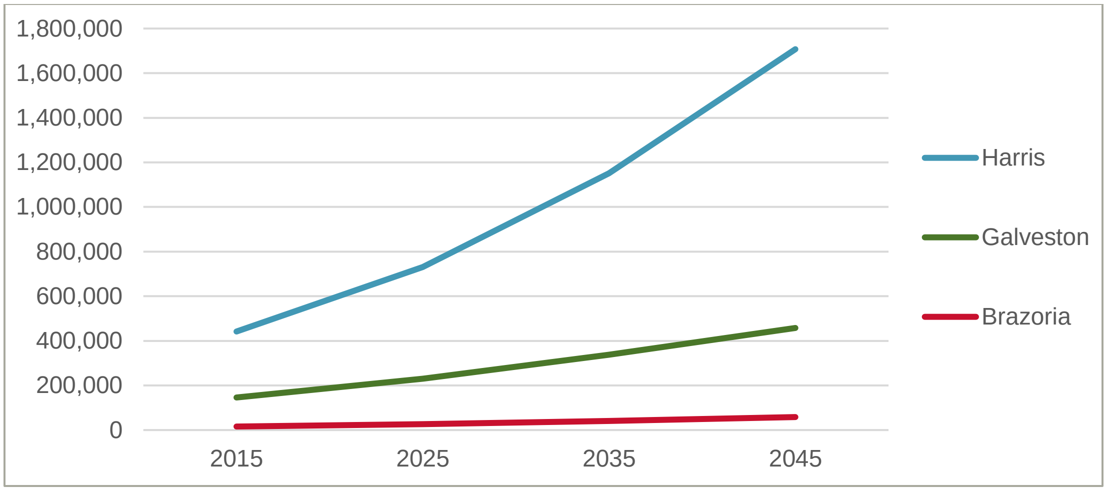


Figure 7-66. Forecasts of Machinery Imports Transported by Truck by County in Tons

H-GAC ports' imports of machinery represented 6 percent of U.S. containerized imports and 19 percent of non-containerized imports in 2018. Both containerized and non-containerized imports through H-GAC ports were less than state imports in 2018, indicating that, on average, H-GAC ports supply chains for imports are limited to regions within the state.

Harris County is the principal destination of machinery imports through the Port of Houston as well as though Galveston.

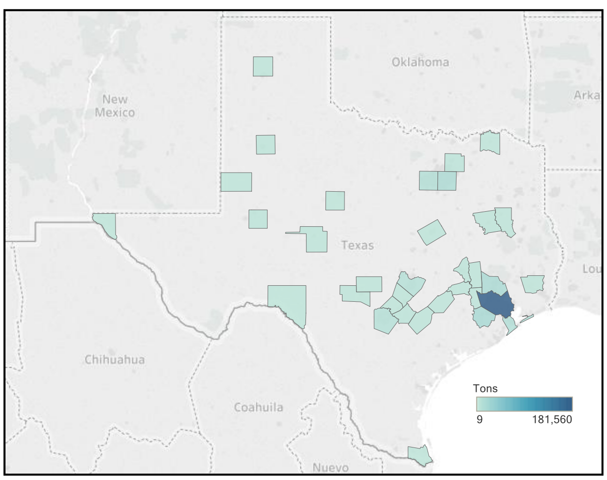


Figure 7-67. County Destinations of Machinery Imports Transported by Truck – Houston

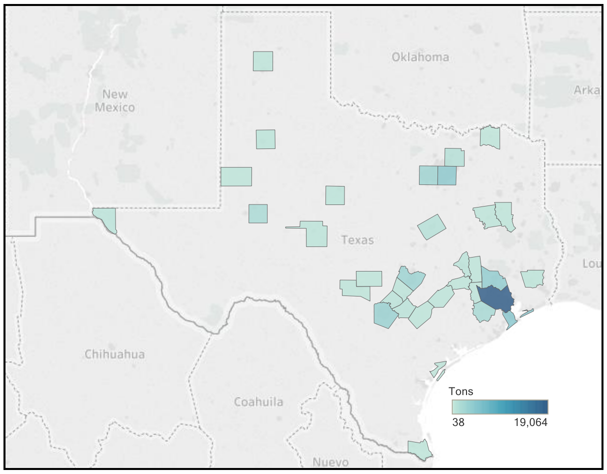
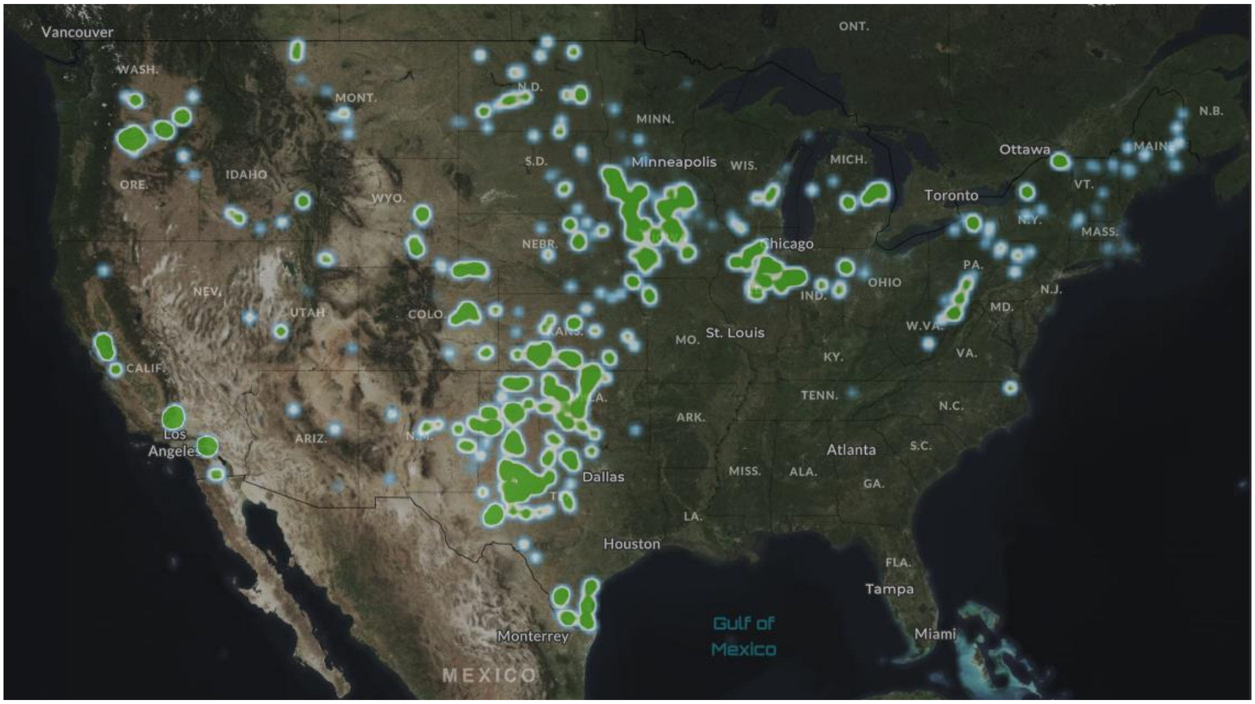


Figure 7-68. County Destinations of Machinery Imports Transported by Truck - Galveston

The top importing companies of machinery through Houston are Vestas American Wind Technology and Caterpillar. Caterpillar is also the top importer of machinery through Galveston, followed by Komatsu.

The importation of wind-related generation equipment including blades, turbines, nacelles and towers into the U.S. is not only influenced by demand for sustainable power generation, but also financial incentives, such as the U.S. Inland Revenue Service Production Tax Credit, which was originally enacted in 1992. While U.S. domestic wind generation manufacturing facilities have expanded, these are often located near centers of onshore wind production. For example, Vestas, a global wind equipment company has three facilities located in Colorado which includes the largest wind tower manufacturing facility in the world. Imported equipment supplements domestically produced products. Typically, equipment is manufactured in specialized facilities and transported to the production site in components. Rail, road and barge transportation are used. When transported by road, the various components are often considered to be oversize; individual blade sizes can reach over 200 feet in length and nacelles weigh nearly 170,000 pounds. As shown in Data Source: USGS – US Wind Turbine Database

Figure 7-69, the region's ports are ideally suited to serve the onshore wind market with their proximity to the onshore wind generating areas in Texas, New Mexico, Oklahoma, Kansas and Nebraska. The Port of Houston is utilized by Vestas and Siemens use Galveston. Other ports in Texas used by wind component manufacturers include Corpus Christi and Brownsville.



Data Source: USGS – US Wind Turbine Database

Figure 7-69. Wind Turbine Locations

Table 7-35. Top Importers of Machinery - Houston

Consignee (Unified)	Metric Tons	TEUs Quantity
VESTAS-AMERICAN WIND TECHNOLOGY INC (OR)	33,221	550
CATERPILLAR INC (IL)	19,877	1,278
GOODMAN MANUFACTURING COMPANY LP (TX)	13,653	2,881
CAM DISTRIBUTED VALVES PLANT A206 (TX)	11,868	980
VESTAS BLADES AMERICA INC (CO)	10,052	924
CACTUS WH ENTERPRISES LLC (TX)	8,359	495
FORUM VALVE SOLUTIONS (TX)	7,131	544
QUARTER TURN RESOURCES INC (OK)	6,703	647
MITSUBISHI CATERPFORK AMERICA (TX)	5,981	896
BESTWAY OIL OASINC (TX)	5,442	366
TRAMONTINA USA INC (TX)	5,337	1,236
CATERPILLAR INC (TX)	4,920	636

Table 7-36. Top Importers of Machinery - Galveston

Consignee (Unified)	Metric Tons	TEUs Quantity
CATERPILLAR INC (IL)	40,769	0
KOMATSU AMERICA INTERNATIONAL (TN)	13,215	0
LBX COMPANY LLC (KY)	7,592	0
CNH AMERICA LLC (WI)	6,709	0
LIEBHERR USA	7,458	0
HITACHI CONSTRUCTION (NC)	3,585	0
SIEMENS GAMESA RENEWABLE ENERGY INC (FL)	3,191	0

7.10 Motor Vehicles

The Motor Vehicles product group includes Motor Cars & Vehicles for Transporting Persons (HS 8703). Motor vehicles are imported as well as exported through H-GAC ports and are largely non-containerized, carried in RoRo vehicle carriers. Imports are mainly transported through the Port of Houston and volume has grown from 2009 through 2018. Exports are also largely through the Port of Houston, but exports have also grown at Freeport beginning in 2015.

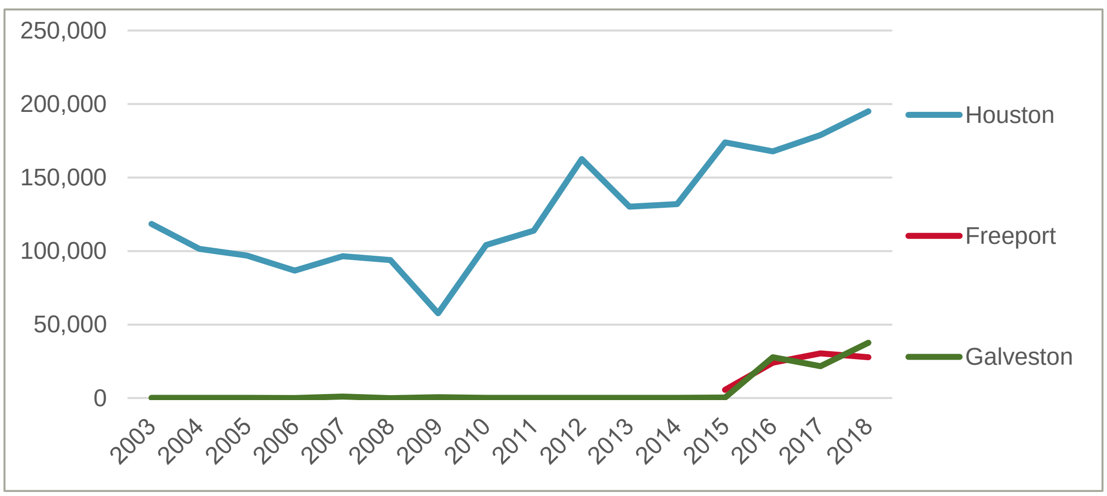


Figure 7-70. Imports of Motor Vehicles by Port in Metric Tons

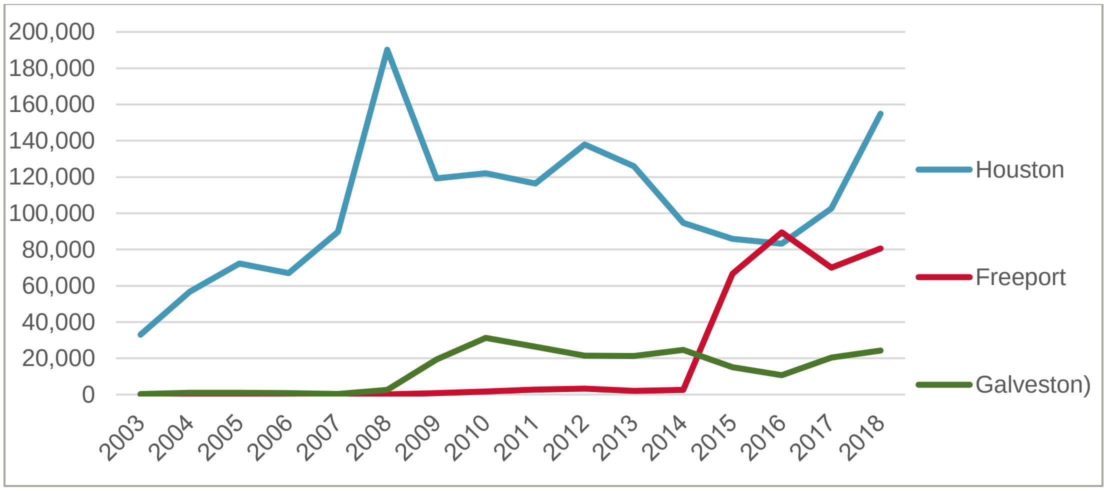


Figure 7-71. Exports of Motor Vehicles by Port in Metric Tons

Forecasts indicate that exports of motor vehicles will more than double through the Port of Houston from 2015 through 2045 but grow more slowly through Freeport, while growth will be lower for imports.

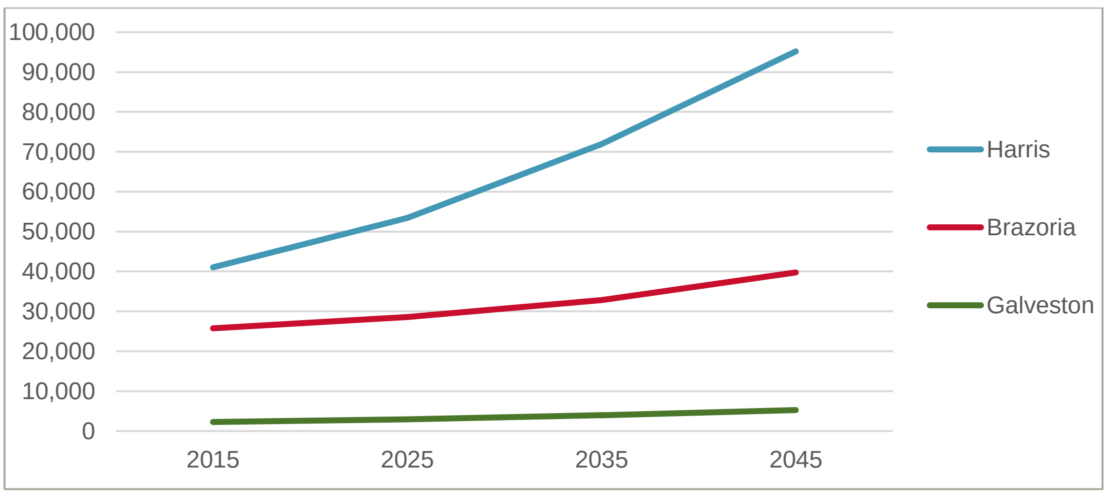


Figure 7-72. Forecasts of Motor Vehicle Exports Transported by Truck by County in Tons

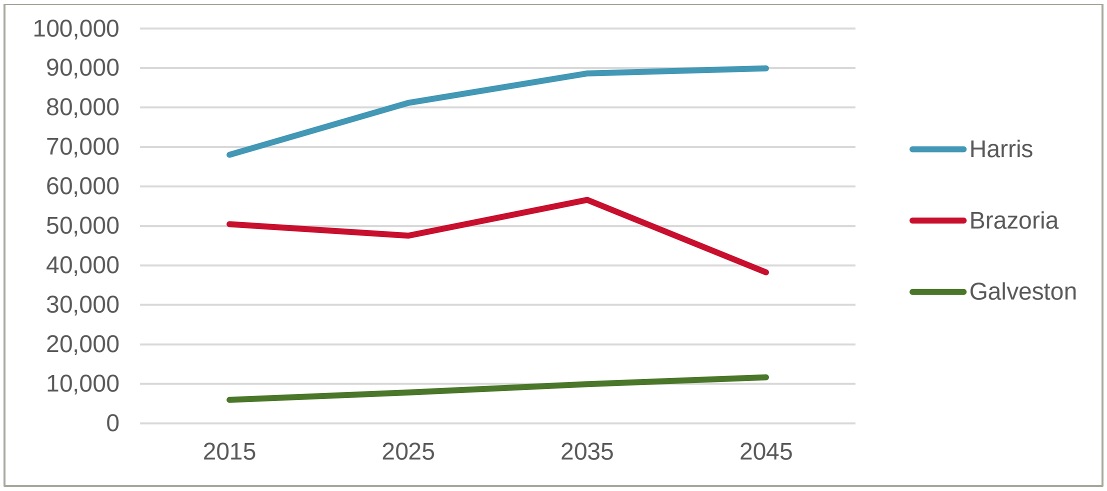


Figure 7-73. Forecasts of Motor Vehicle Imports Transported by Truck by County in Tons

H-GAC ports' imports of motor vehicles represented a relatively small 4 percent share of U.S. imports in 2018. Imports through H-GAC ports were less than 30 percent of state imports in 2018 indicating that H-GAC ports' supply chains for imports are limited to regions within the state. Harris County is the principal destination county for motor vehicle imports through Houston. Typically, vehicle manufacturer's importing into the U.S. adopt a regional distribution strategy. Each regional port of entry supports the vehicle manufacturer's regional dealers. For example, Volkswagen (including Volkswagen, Audi, Bentley and Lamborghini brands) imports vehicles from Germany and to a lesser extent Mexico, into the U.S. through Benicia and San Diego, CA; Houston, TX; Davisville, RI; Jacksonville, FL; and Baltimore, MD (from 2020). BMW imports through the Port of Galveston are supplied to 45 BMW and MINI dealers within four states (Texas, Oklahoma, Louisiana, and Arkansas). Many import ports also host vehicle processing operations. These processing centers are used to install final modifications, updates and customized options for the final consumer as well as minor vehicle repairs. Transportation from the port of entry to the vehicle dealer is usually by truck, though rail maybe used for imports to inland distribution centers.

In addition to Harris County, Bexar County is a significant origin for vehicle exports due to Toyota manufacturing in San Antonio.

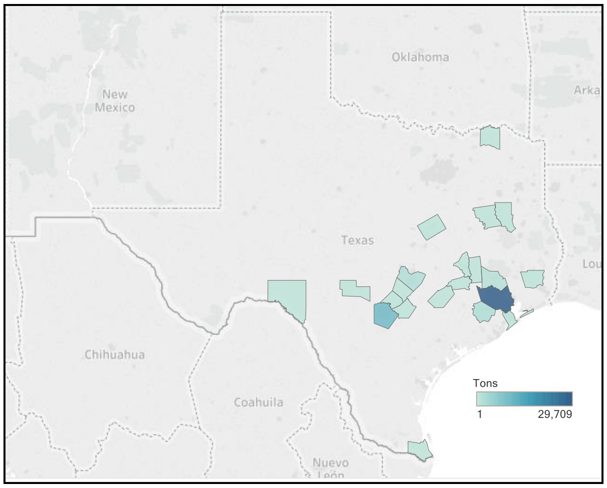


Figure 7-74. Destination Counties for Motor Vehicle Imports through Houston Transported by Truck

H-GAC ports' exports of motor vehicles represent a much higher share than imports, at about 10 percent of the U.S. total in 2018. Exports through H-GAC ports were also about equal to state exports in 2018 indicating that H-GAC ports' serve much of the state export market.

The export of vehicles can be categorized into two very distinct markets. The export of factory new vehicles that are transported from domestic production facilities directly to the port for export and used vehicles. The choice of port for the export of new vehicles is largely driven by the proximity of the port to the production facility and the shipping routes available. For example, General Motors SUVs manufactured in TX, are exported to the Middle East via the Port of Freeport.

Exports of used vehicles are typically to different markets than newly produced vehicles. From 2009 to 2013, used passenger-vehicles made up 34 percent of U.S. passenger-vehicle exports, with 826,000 units exported in 2013. Used passenger vehicles are often exported to developing countries because they offer luxury options at lower prices, are not available new in those countries, or match or exceed the quality of locally available new vehicles. Nearly 28 percent of U.S. used-vehicle exports went to low- or lower-middle-income countries in 2013.[137] Used vehicles are often exported in containers, rather than dedicated RORO vessels, though some shipping lines do serve high volume used vehicle markets with RORO vessels, such as West Africa.

[137] https://www.usitc.gov/publications/332/executive_briefings/coffin_used_vehicle_exports.pdf

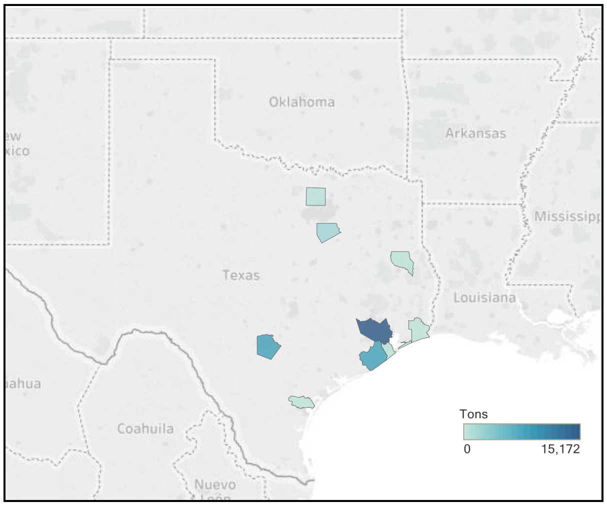


Figure 7-75. Origin Counties of Motor Vehicle Exports through Houston Transported by Truck

The top importer of motor vehicles into Houston is Volkswagen; into Freeport, General Motors; and through Galveston, BMW.

Table 7-37. Top Importers of Motor Vehicles- Houston

Consignee (Unified)	Metric Tons	TEUs Quantity
VOLKSWAGEN AMERICA (VA)	77,176	0
FCA US LLC (MI)	11,973	0

Table 7-38. Top Importers of Motor Vehicles - Freeport

Consignee Declared	Metric Tons	TEUs Quantity
GENERAL MOTORS LLC	33,344	0
GENERAL MOTORS	3,367	0

Table 7-39. Top Importers of Motor Vehicles - Galveston

Consignee (Unified)	Metric Tons	TEUs Quantity
BMW FINANCIAL SERVICES NA INC (NJ)	1,143	0

Table 7-40. Top Exporters of Motor Vehicles - Houston

Exporter (Declared)	Metric Tons	TEUs Quantity
W8 SHIPPING	11,373	3,631
ATLANTIC EXPRESS CORP.	8,796	3,131
USA INTERCARGO LLC	8,281	3,803
LINEAR SHIPPING INC.	7,335	2,321
BRP MEXICO S.A. DE C.V.	4,051	1,594

Table 7-41. Top Exporters of Motor Vehicles - Freeport

Exporter (Unified)	Metric Tons	TEUs Quantity
ATM HOLDINGS INC (TX)	1,744	644
SERVICIOS HONDURENOS (TX)	1,306	445
NORTH ATLANTIC (TX)	1,095	520

7.11 Other Consumer Goods

Other consumer goods include apparel and footwear; home furnishing textiles; furniture; and toys, games and sporting equipment. Imports are almost entirely containerized and almost all come through the Port of Houston. Imports and have grown rapidly across all product categories from 2011 through 2018.

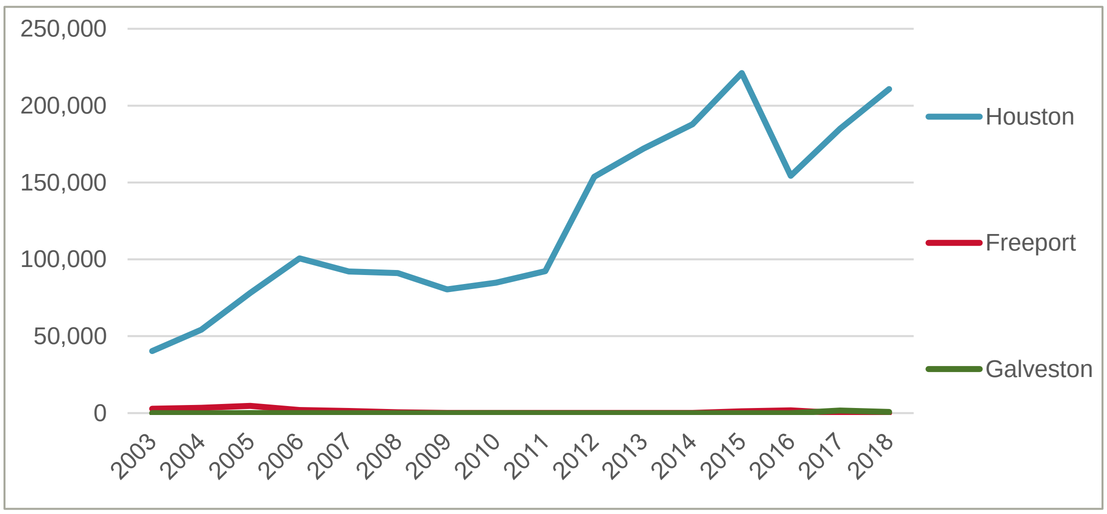


Figure 7-76. Imports of Apparel, Footwear and Home Furnishing Textiles by Port in Tons

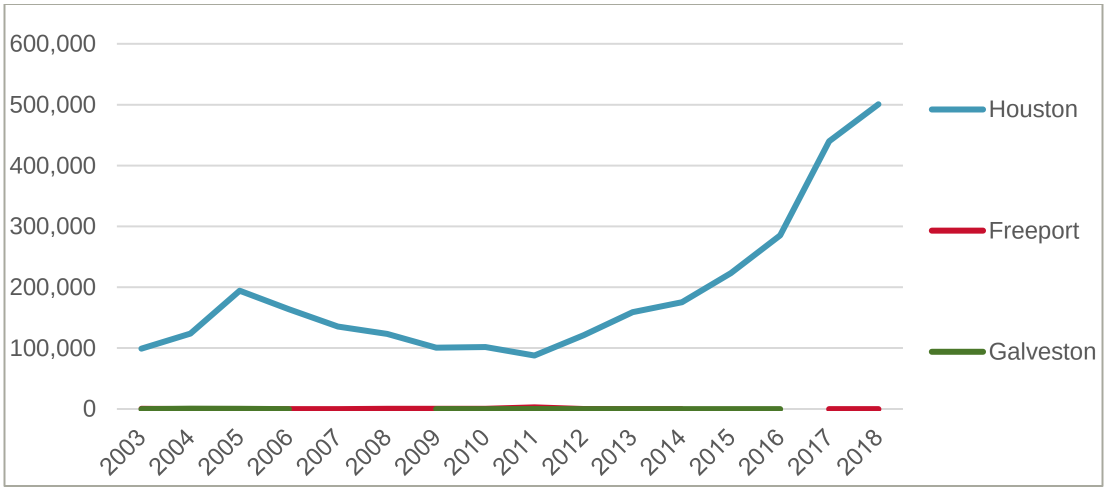


Figure 7-77. Imports of Furniture; Bedding etc.; Lamps etc.; Prefabricated Buildings

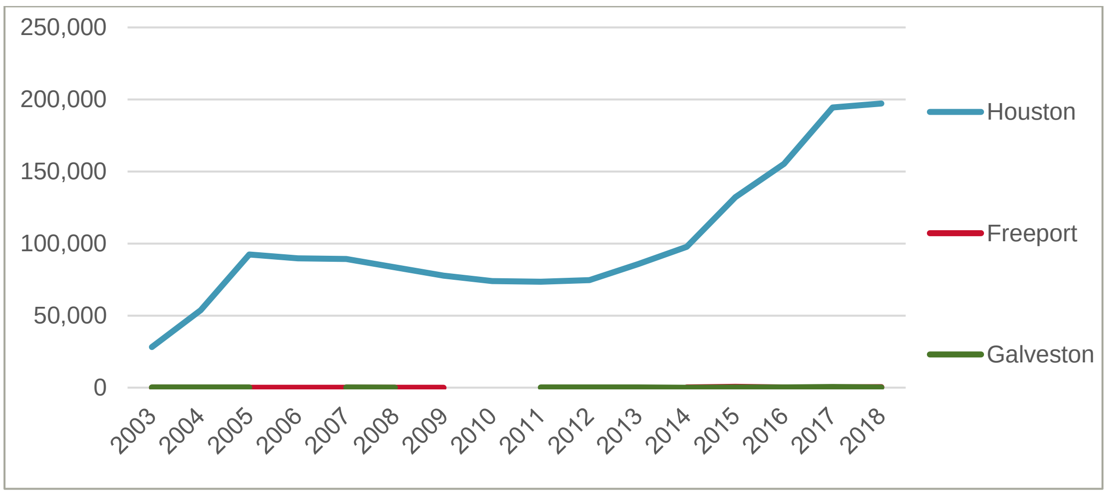


Figure 7-78. Imports of Toys, Games & Sport Equipment; Parts & Accessories by Port in Tons

Consumer goods imports are projected to quadruple in volume from 2015 to 2045.

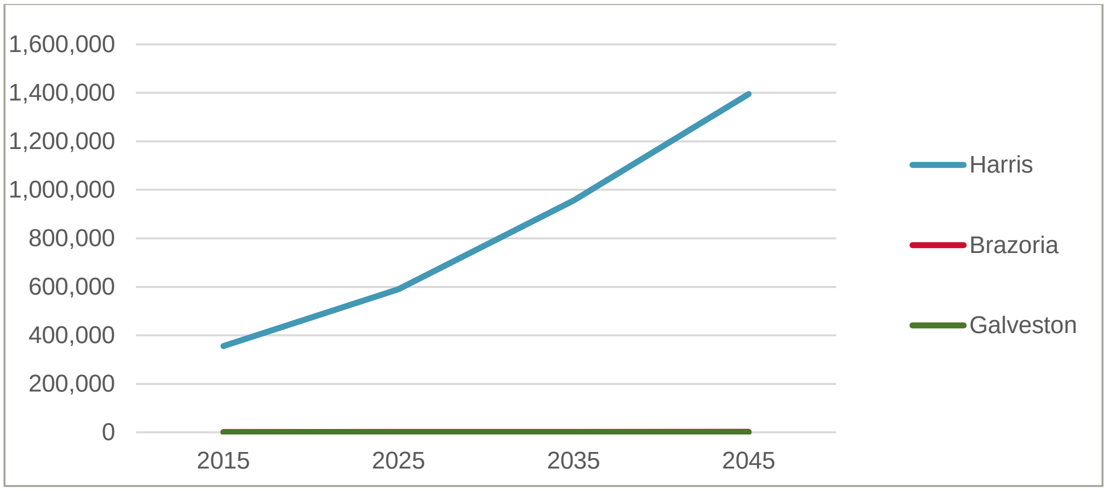


Figure 7-79. Forecast of Consumer Goods Imports Transported by Truck by County in Tons

H-GAC ports' imports of other consumer goods represent relatively low shares of U.S. imports, just 3 percent of total containerized imports for the product group in 2018.

These volumes were about half of state containerized imports in 2018 indicating that the reach of H-GAC ports' supply chains for imports are limited to regions within the state, with Harris County the principal destination of consumer goods imports.

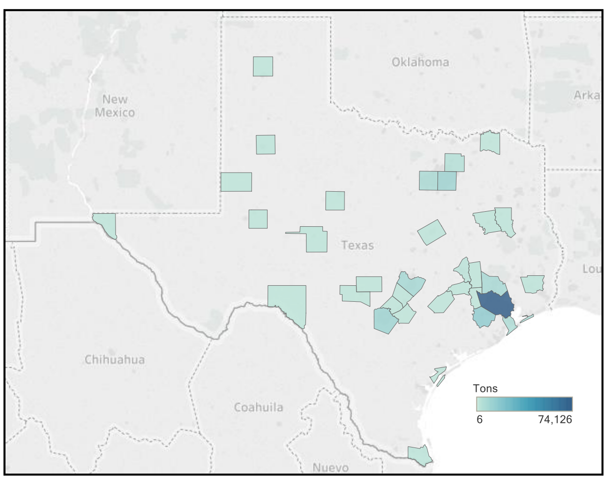


Figure 7-80. Destination Counties of Consumer Products Imports through Houston Transported by Truck

The top importer of furniture is IKEA, followed by Rooms to Go and Wal Mart, each of which is listed under multiple consignees.

The top importer of toys and sporting goods by TEU volume is Wal Mart and by weight Cap Barbell.

Top importers of apparel, footwear and home textiles include Wal Mart and JC Penney.

Table 7-42. Top Importers of Furniture

Consignee (Unified)	Metric Tons	TEUs Quantity
IKEA SUPPLY AG IKEA DISTRIBUTION SE (TX)	58,453	8,367
ROOMS TO GO	29,994	5,561
WALMART STORES INC (AR)	19,173	2,916
BEL FURNITURE (TX)	14,857	3,298
STEVE SILVER CO (TX)	7,070	1,749
LLYTECH INC (TX)	6,936	797
HOMELEGANCE LLC (TX)	5,669	1,455
BEDROOM DISTRIBUITORS INC (WO)	3,725	422
WALMART INC 601 N WALTON BLVD (WO)	3,493	602
WILLIAMS SONOMA INC (MS)	3,451	1,189
CORINTHIAN COLLEGES INC (MS)	3,328	1,286

Table 7-43. Top Importers of Toys and Sporting Goods

Consignee (Unified)	Metric Tons	TEUs Quantity
CAP BARBELL INC (TX)	12,195	707
WALMART	9,946	1,493

Table 7-44. Top Importers of Apparel, Footwear and Home Textiles

Consignee (Unified)	Metric Tons	TEUs Quantity
WALMART	11,067	1,688
JCPENNY	2,525	590

7.12 Container Logistics

7.12.1 Container Based Supply Chain Configurations

In Section 2, the data and analysis has identified that there has been a significant increase in the importation of consumer related items such as food and beverages; other consumer goods; furniture; and, building materials through the region's ports. These products are largely transported in shipping containers. This research and analysis has identified a number of supply chain configurations associated with the transportation and distribution of products and the location for unloading (destuffing) of containers.

A key consideration of shippers and receiver's decision making is where the import container should be unloaded (destuffed) and in some cases transloaded to another truck. Should it be at the goods receivers' warehouse or premises, or some other intermediate location? A significant factor in that decision-making process are the costs associated with handling containers. Once an import container is offloaded from a vessel, it has a certain period of free storage time within the terminal until the container has to be collected by the importer. Any time after this free time has expired is known as demurrage. Typically, this starts 3-4 business days after the container has been unloaded from the vessel. Costs can be upwards of $175 per day. Container users also have some free time of container equipment to deliver the container to the goods receiver, unload it and then return back to the ocean carrier. The return location is usually a container yard at the port where the container was collected from. This free time is again in the region of 3-4 days and starts from when the container is collected from the terminal. Any time the container is still in use and hasn't been returned after the free time has expired, is known as detention. Costs are upwards of $115 per day. On top of these costs are the rental costs for a container chassis of $15-25 per day.

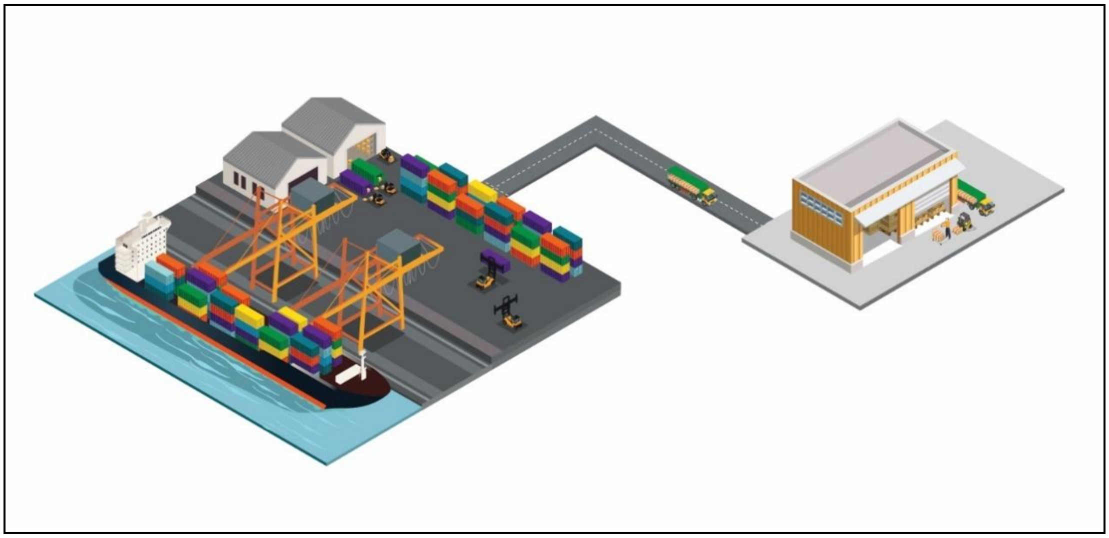
Many issues can affect truck based container movement and the scheduling of resources including driver availability; driver hours of service; time taken to collect a container from the port; time taken to offload at the good's receiver; congestion; and, distance between the port and delivery location. A combination of the issues and the related costs associated with container handling can influence supply chain configuration and some of the more common examples employed by supply chains utilizing the region's ports are outlined below.

7.12.2 On Port Container Transfer

This configuration is employed by the produce importers at both Port of Galveston and the Port of Freeport. These importers have scale and volume to establish dedicated facilities at each port.

Temperature controlled shipping containers arrive at the port by vessel, are unloaded and then staged. While containers wait to be transloaded they are plugged into the port's local electricity network to maintain their controlled atmosphere. At the appropriate time, their contents are unloaded and loaded into over-the-road refrigerated trucks. The refrigerated container does not typically leave the port. These trucks then travel to customers such as retailer warehouses and markets as shown in Data Source: HDR

Figure 7-81 . Port interviews identified that trucks went as far as Canada carrying produce from the port. It is more economical in these situations to transload produce from a shipping container into an over-the-road truck, rather than having a truck travel all the way from Canada back to the port in order to return the empty container. The importer is typically only required to pay for the one-way journey, and the reliance is on the over-the-road transporter to find a revenue generating return journey.



Data Source: HDR

Figure 7-81. On-Port Container Transfer

7.12.3 Transload/Import Distribution Centre

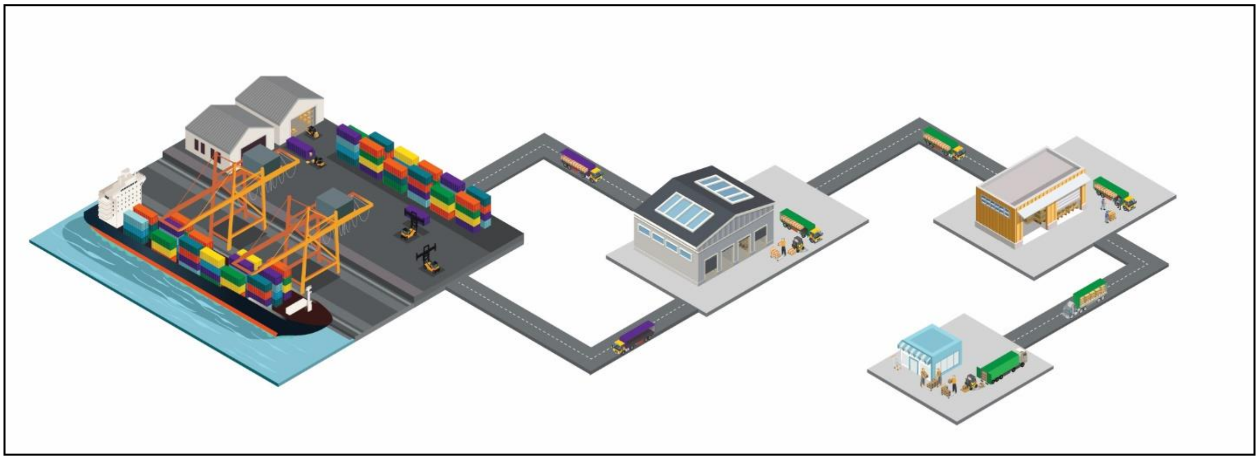
In many ways, the transload/import distribution center (and cross dock facility) configuration is similar in concept to the On Port configuration, except that the container destuffing occurs outside of the port itself. However, these facilities may be in close proximity to the port in nearby industrial centers.

In the pure transload process, product is transferred from the shipping container to a domestic truck. The shipping container is then returned to the port (Data Source: HDR

Figure 7-82). Many import containers are loaded floor to ceiling and do not use pallets. While this maximizes the amount of goods that can be transported in a shipping container (providing the container doesn't exceed weight limits) it can create problems further down the supply chain. At a transload facility goods loaded floor to ceiling can be placed on pallets, prior to loading to a domestic truck. Importers may determine the number of items, size and weight for each pallet and so the transload facility offers an appropriate step in the supply chain process to satisfy these goods receivers' requirements. Issues with transloading include increased damage and potential for theft, so it's not appropriate for all cargoes.

Shippers and receivers occasionally transfer product from 40 feet long (96-inch-wide) ocean containers to 53 feet long (102-inch-wide) domestic containers or trailers at or near the port. Depending on the product or carton size, the goods from three 40-foot containers can be trans-loaded into two 53-foot trailers. Including the time and labor to trans-load, the transportation cost reduction is significant.

Some retailers, such as Walmart and Home Depot, have established import distribution centers in the Baytown area where import containers are unloaded and their products stored and subsequently dispatched to other regional distribution centers, before being forwarded to retail stores. This is part of a "four corners" strategy where retailers who import large volumes of goods, have established import distribution centers, spread out across the west, east and Gulf coasts. This strategy lowers a firm's transportation costs compared with using a single import distribution center, since using ports closer to regional markets and the ultimate delivery location, makes greater use of cheap ocean transport. Walmart operates 6 import distribution centers across the nation including the Baytown facility which opened in 2005 Other Walmart import distribution centers are located in Alabama, California, Georgia, Illinois and Virginia.

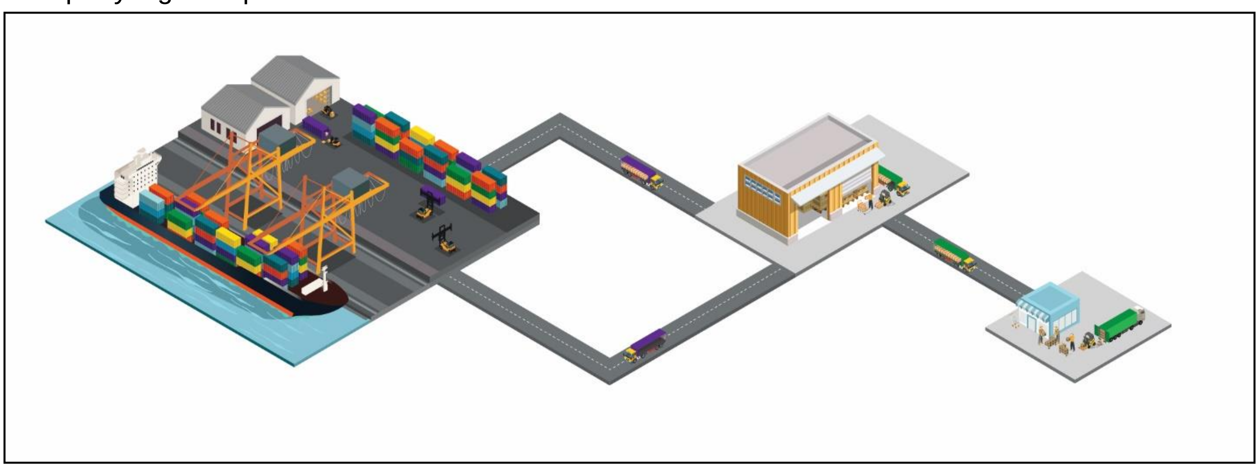


Data Source: HDR

Figure 7-82. Transload/Import Distribution Centre

7.12.4 Direct to Warehouse

The third container-based supply chain configuration is where containers are collected from the port and taken directly to a warehouse or distribution center. Here the containers are unloaded and returned to the port. The unloaded product is stored and/or processed before being dispatched to retail stores or other user locations. The warehouse may be operated by the company who owns the product or contracted to a third-party logistics provider.



Data Source: HDR

Figure 7-83. Direct to Warehouse

7.12.5 Warehouses and Distribution Centers

To gain insight into the largest container destinations, importers of more than 1,000 TEU per year through the Port of Houston were identified using trade data from Datamyne. Using web-based research, approximately 60 percent of the top 70 importer warehouses/distribution centers have been identified (see Figure 7-84). The vast majority of these locations are within the Greater Houston region and there are some specific concentrations including in the Baytown area and in close proximity to the Port of Houston container terminals.

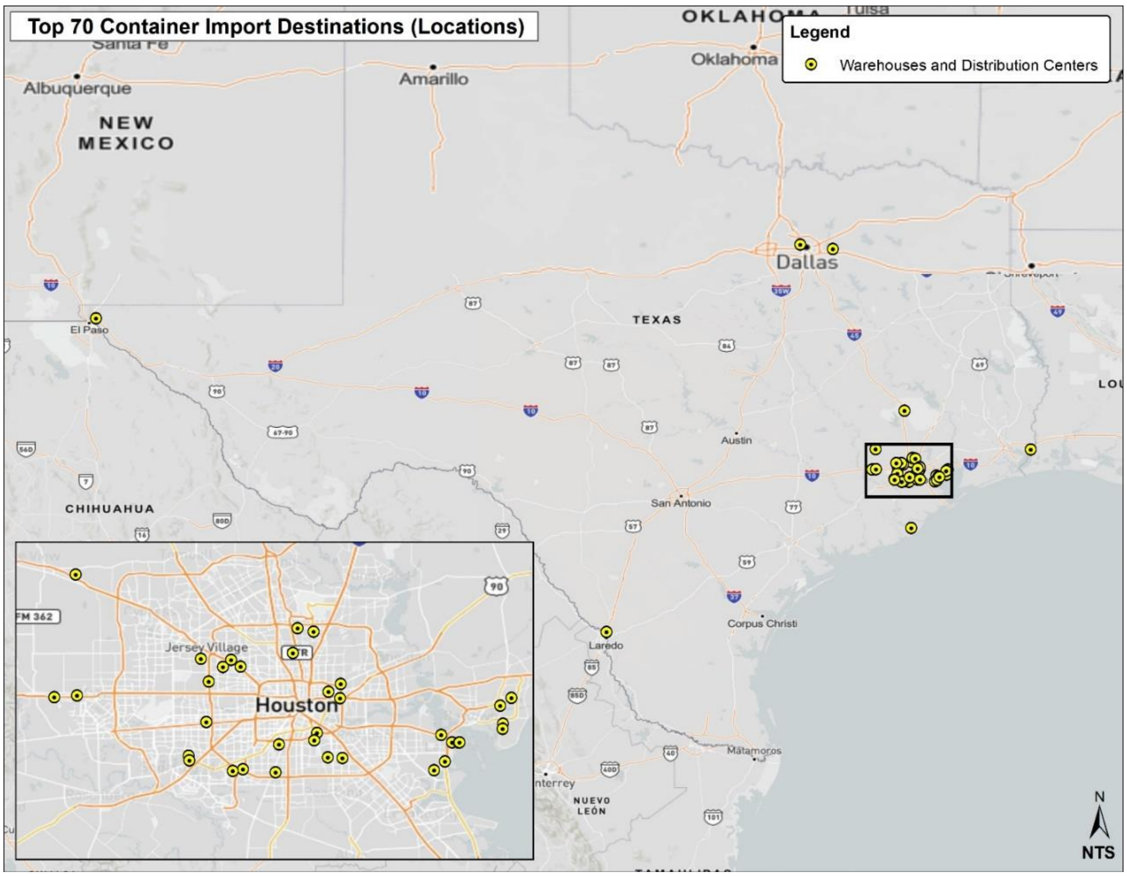


Figure 7-84. Top 70 Container Import Destinations (Locations)

Figure 7-85 illustrates the distribution of import containers at a county level, Harris County being the dominant importer of sea containers.

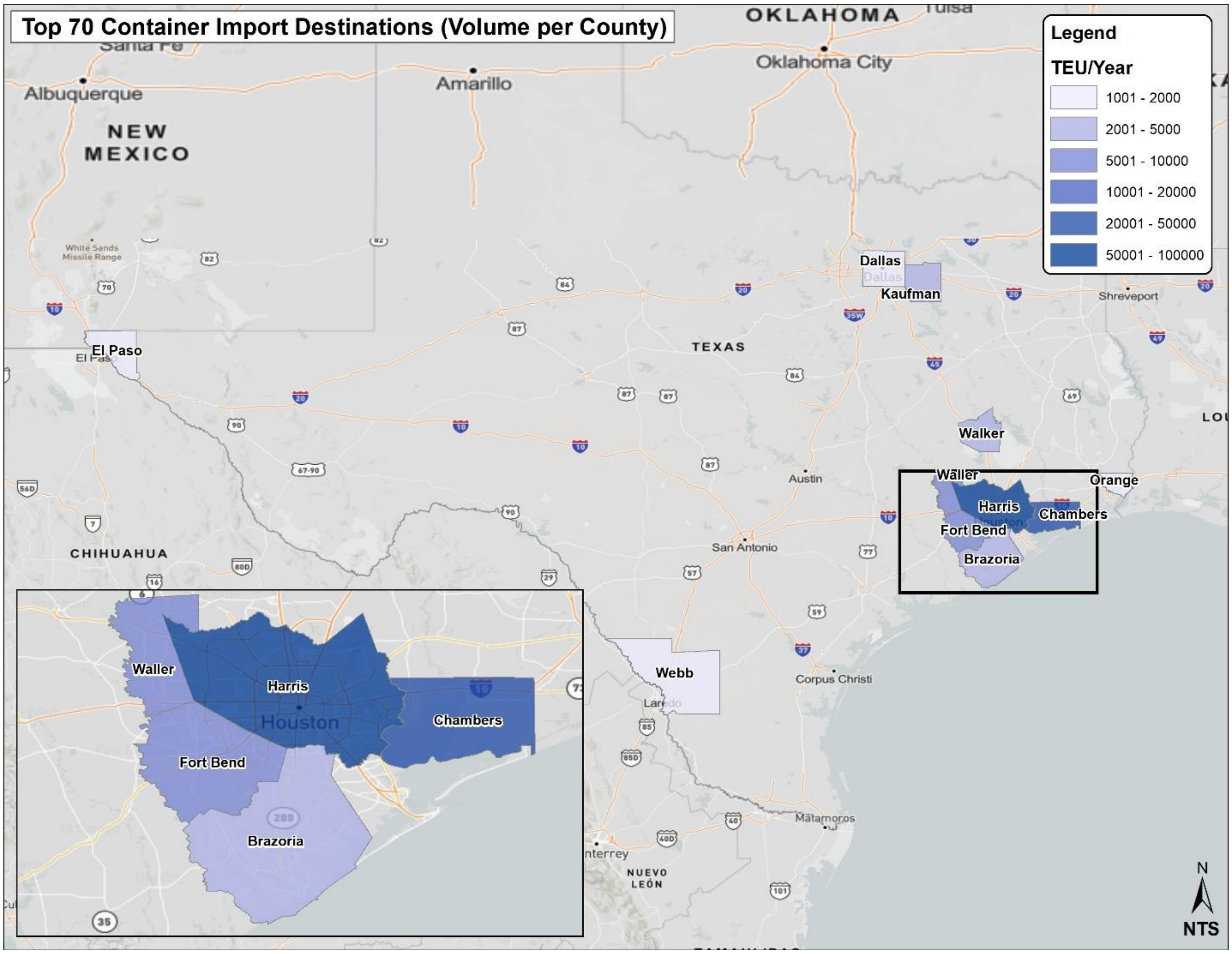


Figure 7-85. Top 70 Container Import Destinations (Volume per County)

7.13 Supply Chain Interviews

7.13.1 Interview Process

The H-GAC supply chain analysis included a set of interviews with importers and exporters associated with the Top 10 supply chains. Targeted companies were the largest shippers within each supply chain group identified using Datamyne data on total weight of shipments and container TEUs transported through H-GAC ports over a one-year period.

These lists were provided to personnel from H-GAC ports to identify and nominate individuals involved in port logistics. This resulted in the following 23 targeted companies.

Multiple Categories

Walmart Stores (AR)

Perishable Foods

Fyffes N. America (FL)

Dole

Other Foods and Beverages

Nestle Waters N. America

Red Bull N. America

Heineken USA Inc. (NY)

Diageo Gulf Winds Inter Beer (TX)

Other Agricultural Products

Olam Cotton

Cargill Cotton

Texas Grain Association

Chemicals

Sintex Minerals & Services (TX)

Mitsui

Exxon Mobile

Newport Tank Containers

Plastics in Primary Forms

Exxon Mobile

Unitcargo Container Line

Building Materials

UFP INTERNATIONAL

Iron and Steel and Articles of Iron and Steel

EXIROS

Machinery

Caterpillar

Vestas

Motor Vehicles

Volkswagen

GM

Other Consumer Goods

IKEA

Rooms To Go

Nominated personnel were contacted by email and invited to participate in phone interviews. A subset of these nominated personnel accepted the invitation with the remainder declining or not responding. For those who accepted, interviews were scheduled and conducted by phone. These interviews included seven companies covering five of the ten supply chains:

Perishable Foods

Dole

Other Foods and Beverages

Red Bull N. America

Diageo Gulf Winds Inter Beer (TX)

Other Agricultural Products

Olam Cotton

Texas Grain Association*

Building Materials

UFP INTERNATIONAL

Iron and Steel and Articles of Iron and Steel

EXIROS

7.13.2 Interview Feedback

Perishable Foods

Banana imports are the largest volume commodity examined within the perishable foods group, and Dole is the one of the top importers of the product with over 200,000 tons per year moving through the Port of Freeport. These volumes are all containerized. The company has experienced recent growth in volume, which is consistent with the growth in imports in 2018 reported earlier.

The company has its own 3-lane gates at the Port of Freeport and experiences some periodic congestion at the gates as well as periodic staff shortages during peak periods.

Products from inbound containers are unloaded from containers into domestic refrigerated trucks in open covered areas near the docks rather than in a dedicated cross-docking building. This process can be interrupted during bad weather. The product is then moved by truck to distribution centers for later delivery to retail outlets.

Given that bananas are all moved by truck, and that this traffic uses state route 36 going northbound, that 2-lane road can present limitations. It is Dole’s understanding that there is a port improvement project plan to expand the roadway to 4 lanes that could alleviate capacity issues in the future.

Other Food and Beverages

The Other Foods and Beverages product category is almost entirely comprised of containerized imports. Within the product group the largest-volume subgroup is alcoholic beverages (primarily beer). Soft drinks/mineral waters and prepared foods both represent smaller volumes.

Input through interviews included information from a beer importer, Gulf Wind International, and an importer of non- alcoholic beverages, Red Bull.

Gulf Winds International is a third-party logistics company (3PL), headquartered in Houston, that provides drayage, warehousing and transloading services for a diverse set of commodities in addition to beverages, e.g. tile and paper. Many of container loads handled by the company are overweight. Dallas is a major center for drayage services, to distribution centers as well as to intermodal rail connections. Dallas generally requires a 2-day trip. Issues identified include driver shortages and an inadequate supply of containers, both of which are especially difficult during surges of import volumes. The company was unable to use extended hours at the port but is hoping to use extended hours in the future when plastic resin traffic will be increasing.

Concerning local-region “street turns” (a process to reload a shipping container, once emptied, with an export shipment without returning the empty shipping container back to the port and is a tactic to eliminate empty container moves), the company does employ this strategy to avoid costs and reduce empty container moves, and actively engages in match making, e.g. for moves related to Walmart.

Red Bull’s import container moves are concentrated from the Port of Houston to its distribution center in Baytown. There are some direct container moves to customers, but these represent a small share of movements. From the distribution center, products are moved by truck including less-than-truckload moves. Given the heavy weights of their products they keep weights under the limits, i.e. reaching truck weight limits before volume limits. Overall the company strives to meet a one-day delivery to distributors.

As mentioned by Gulf Winds, Red Bull anticipates the likelihood that local roads to their distribution center will become overloaded.

The drayage of the company’s products is run by a 3PL that may do “street turns” with containers, but this may be limited since Red Bull is required to return its containers within one day.

Other Agricultural Products

The Other Agricultural Products category includes exported grain (largely non-containerized) and cotton (containerized).

The Texas Grain and Feed Association is not a direct shipper of products, but it is aware of major issues concerning grain exporters. The principal issues concerning truck transportation of grain exports noted were:

- The availability of truck drivers to move products from regional grain storage to the ports (for volumes not transported by rail)
- Expenses of monitoring equipment on trucks needed to comply with hours of service (HOS) regulations

Olam Cotton is a major exporter of cotton from all cotton growing regions and out of many ports. All exported products are containerized. They buy from many local producers and gins and sell internationally. For longer distances containers are moved by rail.

Olam schedules the pickup of cotton from warehouses and commits to a specific day for pickup. In some cases, the company takes containers to the warehouse location but often picks up bales in large van trucks and then moves the product to warehouses near the port.

Availability of containers is the biggest issue especially when they are committed to a large export shipment requiring many containers. If they can't make the complete shipment they have to "split and roll" to the next available vessel. There are many logistics issues including changing port cut-offs, weather delays, congestion, and waiting at ports.

Concerning hours of operation, longer hours would help for movements by rail given that rail operates around the clock. For trucking from local warehouses that do not usually stay open late, early hours might be useful. Since business is very seasonal from October through April, extended hours could be helpful during that season.

Building Products

UFP International is the top importing company for wood products through Houston and is part of Universal Forest Products, Inc. that manufactures and distributes products to construction, retail and industrial markets.

The company Imports wood products in containers through Houston. Origins include all world regions but most heavily from South America, e.g. Brazil.

Imported products go to a reload center 2 miles from the port and put into inventory. These products are then transported by flatbed truck to plants for treatment. From the treatment plants products are later transported to final customers such as Lowes and Home Depot.

The heavy weight of these products is a major problem in Houston. In other U.S. regions the company is able to move heavy containers directly from ports to treatment plants. If this were possible in Houston, they could do without the reloading step, saving considerable costs. This additional cost effectively diverts volumes from Houston to other ports such as Lake Charles and New Orleans. Loosening weight restrictions in Houston could lower the number of truck trips.

The company also noted that demurrage is also major problem due to events over which they have little control. I.e. congestion at ports, crane operations, etc.

Iron and Steel and Articles of Iron and Steel

Exiros is a procurement company owned by Tenaris and Ternium, the steel business companies of the Techint Group.

Exiros imports steel for mills (all through Freeport) and steel products (pipe) through Houston that go to distribution centers such as Midland or direct to customers.

Almost all imports are non-containerized. There are no heavy weight trucks used except for the corridor from Freeport to Bay City. The company uses a mix of flatbed truck and rail depending on cost, with out-of-state destinations largely moved by rail.

Historically a major Issue for trucking has been long wait times affected in part by some seasonal competition from other industries (e.g. construction and agriculture). For rail, the Issue has historically been the availability of rail cars.

A factor that may change commodity transportation patterns is that the company is planning to significantly increase domestic pipe production, thus decreasing pipe imports but increasing steel imports.

7.13.3 Summary of Industry Inputs

In the process of interviewing importers and exporters a few common issues were raised. These ranged from “normal” freight movement and logistics issues to more structural concerns.

Trucking Manpower and Logistics

The lack of available truckers, limitations on driving hours (and related expenses for required monitoring equipment) were mentioned as constraints, although these issues were seen as affecting overall truck service, but not directly controllable by ports.

Traffic Growth and Need for Road Improvements

For several shippers, expected growth in traffic was a major concern, both in the H-GAC region and in more distant markets (e.g. Dallas). Growth in traffic is expected to worsen in general congestion, surges in freight traffic, and seasonal peaks.

Specific routes mentioned were Route 36 north from the Port of Freeport and the roads between the Port of Houston and Baytown, both of which will limit the future ability to move containers from the ports to distribution centers. The need to improve and expand the capacity of these local roads was highlighted.

Container Logistics

The ability to manage container movements and availability were common themes:

- The need to transload locally rather than use containers for distant delivery strands containers that must be returned. Conversely, containers are not available in more distant or remote locations for export use.
- At the local level, the difficulty in managing “street turns” does not allow containers to be used more efficiently. The general point is that there is no system in place to make this work given the participants are all independent actors.
- The availability of extended gate times did not appear to be a general solution to truck delays due to seasonality, weather, freight timing uncertainties, etc. Extending hours was seen as a possible help in the future, especially if they could be designed relative to short-term or seasonal conditions.

7.13.4 Heavy Weight Loads and Related Corridors

Lack of ability to carry heavily loaded containers results in supply chain designs that are more costly and less competitive. A prime example is the wood products importer that moves containerized products to a local warehouse and then transports these products in lighter loads to treatment facilities. In other regions of the U.S. the company moves heavy import containers directly to treatment processing facilities. In addition to increasing the number of trucks on roads, this also effectively diverts volumes from Houston to other ports such as Lake Charles and New Orleans.

7.14 Summary

The analysis and findings identified in this Section have illustrated how each of the region’s ports have specialized or concentrated in handling particular commodities and supporting certain companies with their international and domestic supply chains. The analyses also identify the changes and variability in international trade flows such as the decline in the region’s rice exports and the growth in consumable items such as beverages and furniture. Some of this growth is directly linked to the decision of companies such as Ikea, Dole, Del Monte Walmart and Home Depot to locate warehouses and transload facilities in the region that are fed through the region’s ports.

The analysis of the top 10 commodities indicates that there are many different trading patterns occurring in the region’s ports. For some commodities, the ports serve as national gateways, while for others, the ports are regional gateways and the imports/exports are more local. Where the imports and exports are more local within the region, then transportation is invariably by truck, with the exception of petroleum and chemical related products which are typically transported by pipeline and barge.

The analyses of the various commodities also identify the change and variability in commodity flow due to market, economic and trading conditions. For example, the increase in sorghum exports through the regional ports from 2013/14 to 2016/17 was largely a result of feed mills in southern China seeking cheaper substitutes for expensive domestically produced corn. When China imposed higher trade tariffs in April 2018, the demand for U.S. imports reduced. For agricultural products, weather can also significantly impact harvest yields and product quality. U.S. exports compete in a global market place and importers have choices as to where they purchase their product. As an example, the U.S. share of the global wheat market has also been declining over the past two decades as the European Union and Russia have risen in prominence. Between 2001 and 2005, the U.S. share of global wheat exports averaged 25 percent; by 2016/17, the U.S. share slipped to about 15 percent. These variations and fluctuations in trade filter down to transportation and the number of trucks, rail cars and barges we see on our transportation system.

A supply chain that is having a significant impact upon the region’s ports is the large and growing concentration of plastics manufacturing capacity on the Gulf coast. Exports through H-GAC region ports in 2018 represented more than half of total U.S. exports of these products. This growth is a relatively new phenomena, driven largely by the domestic production of natural gas, a key feedstock for plastic resin production in the USA. In recent years a number of packaging sites have been established in the Ameriport and Cedar Port Industrial areas located to the east of Baytown, while older packaging plants were located within Houston or close to the Houston container terminals. These packaging plants receive the plastic resins by rail, pack them and load the packed products into shipping containers, which are transported by truck to the region’s container terminals. The loaded containers can be heavy and recent regulations mean trucks carrying heavy weight containers for export can now achieve a gross weight of up to 100,000 lb., up 19% from the port’s previous limit of 84,000 lb.

8 Solutions and Strategies

8.1 Key Findings

- A growing population in Texas and the Houston region specifically, will increase the demand for imports into the region and importers and distributors will continue to locate their warehouses and distribution centers to be close to that population, resulting in increased port truck traffic.
- By 2045, with the exception of the Port of Texas City, truck trips associated with each port will double. Port of Houston trips are expected to have grown from 3.5 million one-way truck trips in 2019 up to 8.5. million in 2045. Freeport's will increase from 270,000 to nearly 550,000 and Port of Galveston's from just under 200,000 to nearly 500,000.
- Many individual highway investment projects have been identified by ports and other stakeholders to improve port related mobility, some are funded, while others are not. Investment in highway infrastructure will remain a key need for ports and their customers, especially as ports continue to grow.
- Empty container movements are inefficient and create truck activity. Reducing the number and distance travelled of empty container movements through the development of a virtual container yard and linking importers such as Ikea and plastic packaging resin exporters in the Baytown area would reduce the number of miles empty containers are transported. One scenario estimated 1.95 million truck miles (36 percent) could be saved.
- In October 2017, the Port of Houston extended gate times at the Bayport container terminal from 7 p.m. to 11 p.m. but ceased the trial a year later. As container volumes continue to grow, and congestion in the Houston area increases, it is likely to be "when" not "if" as to the reintroduction of extended gate times.
- Resolving operational issues with existing container-on-barge services at the Houston container terminals would improve the viability and effectiveness of these services, especially when exporting heavyweight plastic resin containers.
- Dedicated transport systems such as Freight Shuttle and EagleRail have the potential to remove a significant amount of containers and truck trips from the highway network, especially on dense corridors such as to and from the Houston container terminals and industrial parks east of Baytown. A key challenge is the development and acceptance of a business case that ensures such a system can compete with trucking costs.
- Other operational strategies, such as increasing the number of dual transactions, (when truckers drop off a container empty or laden with exports and then collect another one laden with imports or an empty container) from the same container terminal, rather than single transaction, would also reduce truck trips and truck miles travelled. A Port wide load matching system, integrated with matchbacks, would improve the efficiency of container movements.

- The Inland Port concept is highly compatible with and supportive of the concept for Houston-to-Dallas rail service, but the service requires sufficient volume to make it financially viable and a frequency and journey time to make it somewhat competitive with trucking.
- To implement the operational strategies outlined in this chapter requires close collaboration, innovation and partnerships between H-GAC, the ports and other stakeholders.

8.2 Introduction

This chapter discusses and identifies a series of improvement alternatives associated with the region's port mobility including:

- Infrastructure and facilities such as highway improvement projects
- Multimodal improvements
- Alternative transportation systems
- Operational strategies and policy level changes

Out of the alternatives discussed in this report, two highway improvement projects (I-69 Bypass and Independence Parkway Bridge), one each of multimodal improvements (Container-on-Barge), alternative transportation systems (such as Freight Shuttle) and operational strategies (Virtual Container Yard) are selected for a detailed benefit assessment and discussed in Section 8.9 of this Report.

The project also recognizes and considers other issues and factors in the assessment and development of improvement alternatives. These include:

- Diverting freight flow away from Houston's congested urban core
- Changes in commodity flows
- Panama Canal expansion
- Growth in chemical manufacturing, particularly plastic resins

Information to support this chapter has been sourced from industry feedback; data from the study's other chapters; stakeholder outreach including a workshop with the H-GAC PAMS steering committee, and industry data sources, including Datamyne.

Even though petroleum products, crude oil and chemicals comprise over 85 percent of all trade flows in the region's ports, a conscious decision by H-GAC, and the project steering committee that improvement alternatives associated with the PAMS study would not specifically focus on these bulk liquid supply chains. The rationale behind that decision was that these supply chains were already making significant use of non-truck-based transportation including pipelines, barge and rail. Furthermore, the development and enhancement of pipelines is mostly within the remit of the private sector and which H-GAC has no influence over from a transportation planning perspective.

8.3 Growth and Future Port Volumes

An important consideration in identifying and assessing alternative improvements is future port-related trade volumes and the resulting effects on increased transportation movements. All surface-based transportation modes support the region's ports, and each has a role to play in supporting port growth.

8.3.1 Maritime Trade and Volume Growth

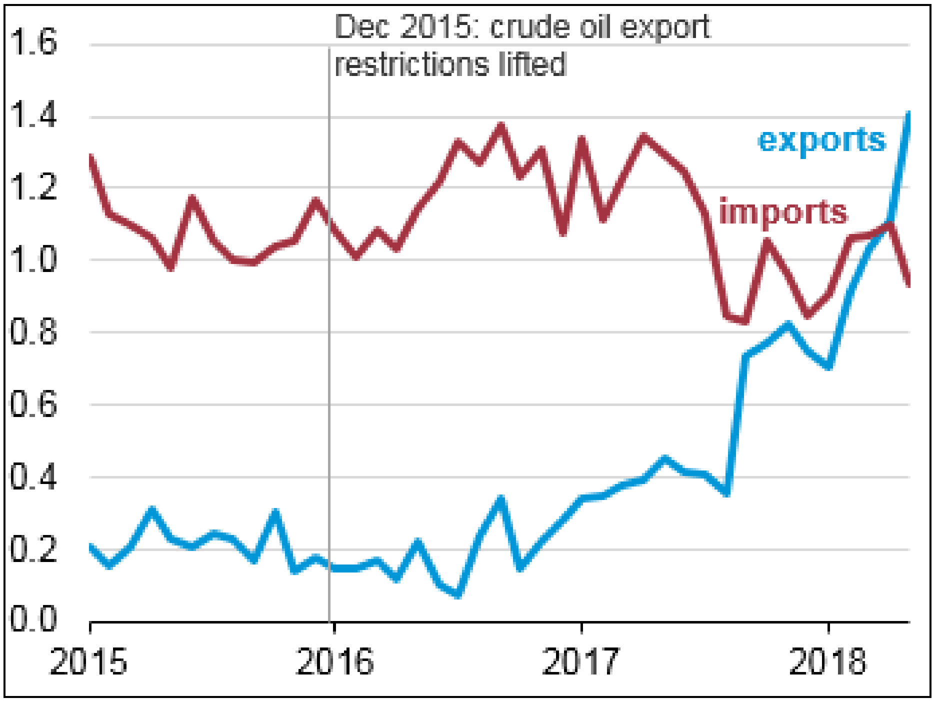
The United Nations Conference on Trade and Development (UNCTAD) "Review of Maritime Transport 2017" identified a series of medium-term traffic projections. UNCTAD cited that world seaborne volumes will continue to expand at a compound annual growth rate of 3.2 percent between 2017 and 2022. This is consistent with UNCTAD historical average growth rate of 3 per cent in 1970-2016. UNCTAD forecasted that world containerized trade volume, in particular, will grow at five percent and major commodities at 5.6 percent between 2017 and 2022.

A growing population in Texas and the Houston region specifically, will also increase the demand for imports into the region. According to the U.S. Census Bureau in 2017, three of the top five cities in the nation with the largest population growth were in Texas. By 2045, the state's population is expected to grow by 40 percent to nearly 39 million people.

The "2017 Texas Freight Mobility Plan" identifies that statewide waterborne tonnage is expected to increase by 49 percent from 598 million tons in 2016 to 889 million tons in 2045. Outbound traffic grows 86 percent from 2016 to 2045, while inbound and intrastate traffic increase by 17 and 27 percent, respectively.

Goods and commodity flows are always changing, as markets respond to supply and demand, resource costs and a range of other dynamics. A notable example of how rapid change can occur is illustrated by the recent history of U.S. crude oil exports. On December 18, 2015, the U.S. enacted legislation authorizing the export of U.S. crude oil without a license. Prior to December 2015, crude oil exports were restricted to: (1) crude oil derived from fields under the State waters of Cook Inlet of Alaska; (2) Alaskan North Slope crude oil; (3) certain domestically produced crude oil destined for Canada; (4) shipments to U.S. territories; and (5) California crude oil to Pacific Rim countries[138]. The effect of increased domestic production and relaxation of export controls is illustrated in Figure 8-1. This example shows that that supply chains and commodity flows can change rapidly.

[138] "Petroleum & Other Liquids," U.S. Energy Information Administration Independent Statistics & Analysis, July 29, 2019. Available at https://www.eia.gov/dnav/pet/pet_move_exp_dc_NUS-Z00_mbblpd_m.htm.



Source: Energy Information Administration

Figure 8-1. Crude Oil Imports and Exports through the port district of Houston-Galveston (million barrels per day)

8.3.2 Changes to Regional Port Hinterlands

The H-GAC region's ports will grow and prosper primarily because the larger region is growing and prospering, and the local ports support much of the region's international and domestic maritime trade. This "captive" cargo will continue to be the core driver of regional port activity.

Ports also handle, to varying degrees, what is known as "discretionary" cargo – that is, cargo that can be well-served by more than one port, and may move from one port to another depending on conditions. For example, a container dispatched from Northeast Asia destined for a goods receiver in Dallas-Fort Worth is more than likely to travel through a port on the West Coast and be railed to Dallas-Fort Worth. If that container was destined for a receiver in the Houston region, it would more than likely be carried on a vessel from North East Asia to the Port of Houston. If a container was coming from the east coast of South America to Dallas-Fort Worth then that container is likely to pass through the Port of Houston, rather than another port. As a region improves its port facilities, and particularly its transportation connections to inland "hinterland" markets, it becomes more competitive as a gateway for discretionary cargo.

As a result, a key opportunity for volume growth though H-GAC ports is to improve their service to hinterland markets- making them faster and more efficient than competing ports and their respective inland transport connections. However, hinterland market opportunities are complex to define – they are influenced by many factors that include origins and destinations of cargo, commodity type, handling type, transportation cost, reliability of services, supply chain configuration, frequency of vessel sailings and services, risk management (deliberately spreading moves through multiple ports), etc.

The supply chain and commodity flow analyses performed for this project demonstrate that much of the market area for H-GAC ports is local, but there are some longer-distance hinterland opportunities. One such opportunity, which has been flagged in other studies, is Dallas-Fort Worth. Dallas-Fort Worth is a significant consumer market, well-positioned on the interstate highway network and well-served by cross-country rail services (especially intermodal rail); many companies locate their distribution warehouses in this region to serve the metropolitan areas throughout Texas. Attracting more Dallas-Fort Worth volume through the region's ports, capturing some share of what would otherwise move through Los Angeles and Long Beach, is an important opportunity for the H-GAC region – and, to the extent it could offer Texas freight shippers and receivers a cheaper, faster, more reliable way to move goods.

A 2015 study performed by TEMS Inc. anticipated that the Panama Canal expansion would significantly change the cost-speed-reliability equation for global shipping, making the H-GAC region a more attractive way to reach not only Dallas but also deep into the mid-American hinterland. Alternatively, a 2011 study undertaken by MARAD assessing the potential impacts of the Panama Canal expansion project suggested that shipment patterns to Dallas would not change following the expansion. While the expansion is now completed, it is too early to draw conclusions on which position is more accurate – nor, for purposes of this study, is it necessary to do so. Instead, what we should recognize is that:

- Mobility improvements for the region's ports can significantly benefit access to local markets and users, who are the proven and primary drivers of demand for the region's ports; and
- Mobility improvements to reach and serve inland hinterland markets can positively leverage other major global investments (like the Panama Canal, mega-containerships, etc.) and better position the region's ports for a larger potential share of hinterland markets over the longer term.

The strategies and solutions offered in this study aim to meet current known local issues and opportunities as a first priority, while also supporting the opportunity to capture gateway traffic moving into the future as an additional benefit.

8.3.3 Port Truck Trip Growth

With growing port volumes, the number of truck trips associated with the region's ports is expected to increase. The consultant team developed a Port Truck Trip Calculator to inform future truck volume projections, for the region's ports and the agency's truck trip model. This calculator uses Transearch data as the baseline for commodity growth through 2025, 2035 and 2045. The dataset provided for this analysis includes truck movements and excludes movements to and from the ports using rail and waterborne modes. The calculator has been developed to account for different modal shares for different commodities and container versus non-container allocations across commodities e.g. grain (bulk and containerized goods).

The outputs of the Port Truck Trip Calculator for each port are identified in Figure 8-2 through Figure 8-5.

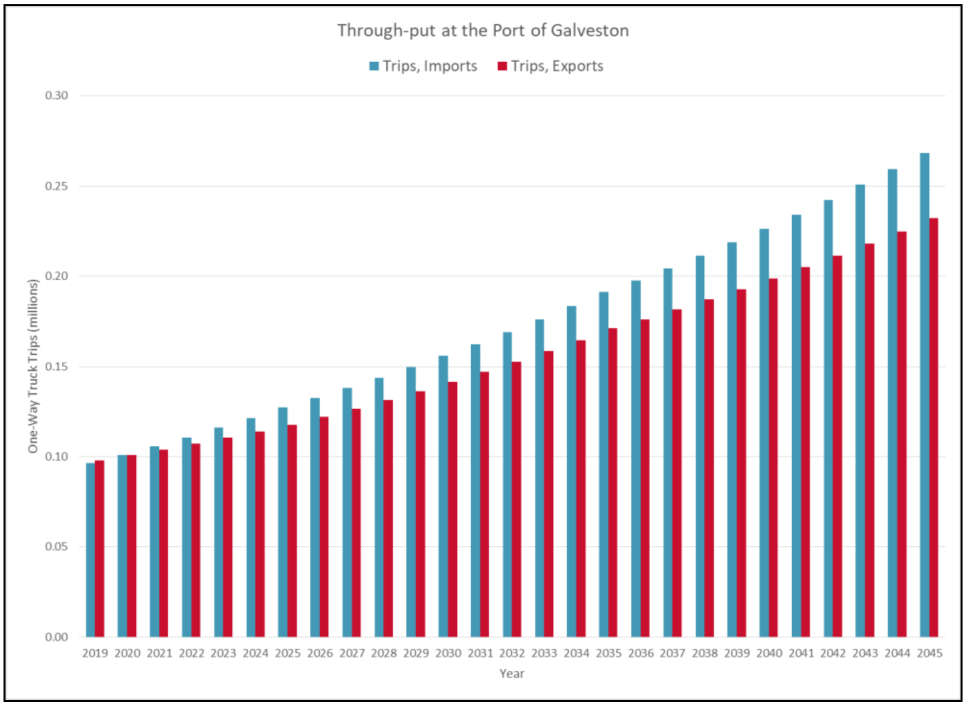


Figure 8-2. Port of Galveston Future Truck Trips

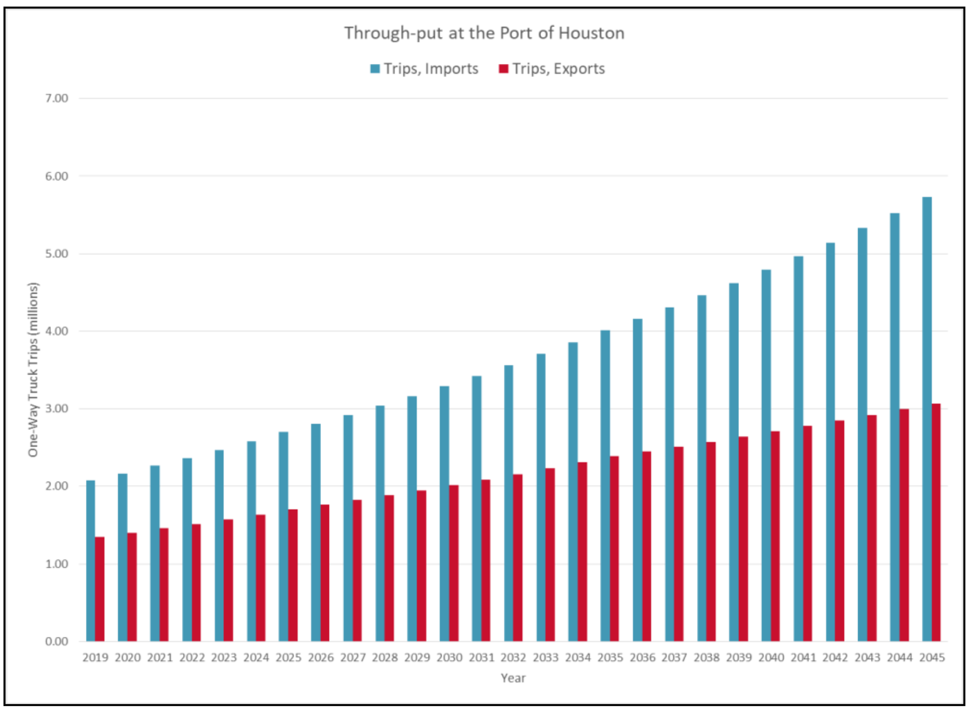


Figure 8-3. Port of Houston Future Truck Trips

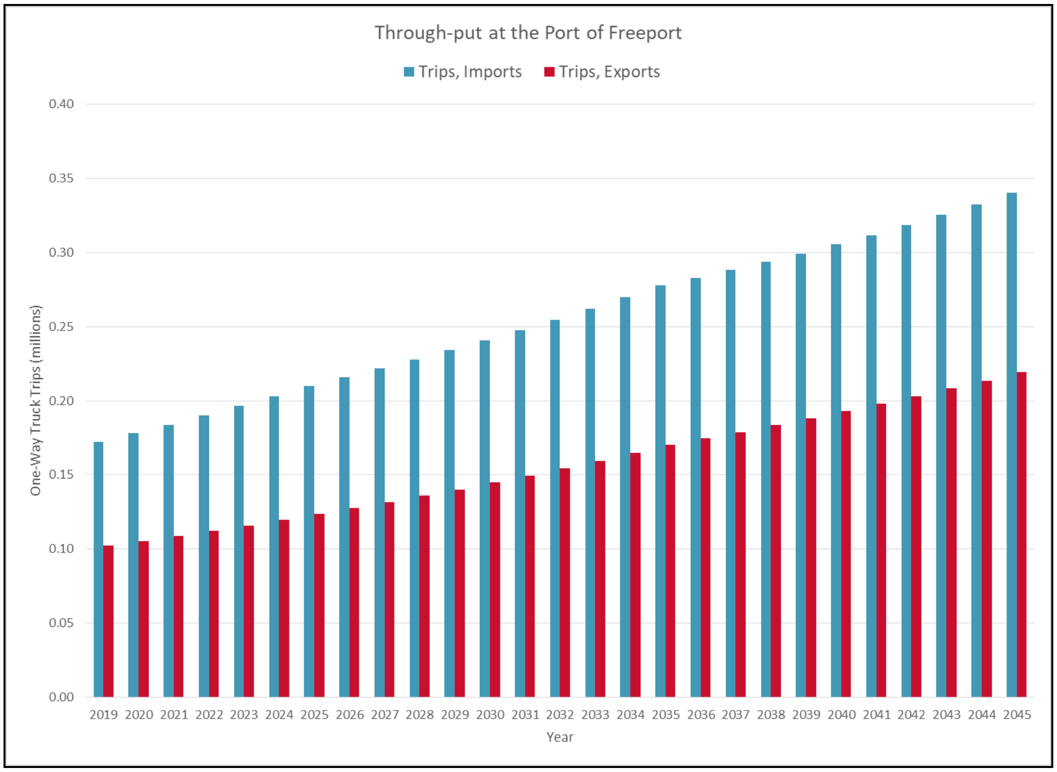


Figure 8-4. Port of Freeport Future Truck Trips

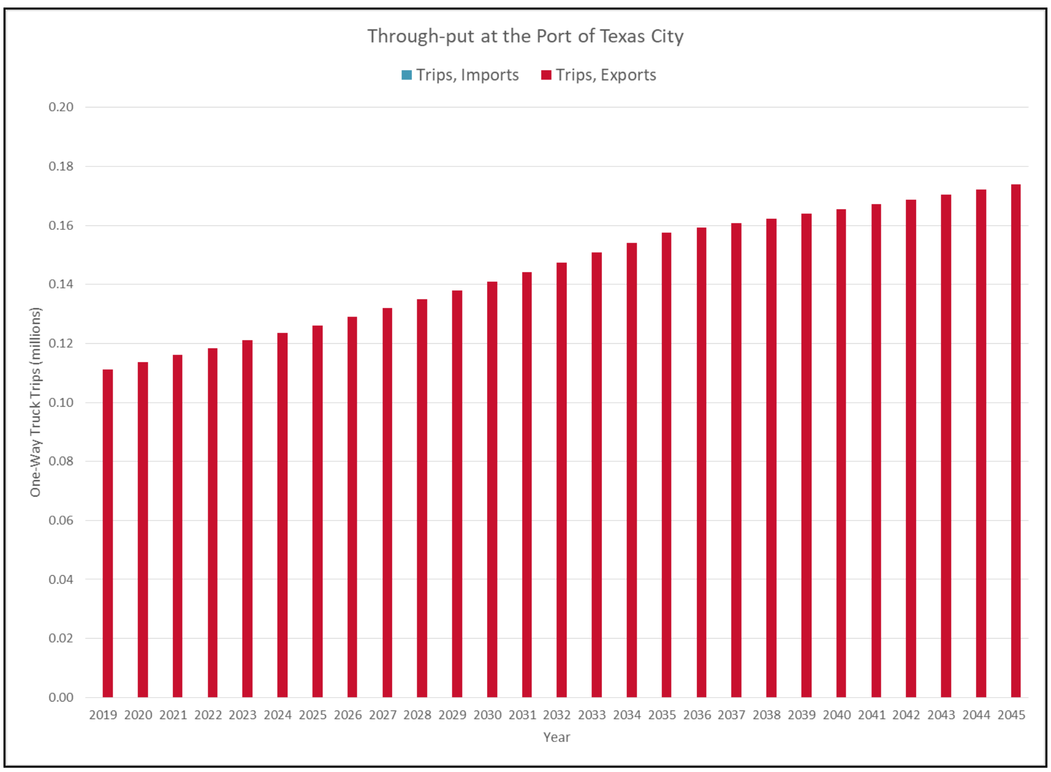


Figure 8-5. Port of Texas City Future Truck Trips

By 2045, with the exception of the Port of Texas City, the model suggests that truck trips associated with each port will double. It is unlikely the capacity of the regional highway network can be increased in line with demand to accommodate growing truck traffic and growing passenger traffic. Therefore, other solutions and strategies must be developed to help alleviate road congestion.

8.4 Infrastructure and Facilities

8.4.1 Regional Highway Improvements

The highway system is vital to the movement of goods flowing to and from the region's ports. The need for continued highway investment, is widely acknowledged by the various entities associated with highway planning in the region including TxDOT, H-GAC and the counties. The region's ports have already benefited from previous highway capacity expansion projects, especially in areas immediately serving the ports, where the direct relevance and impact to a port's capability is better understood. Investments in other regional highway projects located some distance from the ports, also benefit port-related trucking activity, especially those that facilitate truck movement on the I-10 and I-45 corridors. Many of the port-related highway investments are already identified and included in mobility plans, freight plans, transportation plans and the region's Transportation Improvement Plan

Based on discussions with the steering committee and other stakeholders, the following two infrastructure projects were selected for a detailed benefit-cost assessment as part of this study:

- I-69 Bypass and
- Independence Parkway Bridge

8.4.2 I-69 Bypass

Texas DOT is developing the Grand Parkway, a proposed 180-mile circumferential highway traversing seven counties in the Greater Houston area, as shown in Figure 8-6. Approximately one-third of this new loop has been completed, specifically, the northwestern portion. The northeastern part is expected to be the most beneficial to trucks serving the Port of Houston, providing a link from the Fred Hartman Bridge (Route 146), through Baytown and Chambers County's Cedar Port Industrial Park north to connect to I-69. The northeast section, comprising of SH 99 from Fred Hartman Bridge to I-10, known as segment I-2 has been open to traffic since March 2008[139] and is a toll road[140]. Five-axle trucks with an electronic toll tag pay $7.80 to travel the full segment. The upgrade to a controlled access toll road is expected to be completed by 2022[141]. The remainder of the northeast loop, known as segments H and I-1, are expected to be completed by 2022[142]. This will also be a controlled access toll road. Because truck traffic

139 https://www.TxDOT.gov/inside-TxDOT/projects/studies/houston/sh99-grand-parkway/overview/segment-i2.html

140 https://www.txtag.org/en/about/tollroad_grndpky_sh99.shtml

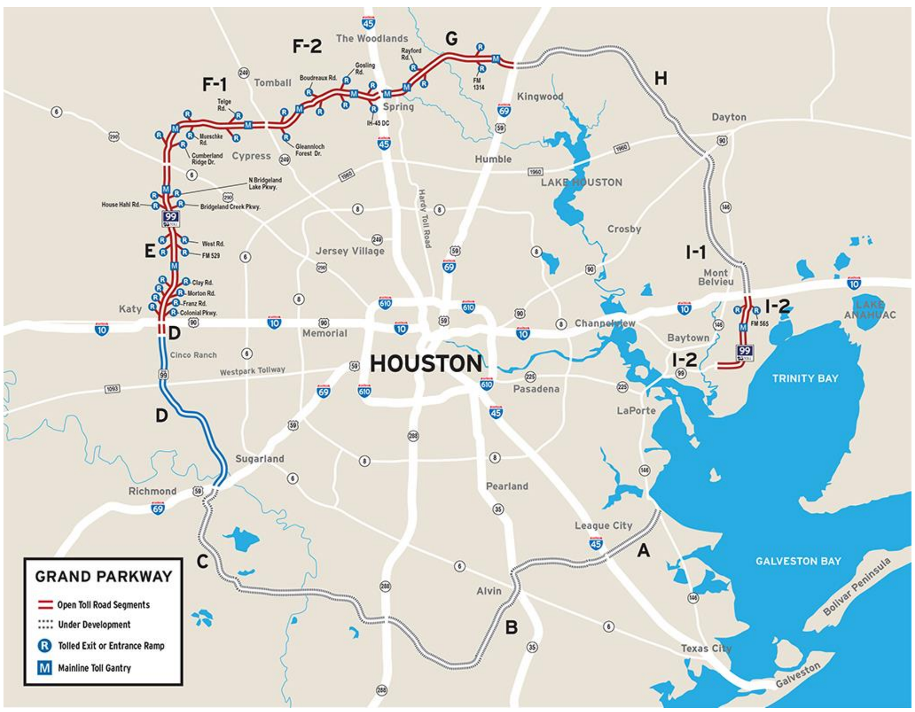
141 https://www.TxDOT.gov/inside-TxDOT/projects/studies/houston/sh99-grand-parkway/overview/segment-i2.html, Port of Houston Prioritized Project List

142 https://www.TxDOT.gov/inside-TxDOT/projects/studies/houston/sh99-grand-parkway/overview/segment-h-i1.html, Port of Houston Prioritized Project List

tends to avoid toll roads, the actual use of the Grand Parkway by port-related traffic to connect to I-69 has to be examined after completion of sections H, I-1, and I-2.

The southern segments of Grand Parkway including Segment B from I-45 South to SH 288, Segment C from SH 288 to US 59 South and unfinished portions of Segment D from US 59 South to I-10 on the west are part of the ten year Unified Transportation Plan (UTP) for the region.

The completion of these segments along with unfunded Segment A from I-45 South to SH 146 is expected to provide a bypass around the congested corridors in Houston urban core. This bypass may facilitate some truck trips traveling from Port of Houston terminals and other ports in the area to the west including Austin and San Antonio as well as to the south towards Laredo and Mexico, though truck drivers may still favor more direct routes through Houston, even though those routes are more congested. A key consideration will be whether truck drivers are prepared to utilize the bypass travelling further, but having better journey time reliability, rather than traversing the congested Houston core.



Source: TxTag

Figure 8-6. I-69 Bypass/Grand Parkway

8.4.3 Independence Parkway Bridge

Currently, there are three major crossings across HSC: SH 146 (Fred Hartman Bridge), Sam Houston Tollway (Ship Channel Bridge) and I-610. The Ship Channel Bridge is the only toll bridge and is currently undergoing replacement with two separate bridges, one for each direction of traffic. The southbound bridge is expected to open to traffic in Fall 2021 and the northbound bridge is expected to open in Fall 2024[143].

[143] https://www.shipchannelbridge.org/overview.html

Given the truck travel demand in this region, a fourth bridge to cross HSC was investigated as part of this study. The cross-section of the new bridge was assumed to be the same as existing Fred Hartman Bridge, with four lanes proposed in each direction.

Independence Parkway is located approximately half-way between SH 146 and Sam Houston Tollway and connects SH 225 on the south with I-10 on the north through a ferry service called Lynchburg Ferry. The proposed bridge is assumed to replace the ferry service to provide a fourth option for the trucks to travel between SH 225 and I-10 and further travel east along I-10 or north along US 90

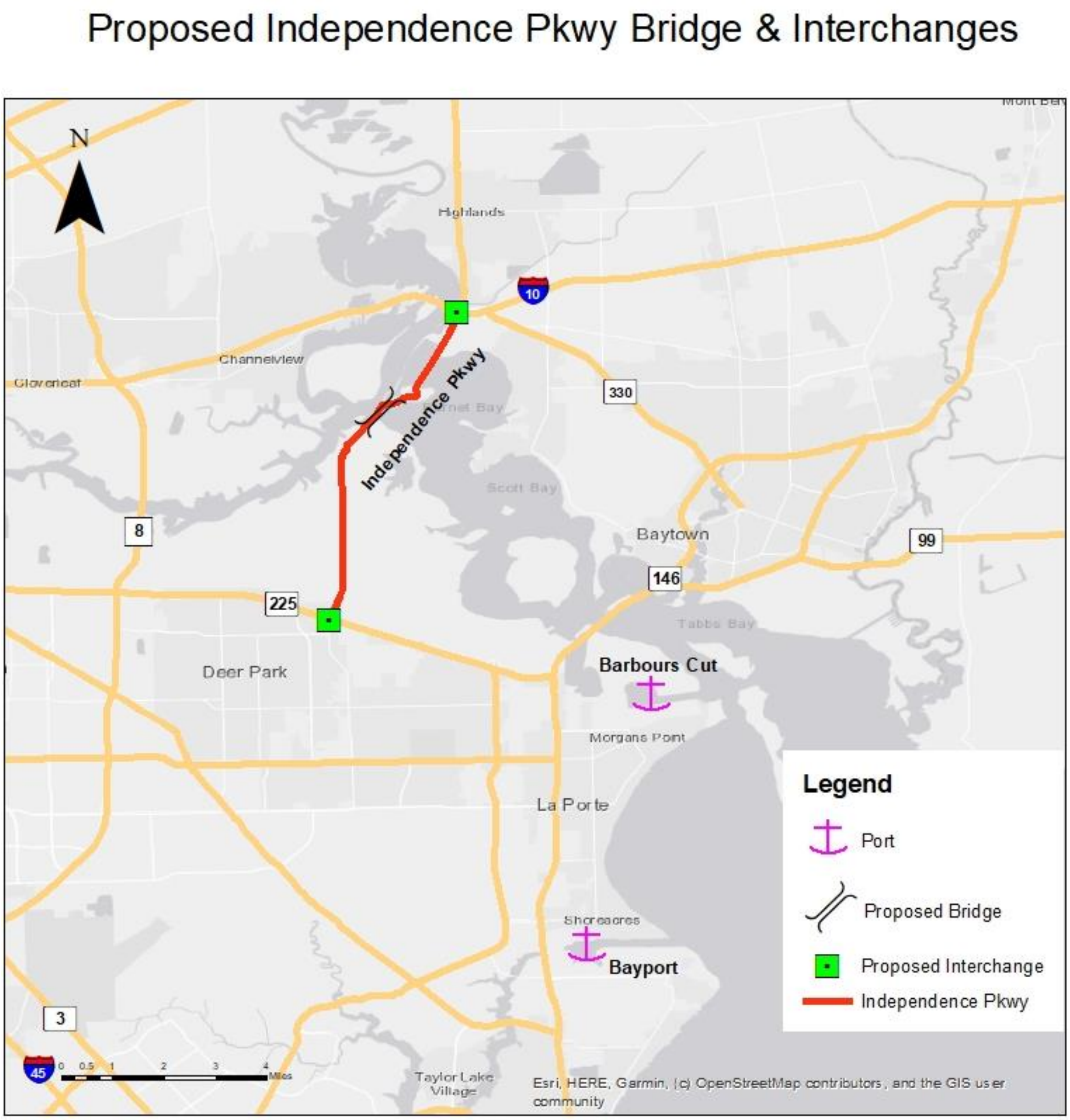


Figure 8-7. Independence Parkway Bridge

8.4.4 Other Highway Improvements

Port of Houston Related Highway Improvements

Bayport and Barbours Cut Container Terminals and Baytown

Besides the Grand Parkway project, the Baytown area will also benefit from improved northbound connectivity through a planned direct connector from SH 330 to I-10[144] and a new entrance ramp to I-10 East[145]. The direct connector project has been assigned 'medium priority' by PHA and TxDOT. There is no completion date assigned for the entrance ramp.

SH 146 is not formally part of the Grand Parkway project but does provide the missing eastern link in the loop. SH 146 investments[146] include expansion up to six lanes, creating a limited access highway, which will facilitate access from I-10 East, Baytown, and the eastern part of the Port of Houston down to the I-45 Galveston Causeway into the Port of Galveston. The project is essential to improved accessibility to both Barbours Cut and Bayport container terminals.

Bayport Container Terminal will also benefit from the planned expansion from four to six lanes of Port Road, its only local access road, by 2020[147]. Direct connectors and widened frontage roads will improve the connectivity between the terminal and SH 146 by 2020[148]. A widened Red Bluff Road by 2019[149] and widened Southern Access Road by 2025[150] will improve accessibility between the terminal and business parks west of it.

Both Barbours Cut and Bayport container terminals will gain improved accessibility from improvements planned for Fairmont Parkway. The Parkway is set to be widened[151] and benefit from geometric improvements and signal optimization at 14 intersections between Sam Houston Tollway and 7th Street[152], just east of SH 146. Both projects' completion dates are still to be determined.

Barbours Cut Container Terminal will benefit from the planned expansion to six lanes of Barbours Cut Road, its only local access road, and the construction of direct connectors from Barbours Cut Road to SH 146 and SH 225[153]. Both projects have no estimated completion date yet, however they have been scheduled as high priority by TxDOT and PHA.

---

[144] Texas Freight Mobility Plan 2017

[145] Texas Freight Mobility Plan 2017, Port of Houston Prioritized Project List

[146] H-GAC TIP, H-GAC Regional Transportation Plan 2040, Texas Freight Mobility Plan 2017, Port of Houston Prioritized Project List

[147] H-GAC Regional Transportation Plan 2040

[148] H-GAC Regional Transportation Plan 2040, H-GAC TIP

[149] H-GAC TIP, H-GAC Regional Transportation Plan 2040

[150] H-GAC Regional Transportation Plan 2040

[151] Texas Freight Mobility Plan 2017, Port of Houston Prioritized Project List

[152] H-GAC Regional Transportation Plan 2040, Texas Freight Mobility Plan 2017, Port of Houston Prioritized Project List

[153] Texas Freight Mobility Plan 2017, Port of Houston Prioritized Project List

South of Houston Ship Channel

Independence Parkway serves the Port of Houston south of the HSC. A project to replace the roadway with a 5-lane typical section between SH 225 and Lynchburg Ferry will increase the accessibility of the mainly petrochemical industry and petrochemical terminals along that road[154]. H-GAC anticipates completion of this project in the long term.

Direct connectors between Sam Houston Parkway and SH 225 are planned to improve the flow of traffic between these highways, allowing traffic to bypass the frontage roads and traffic lights[155]. A completion date is still to be determined by TxDOT.

North of Houston Ship Channel

A project to replace Clinton Drive with a 5-lane typical section between Federal Road and I-610 aims to improve the accessibility of Galena Park[156]. No completion date is yet to be identified.

A project to replace Industrial Road with a 5-lane typical section east of Federal Road aims to improve the accessibility of Brown Shipbuilding Industrial Park and Greensport[157] This project has been planned by H-GAC and PHA for the long term without a completion date identified.

The following projects serve to improve the accessibility of the area between Greens Bayou and Sam Houston Tollway south of I-10:

- Jacintoport Boulevard connection to Penn City Road (high priority)[158]
- Jacintoport Boulevard widening to four lanes (low priority)[159]
- Penn City Road roadway replacement with 5-lane typical section from I-10 to 3100 Block (long term)[160]
- Haden Road extension to Penn City Road connector (low priority)[161]

The construction of direct connectors between Sam Houston Parkway and Jacintoport Boulevard[162] would drastically improve the connectivity of the entire Jacintoport Area to and from the south. A completion date has not been set and the project's urgency is defined as low priority by TxDOT and PHA.

The following projects serve to improve the accessibility of the area between Sam Houston Tollway and the Old River, south of I-10. There are plans to widen Sheldon Road between Jacintoport Road and I-10 to four lanes[163]. TxDOT and PHA assigned the

[154] H-GAC Regional Goods Movement Plan, June 2013
[155] Texas Freight Mobility Plan 2017
[156] H-GAC Regional Goods Movement Plan, June 2013
[157] H-GAC Regional Goods Movement Plan, June 2013, Port of Houston Prioritized Project List
[158] Texas Freight Mobility Plan 2017
[159] Texas Freight Mobility Plan 2017
[160] H-GAC Regional Goods Movement Plan, June 2013, Port of Houston Prioritized Project List
[161] Texas Freight Mobility Plan 2017
[162] Texas Freight Mobility Plan 2017, Port of Houston Prioritized Project List
[163] Texas Freight Mobility Plan 2017, Port of Houston Prioritized Project List

project with a ‘medium priority’. As part of the long-term plans, H-GAC proposes to replace this section with a 5-lane typical section[164]. The other project aiming to increase north-south connectivity is the widening of Appelt Drive over its full length, to be completed at a still to be determined date by TxDOT and PHA[165]. In order to improve the east-west connectivity between the terminals and the Sam Houston Tollway, replacement of Jacintoport Boulevard with a 4-lane typical section has been included in long term plans by TxDOT[166].

Port of Galveston Related Highway Improvements

More than an estimated billion dollars will be spent on transportation infrastructure improvement in Galveston County over the next decade.[167] There will be major improvements to the two main arteries running through the county: I-45 (Gulf Freeway) and SH146. These corridors serve the ports of both Galveston and Texas City.

The I-45 project[168] will expand I-45 from six lanes to eight lanes between NASA 1 in southern Harris County and FM 1764 in Texas City, including a 1.5-mile stretch of ten lanes with three-lane frontage roads on either side of the Harris-Galveston County Line.

SH 146 investments[169] include expansion up to six lanes and conversion to a limited access highway, which will facilitate access from I-10 East, Baytown, and the eastern part of the Port of Houston down to the I-45 Galveston Causeway into the Port of Galveston.

Locally, a four-lane 61st Street extension has been planned from Broadway to Harborside Drive on a still to be determined timeline[170] by TxDOT and H-GAC. In order to improve traffic flow to and from the port’s eastern public wharves, traffic light synchronization has been planned by TxDOT for the downtown area on Harborside Drive. However, this project has an undefined timeline.[171]

The state funding for port projects contained within Legislative Rider 45 and Rider 48 identified improvements to Old Port Industrial Road, 33rd Street, and the intersection of 28th Street and Harborside Drive to improve traffic flow.

Port of Texas City Related Highway Improvements

The Port of Texas City is expected to benefit from the same highway improvements related to the Port of Galveston. However, there are two local projects that specifically contribute to the accessibility of the Port of Texas City. These include two direct connectors between Loop 197 and I-45 that are expected to be completed to facilitate an

[164] H-GAC Regional Goods Movement Plan, June 2013

[165] Texas Freight Mobility Plan 2017, Port of Houston Prioritized Project List

[166] Texas Freight Mobility Plan 2017

[167] http://www.developgalvestoncounty.com/road-improvements

[168] H-GAC TIP, H-GAC Regional Transportation Plan 2040, Texas Freight Mobility Plan 2017

[169] H-GAC TIP, H-GAC Regional Transportation Plan 2040, Texas Freight Mobility Plan 2017, Port of Houston Prioritized Project List

[170] H-GAC TIP, H-GAC Regional Transportation Plan 2040, Texas Freight Mobility Plan 2017

[171] Texas Freight Mobility Plan 2017

uninterrupted traffic flow. The construction of a new four-lane principal arterial named Shoal Point Access Road from Loop 197 to Southern End Terminal Site will create access to the newly developed southern part of the Port of Texas City.

Port of Freeport Related Highway Improvements

Approximately $250 million worth of projects has been identified to upgrade the 55-mile stretch of SH 36 from the Port of Freeport to I-69 at Rosenberg.[172] These projects include a grade-separated crossing with SH 35 and widening the entire stretch from two to four lanes. Some segments of the SH-36 upgrade do not have a set target date and realization of these improvements are set by TxDOT as ‘medium priority’. To accommodate anticipated growth at the port, efforts have been underway and are planned to create an improved route from the Port of Freeport via SH 36.

On SH 288, six grade separations and a one mile stretch of two-lane frontage road have been identified as future projects[173] between the Port of Freeport and Beltway 8. The timeline for the frontage road is 2025, timelines for the grade separations have yet to be determined by TxDOT.

In the direct vicinity of the Port of Freeport, three infrastructure investments are planned. Another grade separation project has been proposed for SH 332 and FM 523[174]. The construction date is not set yet by TxDOT. An elevated intersection has been planned for the intersection between Pine Street, or FM 1495, and SH 36. H-GAC assigned the project to be realized on the ‘interim term’[175]. There are long term plans to replace the Pine Street, or FM 1495, roadway with a five-lane typical section between SH 288 and the Port of Freeport Terminal on Pine Street[176].

---

[172] Texas Freight Mobility Plan 2017, Port of Houston Prioritized Project List, H-GAC Regional Transportation Plan 2040, H-GAC TIP

[173] Texas Freight Mobility Plan 2017

[174] Texas Freight Mobility Plan 2017

[175] H-GAC Regional Goods Movement Plan, June 2013

[176] H-GAC Regional Goods Movement Plan, June 2013

8.4.5 Truck Staging

During interviews with Ports and other agencies, truck staging near the ports remained a top issue. Specifically, there are limited facilities for trucks to park as they wait to enter port facilities and terminals. For example, trucks waiting to enter the Del Monte facility in the Port of Galveston are known to disturb nearby residential areas. Grain transloading sites and other facilities that experience seasonal spikes of demand, are more likely to be affected by operational capacity constraints when demand for those facilities exceeds the ability to load and unload trucks without causing significant queues.

However, access to other terminals - such as the Bayport and Barbours Cut container terminals - do not appear to be causing issues with trucks queuing on the local highway networks. The Bayport container terminal entrance is shown in Figure 8-8.

More modern facilities are designed with sufficient truck queuing space. However, older terminals and particularly those in constrained locations such as along the Houston Ship Channel tend not to have the opportunity to expand gate capacity and trucks can often queue on the highway network as they wait to access the cargo terminals. However, there are some facilities, such as the export grain Woodhouse Terminal, that can accommodate limited truck staging and entrances to the Turning Basin Terminal-Northside are designed to facilitate truck queues.

Source: Port of Houston Authority

Figure 8-8. Bayport Container Terminal Truck Entrance

While reducing truck wait times improves truck productivity, developing permanent or temporary truck staging areas can improve traffic congestion inside and outside a terminal and reduce emissions. Examples of prior circumstances that benefitted from truck queuing include:

- In July 2017, the Port Authority of New York/New Jersey (PANY/NJ) had two or more hours of truck delays at APM Terminals due to a cyber-attack that shutdown the system receiving electronic bookings and communicating with customers. The PANYNJ developed and organized a temporary waiting area just outside the terminal in a dedicated space to avoid impacting general traffic.

- More recently in May 2019, Virginia International Gateway continued seeing significant truck queuing on Route 164 near the West Freeway exit ramps and in the parking lot of the Driver Assistance building – despite a designated truck queuing policy and area. See Figure 8-9.

Figure 8-9. Virginia Int'l Gateway – Truck Queuing on Renfrow Road

In addition, given there can even be delays from waiting for collecting or dropping off equipment such as chassis, a queuing area away from primary travel lanes minimizes congestion inside and potentially around a terminal.

A further example of a port specific staging area is the one proposed by the Port of Corpus Christi Authority as shown in Figure 8-10. This combined truck queuing area comprises a truck parking area, a scheduling system and an administration building. The project will alleviate safety problems associated with traffic congestion on the Joe Fulton International Trade Corridor caused by the long backup of trucks waiting to enter the ADM grain facility.

Source: Texas Ports 2017–2018 Capital Program

Figure 8-10. Proposed truck staging area integrated with facilities

With increases in overall trucking activity associated with growing port volumes, this issue of truck staging and lack of appropriate facilities could become a future problem in proximity to port terminals. Consideration could be given to the provision of dedicated truck stop facilities, or to other solutions such as the provision of staging areas along the shoulders of roads (such as certain sections of Clinton Drive), away from residential areas that allow the temporary parking of trucks. This could also be combined with a call forward system implemented at facilities such as grain terminals, where drivers arriving at the staging location contact the grain facility to announce their presence and are then subsequently called forward at the appropriate time.

8.5 Multimodal Improvements

This section of the report discusses multimodal alternatives and improvements that seek to reduce port-related truck transportation. It explores a number of alternatives and assess their feasibility in relation to region's ports and the commodities and markets served by those ports.

The primary alternative modes of truck transportation are Rail and Barge operations. Though both modes are discussed in more detail below, a detailed benefit assessment is provided for Barge Operation in Section 8.9.1 of this report.

8.5.1 Rail

The rail industry is key to the movement of goods to and from the region's ports and is an integral part of the region's transportation network. All four ports in the H-GAC region are connected to the nation's rail network.

This Technical Memo identifies and recommends four groups of rail solutions:

- Advancing planned/programmed rail infrastructure improvements
- Working to re-establish a robust Houston-to-Dallas intermodal rail connection
- Promoting "Inland Port" development concepts to support Houston-to-Dallas service
- Continue exploring longer-term service expansion and enhancement, including new rail connections and on-dock / near-dock terminals

Advance Planned/Programmed Rail Infrastructure Improvements

The following section and Table 8-1 identify railroad capacity improvement projects in the Houston area identified in the Texas Freight Mobility Plan 2017, Appendix D[177], published by the Texas Department of Transportation on March 7, 2018.

Table 8-1. Houston-Area Rail Projects in 2017 Texas Freight Mobility Plan

Location	Project Name	Project Description	Est. Cost ($ millions)	Source/ Sponsor	Class I Railroad Stakeholder	Public Benefit
	Rail Projects Beyond the 5-Year Freight Investment Plan					
Baytown	FM 565 and 1405 Grade Separation	Grade separation to support industrial growth in Chambers County	TBD	H-GAC/ Gulf Coast Rail District	UP	Per FHWA/FRA policy and guidance
Houston	Griggs & Long Grade Separation	BNSF Mykawa Subdivision, MP 19.35. Grade separate crossings at Griggs and Long. (DOT #023214G, 023215N); UPRR Crossings 755628E, 755627X	TBD	H-GAC	BNSF, UP	Eliminate multiple angled at-grade crossings adjacent to multiple rail yards. Identified by FRA in April 2016 as site of 10 or more incidents in the last 10 years. https://www.fra.dot.gov/eLib/details/L17404
Houston	US-90 Grade Separation at Dayton Yard		$150.0	H-GAC	BNSF, UP	Eliminate traffic delay on US 90 due to rail congestion
Houston	West Belt Grade Separation (Phase 2)	Construct grade separation at Lyons Avenue DOT 287994N and close 3 at-grade crossings on West Street DOT 758284D, 748688W	$28.5	H-GAC/ Gulf Coast Rail District	BNSF, UP	Per FHWA/FRA policy and guidance

[177] http://ftp.dot.state.tx.us/pub/txdot/move-texas-freight/studies/freight-mobility/2017/appendices.pdf

Location	Project Name	Project Description	Est. Cost ($ millions)	Source/ Sponsor	Class I Railroad Stakeholder	Public Benefit
Houston	Second Main Line Construction (Houston)	Construction of a second main line in Houston from the GH&H Junction to Strang on the Port Terminal Railway Association track: This would eliminate more than 2.5 hours of train delay daily, which is caused by this single track constraint that connects to double track in both directions. Supports port and chemical industry expansion.	$130.0	H-GAC/ Gulf Coast Rail District	BNSF, KCS, UP, PTRA	Per FHWA/FRA policy and guidance
Houston	Second Main Line Construction	Second Main Track, Dawes to Dayton, TX (BNSF-UP 50/50 Line)	$100.0	H-GAC	BNSF	Per FHWA/FRA policy and guidance
Houston	Alameda-Genoa Road Grade Separation	BNSF Mykawa Subdivision, MP 14.06. Crosses three tracks at end of BNSF yard (DOT #023207W)	TBD	H-GAC	BNSF	Per FHWA/FRA policy and guidance
	Port-Rail Projects					
Freeport	Velasco	Extend rail to provide on-dock rail service to Velasco Terminal 4 tracks, 2000' ft. each.	$12.0	Port Access Study (Rail)		
Galveston	Port of Galveston	Restore on-dock rail to slips 37/38	$3.0	Port Access Study (Rail)		
Galveston	Pelican Island Bridge	Construct new rail bridge to serve future terminal	TBD	Port Access Study (Rail)		
Houston	Broadway Street	Convert a 0.28-mile (1,478-foot) segment of single-track railway to double-track railway near the Houston Ship Channel (HSC) in Houston, Texas	$21.3	Port of Houston		

Location	Project Name	Project Description	Est. Cost ($ millions)	Source/ Sponsor	Class I Railroad Stakeholder	Public Benefit
Houston	SH 146 and Old SH 146	Construction of approximately 6,500 linear feet of new single-track rail line from near the intersection of the existing UPRR ROW at Red Bluff Rd. to the proposed warehouse development. The project will include three at-grade crossings with signalization at SH 146 and Old SH 146, plus modification to switched and turnouts for tying into the existing mainline, and for future expansion. The project may also include approximately 1,200 linear feet of soundwall.	$13.6	Port of Houston		
Houston	Port Terminal Railroad Association (PTRA) Track (Highway 225 to Red Bluff Road)	Construct 2nd rail track allowing PTRA access from 225 to Red Bluff Road to connect with crossing at Red Bluff Road being constructed in 2015, connection to future Bayport Container Terminal	$78.32	Port of Houston		
Houston	SH 146 and Red Bluff Area	Construct double track and a run-around track from Red Bluff Road/SH 146 road crossing to future container terminal development	$10.116	Port of Houston		

Source: TxDOT, Texas Freight Mobility Plan 2017, Appendix D

Robust H-GAC Region-to-Dallas Intermodal Rail Service

In 2013, UP launched a weekly rail service between the Barbours Cut Container Terminal and the Dallas Intermodal Facility in Wilmer, TX. The service had an acceptance cut off time at 17:00 on a Wednesday and the container subsequently being available in Dallas at 08:00 on the Friday.

However, in April 2019, UP announced that it was no longer going to continue to operate this particular service, citing low volumes. One potential reason for the low volumes is the competition with truck movement, including transload operations in the Houston area (as described in the Section 7 - Supply Chain Analysis) and the 5-6-hour drive from Houston to Dallas, when compared with a 27-hour rail movement.

Despite this service reduction, there appears to be quantifiable demand for a rail service between the H-GAC ports and the Dallas Fort-Worth area. Analysis of Datamyne trade data identified some large importers in the Dallas area; industry feedback noted a non-quantified but sizeable number of containers destined for Dallas; and analysts believe that efficient, reliable intermodal rail service between the region's ports and the Dallas area will be an important factor in determining the extent to which ocean carriers may respond to the widening of the Panama Canal by increasing their utilization of the region's ports to serve Midwest hinterland markets. Competing ports also view Dallas as a key opportunity; in 2018, Kansas City Southern (KCS) initiated a once a week rail service from the Port of New Orleans to its intermodal yard at Wylie,TX.

	Origin Region Name			
STCC4 Description (group)	Grand Total	Harris County, TX	Brazoria County, TX	Galveston County, TX
Grand Total	2,718,977	2,576,331	84,324	58,322
Primary Iron or Steel Products	1,568,208	1,559,677	7,814	717
Portland Cement	133,130	133,130		
Malt Liquors	83,653	83,628	25	
Plastic Mater or Synth Fibres	71,584	53,818	17,767	
Gravel or Sand	69,182	54,178	15,005	
Tropical Fruits	43,152	2,169	17,977	23,006
Ceramic Floor or Wall Tile	42,535	42,535		
Cut Stone or Stone Products	39,959	39,959		
Valves or Pipe Fittings	37,732	37,287		446
Blast Furnace or Coke Oven Products	37,429	37,429		
Misc Plastic Products	37,101	36,833	268	
Misc Industrial Organic Chemicals	34,946	21,786	9,848	3,312
Plywood or Veneer	28,016	28,014		2
Primary Aluminum Smelter Products	25,472	25,472		
Misc Fabricated Wire Products	23,261	22,889		372
Constr Machinery or Equipment	21,660	5,242	1,728	14,690
Misc Fresh Vegetables	18,566	7,325	4,932	6,309
Surface Active Agents	16,986	16,986		
Fabricated Metal Products, Nec	15,008	13,609	1,018	381
Distilled or Blended Liquors	13,476	13,476		
290 Other Categories	357,920	340,891	7,943	9,086
	0M 2M 4M Tons	0M 2M 4M Tons	0M 2M 4M Tons	0M 2M 4M Tons

Source: Analysis of Transearch 2015 data.

Figure 8-11. Imports (Excluding NAFTA) Moving from the H-GAC Port Counties to the Dallas Business Economic Area by Truck, 2015

Analysis of 2015 Transearch data shows a total of more than 2.7 million tons – roughly equivalent to 500 fully-loaded combination trucks per day – of imported freight (excluding NAFTA imports) moving from the H-GAC port counties to the Dallas region (defined as the multi-county Dallas Business Economic Area). More than half the tonnage is associated with primary iron or steel products.

There are some challenges in interpreting this data. First, as discussed in the Commodity Flow Technical Memo, Transearch appears to be capturing only around 60% of the truck moves associated with port import traffic, so the figures above are probably too low. On the other hand, while some cargo categories are highly containerized, some are not, and clearly not all of the tonnage in Figure 8-11 could potentially be handled by intermodal rail. More detailed market studies would be needed to produce a specific tonnage forecast, but based on reasonable initial planning assumptions (the Transearch figure is 60% of the 'real' total, and 10% of the adjusted total is both containerizable and divertible from truck to rail), the analysis suggests an initial market target of roughly 450,000 tons per year, or between (roughly) 75 and 100 containers per day. Additionally, international containers that arrive in Dallas and transload to truck for delivery to Houston markets could instead remain on rail, and the empty containers could be returned by rail, providing additional market traffic and railroad revenue streams.

To capture the existing market – and eventually to influence ocean carriers to route more hinterland traffic through the H-GAC region ports – it might be necessary to offer every-other-day or even every-day service. The most successful model for a comparable move is the Port of Savannah to Atlanta (which is a similar distance, circa 250 miles, when compared to Houston-Dallas) where there is daily double-stack service from two Class I railroads. Rail services would have to offer high frequency and reliability, at a cost lower than trucking, to be competitive. However, offering this level of service requires the railroads to accept a certain level of business risk: having tried a weekly service and abandoned it due to unacceptably low volumes, the railroads would now have to offer a significantly more frequent service (ideally daily, to be competitive with trucks), in the hopes they would attract traffic to become and remain viable and profitable.

The public sector could potentially play a useful and catalytic role in this process, serving essentially as a risk partner for the railroads – incentivizing them to offer attractive service, assisting and supporting their marketing efforts, providing assistance during 'ramp up' stages, and/or employing other strategies – enabling and encouraging the railroads to make sustained commitments to Houston-to-Dallas intermodal service. This Technical Memo recommends further structured investigations of this possibility by H-GAC, the region's ports, other regional and state public sector partners, and Texas operating railroads.

Rail Served Inland Ports

An inland port is a facility that is connected, typically by rail, but also by inland waterways, to a maritime port of entry. The role of the inland port is to concentrate cargo volume onto a frequent rail or barge service and then facilitate the loading/unloading from barge/rail to a truck for delivery of containers between the inland port and shippers and goods receivers. The concentration of cargo onto a rail service that either originates from or is destined to a maritime port, is typically the main differentiator between an inland port and an intermodal terminal, though there may be other ancillary services such as customs processes that occur at the inland port.

Key success factors that make an inland port viable include:

- Close proximity to distribution, warehousing and manufacturing operations – the customers.

- Regular rail or barge services feed the inland port with import containers and loaded export containers or empty containers travel back to the port.
- Having sufficient scale or volume to justify operations including frequent (ideally daily) rail or barge services between the inland port and the maritime port.
- Ensuring there are cost and operational benefits for customers when comparing an inland port operation with direct trucking services from the maritime port of entry.

Examples of rail served inland ports include:

- South Carolina Inland Port (SCIP) at Greer, SC. Inland Port Greer opened in 2013. A daily rail service operated by Norfolk Southern, links the inland port with the Port of Charleston 212 miles away. The Inland Port is in close proximity to port-dependent companies including BMW, Michelin and Adidas. Approximately 25 percent of the Port’s container volume is transported by rail and in 2017 the SCIP handled 122,000 containers. The cut off time at Charleston for containers moved to the SCIP is 3:30PM, with the containers being available for collection at 08:00AM.
- Rickenbacker Inland Port at Columbus, OH. Serviced by Norfolk Southern, the facility opened in 2008 and is capable of handling 400,000 containers annually. Seventy five percent of containers handled are international traffic and 55 percent of volume originates from the West coast ports (via agreements with BNSF) and 45 percent from East coast ports (NS Heartland Corridor to the Ports of Virginia). Companies located close to the inland port include Eddie Bauer, Whirlpool, Pet Smart, Boars Head, DHL Supply Chain and CEVA Logistics.

The Inland Port concept is highly compatible with and supportive of the concept for Houston-to-Dallas rail service expansion. Providing improved rail service to Dallas, along with additional opportunities to develop adjacent lands with compatible land uses for industries that benefit from the rail service being offered and the H-GAC region ports that feed it. Inland Port development could include a mix of both importers and exporters to promote directionally balanced rail traffic as far as practical.

Importantly, the concept is not limited to the Houston-Dallas corridor – it is applicable anywhere there is, or could be, a suitably dense cluster of rail-served, port-served industrial customers.

Longer-Term Service Expansion and Enhancement

Longer-term rail opportunities have been identified during this study, or are running concurrent with this study, for both Freeport and Houston.

- In January 2015, the Brazoria-Fort Bend Rail District (BFBRD) was established to create, finance, maintain, and operate a proposed freight rail connector between Port Freeport and an intermodal rail hub near Rosenberg/Kendleton, Texas. From Rosenberg/Kendleton, connections to multiple Class I railroads and their respective national networks would be offered, and rail shipment capacity would be provided at Freeport to facilitate transfers between vessels and railcars.

An initial study has been completed and further development studies are underway as this report is being written.

- Study partners have urged the general consideration of on-dock intermodal rail to serve the region's container ports. The Port of Houston's Barbours Cut Container Terminal is already served by a 42-acre near-dock intermodal yard, which is immediately adjacent to the terminal and functions in all respects like an on-dock facility. The Port of Houston's Bayport Container Terminal is not served by on-dock or near-dock rail; the Port of Houston reports there is currently no identified demand for rail service at the terminal, but if/when market conditions warrant, the concept could be explored further. It is recommended that conditions be closely monitored and specific 'market triggers' be identified as points where additional study could be warranted and initiated.

8.5.2 Container-on-Barge

Background

As identified in the PAMS Barge and Short Sea Shipping Report, all four of the region's ports make extensive use of domestic maritime and intraport movements, though the majority of goods transported are related to petroleum and chemical products. A challenge with scoping multimodal improvements is identifying which supply chains or commodities have the potential to be shifted from truck to short sea shipping. Other factors include the location of supply chains relative to a navigable waterway; potential market demand; and what infrastructure or operational impediments exist. For any freight move, the critical factor is reliability or consistency.

Despite the typical need to move one container on truck, there are examples of successful container on barge services that have or are currently moving goods between two U.S. points that could otherwise be served by truck or rail. These include the transport of containers carrying resins for export from Cedar Bayou Barge Terminal. In addition, local barge services occasionally provide container repositioning in Galveston Bay. Other current successful container-on-barge services are described in Table 8-2.

Other Existing Services

There have been services at various times on every U.S. coast as well as along various waterways. In addition, short sea shipping is common in Europe due to an element of funding support from the European Union and the vastness of its navigable inland and coastal waterway system.

Other services that have been funded by America's Marine Highway Program include the Port of Brownsville to Port Manatee cross Gulf service in 2010. Federal monies for capital infrastructure were provided for the purchase of container-handling equipment (e.g. side-picks), but volumes ultimately did not warrant sustaining these services. Further, while the Illinois Soybean Association has looked into using container-on-barge to the Port of New Orleans, a consistent issue has been backhauling.

The same applies to an East Coast service which might reduce truck traffic along I-95 between Maine and Florida. While I-95 in South Carolina, Georgia and Florida are congested 60 percent of the time according to the Federal Highway Administration, there does not seem to be an ability to develop a self-sustaining coastal container-on-barge service along this portion of the East Coast. In most cases, like the I-55 Corridor along the Mississippi River, competing modal services drop their rates to recapture market share. In the case of the I-55 corridor, while there could be a service from Illinois to Louisiana, rail interests can immediately modify rates to recapture market share.

Table 8-2. Current U.S. Container-on-Barge Services

Service	Start - End Dates	Navigable Waterway	Service Description
Hampton Roads – Richmond, VA	2008 – Present	Elizabeth River	The "64 Express" started running with the help of a Congestion Mitigation and Air Quality (CMAQ) Grant overseen by the Richmond Regional Transportation Planning Organization. The service has grown from one sailing per week to three and may continue growing to daily (Monday through Friday). The service still runs today with the support of a Marine Highway Grant for the development of a third barge. In fact, in 2018, the service transported 31,500 containers. In April 2019, the Virginia Port Authority announced it was adding a second barge and two more days for its weekly service due to growth with the support of a USDOT/Maritime Administration Marine Highways Grant.
Memphis, TN – Baton Rouge, LA	2016 – Present	Mississippi River	The service started in 2016 with the support of a Marine Highway Grant to reposition empty containers from Memphis, TN to Baton Rouge, LA for the increasing volume of resin exports from Baton Rouge to New Orleans. These containers are subsequently loaded with plastic resins and then transported to the Port of New Orleans for export.
New York – New Jersey	2016 - Present	Upper & Newark Bay	The Red Hook Cross Harbor Barge service started in 2016 with the help of a Marine Highway grant. It moves containers across New York harbor to a barge terminal in Newark.

Local Challenges

As Section 5 Barge and Short Sea Shipping identified, there are factors that affect the operation of a barge service. The major issue at the Houston container terminals is that barges are unloaded/loaded with container Ship-to-Shore (STS) cranes. These cranes are also used to offload container vessels and barges compete for wharf space with these vessels. The container vessels have priority over the barge and may have to move part way through loading if a container vessel arrives and requires the space. The barge may have to wait until wharf space becomes available. This can result in export containers missing their scheduled export sailing and increases cost and service unreliability. With high levels of berth utilization and potential growth in vessel numbers, this situation results in an unsustainable and unreliable system that unless resolved, could impact customer service levels and potentially cause the service to either cease or operate intermittently. A number of potential strategies exist and are detailed below.

If container-on-barge is expected to be a critical component of the Port of Houston's mobility plan going forward, it may have the potential to attract a higher level of investment to better integrate with terminal operations and deliver improved handling and storage facilities for container-on-barge bound containers. In 2020, the Port of Houston received $180,000 in grant funding from MARAD to support the development of an Operational Plan for container-on-barge activity.

Dedicated Container-on-Barge Dock

An example of such a facility is the Alpherium terminal, in Alphen aan den Rijn, The Netherlands, as shown in Figure 8-12 and Figure 8-13. The Alpherium is a container terminal that loads and unloads barges used in Europe for inland navigation. Users at this facility include the Heineken brewery to ship their beer to the Port of Rotterdam for export.

Challenges with this type of facility, include cost and also land space availability, especially when there is a need for increasing container yard space for staging growing container volumes and the need for berth space to accommodate more ocean-going vessel calls.

Source: Alpherium

Figure 8-12. Alpherium Terminal

Source: Alpherium

Figure 8-13. Alpherium Terminal

Self-Discharging Container Barge

In the Port of Rotterdam, Mercurius Shipping operates two self-discharging, self-propelled vessels for distributing containers between container terminals and warehouses with waterway access (Figure 8-14). One vessel can accommodate 144 TEU, the other 164 TEU. The vessels have a crane capable of lifting containers from an adjacent terminal to the vessel and also to another barge tied up alongside the self-discharging vessel as shown in Figure 8-15. The vessel cranes can lift 30 and 40 ton respectively and both twenty- and forty-foot type containers. The vessels utilize a ballast system to ensure the vessel remains upright and level when offloading containers.

Source: Mercurius Shipping

Figure 8-14. Self-Discharging Container Vessel

Source: Mercurius Shipping

Figure 8-15. Self-Discharging Container Vessel with Container Barge

The advantage of a self-discharging barge is that it doesn't rely on shore-based cranes or lifting equipment. The vessel can be positioned alongside a length of berth that does not have equipment for lifting containers to/from the barge. This provides greater flexibility as to the location where the vessel can be moored at a terminal and also the type of terminals it can serve.

However, it is recognized that both the vessel type and crane employed in Rotterdam, are not typically found in the U.S., where most inland and port operations are tug and barge combinations. The type of crane is also different. An estimated cost for a U.S. designed and built self-discharging barge would be in the region of $5-6M.

Roll On/Roll Off

Container on barge operations are a lifeline for some coastal communities in Alaska. These small ports do not have the volume of trade for dedicated container cranes and instead rely on roll on/roll off (RORO) operation where containers and other equipment are loaded onto a deck barge. When the barge arrives at the destination, a ramp connects the barge with the wharf and mobile container stackers are used to transport the containers from the barge to the terminal.

Another alternative with RORO operations is for containers to be loaded onto a flat deck barge while they are mounted on a trailer chassis. The chassis is transported onto the barge by a terminal tractor unit utilizing a ramp connecting the barge and the wharf terminal. The chassis is then unhitched from the tractor unit and left on the barge. The barge travels to the destination and the chassis are transported from the barge using a terminal tractor that may have been transported on the same barge as the chassis or is located at the discharge terminal. A disadvantage with this type of operation is that containers cannot be stacked on top of each other, resulting in fewer containers that can be carried by a barge.

Mobile Container Handling Equipment

Barges are loaded/unloaded at the Cedar Bayou facility using mobile container handling equipment as shown in Figure 8-16 and Figure 8-17 below.

Source: Kalmar

Figure 8-16. Mobile container handling equipment

Source: Kalmar

Figure 8-17. Barge loaded with containers at Cedar Bayou

Unloading containers from barges using this type of equipment could be considered for the two Port of Houston container terminals.

8.6 Alternative Transportation Systems

Potential solutions for port-related mobility also include establishing dedicated freight infrastructure that segregates specific freight flows from other transportation users. The National Cooperative Freight Research Program (NCFRP) Report 34 Evaluating Alternatives for Landside Transport of Ocean Containers, assessed alternatives to diesel trucks for ocean container transport to or from deep-water ocean ports and inland destinations within 100 miles. The report published in 2015, identified 13 advanced fixed guideway technologies to move containers to and from the Los Angeles/Long Beach ports. At the time of the report's publication, very few of those identified technologies had progressed from a concept to actual design, engineering and fabrication.

In more recent years, systems such as the Virgin Hyperloop One and Freight Shuttle, have attracted attention and funding to move forward into testing and further development phases.

In this chapter, a selection of new technologies are identified that have the potential to transport port-related cargoes and support the overall objectives of the PAMS project. The common characteristics of these systems are:

- Requiring a dedicated Right of Way (ROW) with infrastructure that is unlikely to be available to common users;
- Using alternative technologies for vehicle propulsion, generally cleaner than the existing alternatives using combustion engines.

Out of the technologies discussed in this report, the Freight Shuttle System (FSS) initiated by the Texas A&M Transportation Institute is discussed in more detail in Section 8.6.5 and a benefit assessment for this alternative is provided in Section 0.

8.6.1 Virgin Hyperloop One

The Hyperloop concept is a transportation system using low-pressure tubes that was popularized in 2012 by entrepreneur Elon Musk. The idea sparked interest and others were actively encouraged to continue developing the open source concept. This led to the formation of several startups with varying degrees of success. Hyperloop Transportation Technologies constructed a full-scale test track in France. Virgin Hyperloop One plans to bring a Hyperloop system into operation by 2021 by combining magnetic levitation and using a low-pressure vacuum-sealed environment to move the pods. A 1,500-feet test track has been built to run tests.

In April 2018 Virgin Hyperloop and DP World announced a cooperation to apply Hyperloop technology to freight movement: DP World Cargospeed, a rendering of which is shown in Figure 8-18. This is an international brand for hyperloop-enabled cargo systems to support the fast, sustainable and efficient delivery of palletized cargo. It plans to deliver freight at the speed of flight and closer to the cost of trucking.

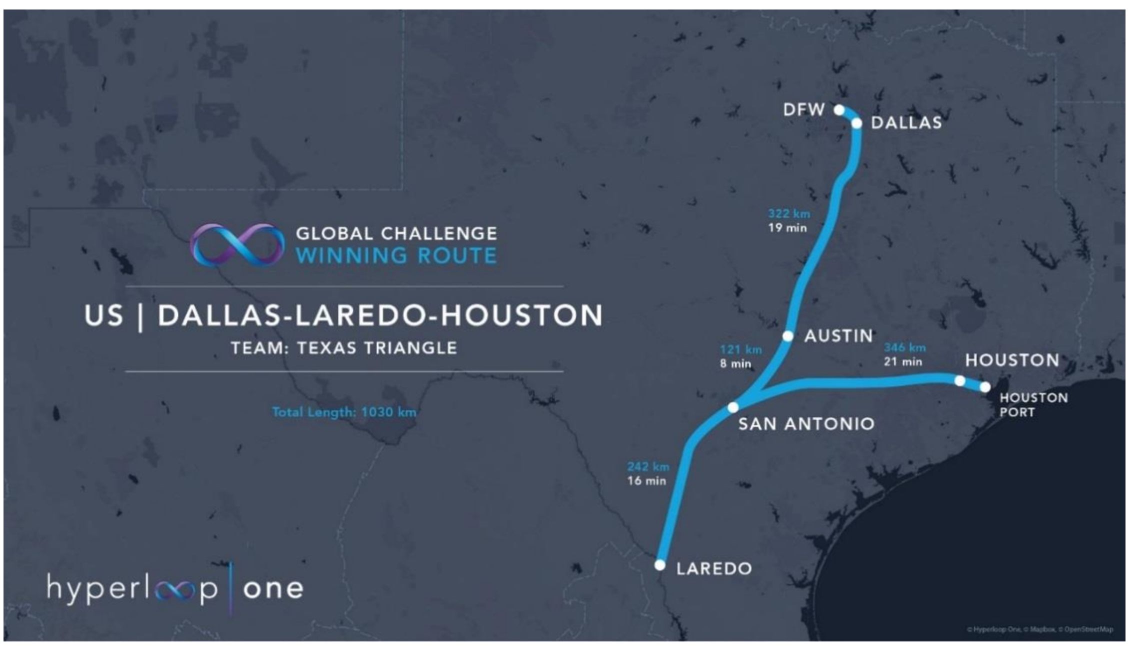
A Hyperloop-enabled supply chain can help reduce finished goods inventory by 25%, cut required warehouse space by 25%, and shrink inventory lead times according to studies by McKinsey & Co.

Source: Virgin Hyperloop One

Figure 8-18. DP World Cargospeed transload facility

In 2017 Virgin Hyperloop One announced the winners of its Hyperloop One Global Challenge to identify the strongest potential Hyperloop routes in the world. One of the ten winners is the Texas Triangle: the 640 miles Dallas-Laredo-Houston would connect 18.7 million people in five urban centers, expected to reach 33 million inhabitants by 2030. The border city of Laredo is home to North America's busiest inland freight port, and the Houston terminus would be in the Port of Houston with the goal of integrating passenger and cargo movement, as shown in Figure 8-19.

The primary target of Hyperloop is high speed, high density passenger travel and high value goods. Fundamentally, it is not equipped to ship sea containers, making the system seem incompatible operations at seaports and inland ports, unless containers were unloaded and the contents reloaded into Hyperloop vehicles.



Source: Virgin Hyperloop One

Figure 8-19. Hyperloop One route Dallas-Laredo-Houston

8.6.2 Hyperloop Transportation Technologies

Similar in concept with Virgin Hyperloop One, Hyperloop Transportation Technologies (HyperloopTT) uses low pressure tubes through which passenger and cargo capsules travel. In October 2018, HyperloopTT announced it will begin construction of a hyperloop system in Abu Dhabi which is due to commence towards the end of 2019.

Hamburger Hafen und Logistik AG (HHLA), the leading container terminal operator in the Port of Hamburg in Germany and research and development company HyperloopTT entered into a joint venture in December 2018 to develop and test a hyperloop system that will be able to transport shipping containers. The project will begin with an initial study on connecting a cargo-based Hyperloop system from an HHLA container terminal to container yards located further inland. They will start their experimental initiative by building a transfer station at a Hamburg container terminal and a 328-foot cargo route together with a freight capsule and a loading dock, as rendered in Figure 8-20.

Source: HyperloopTT

Figure 8-20. HyperloopTT at the Port of Hamburg

8.6.3 TransPod

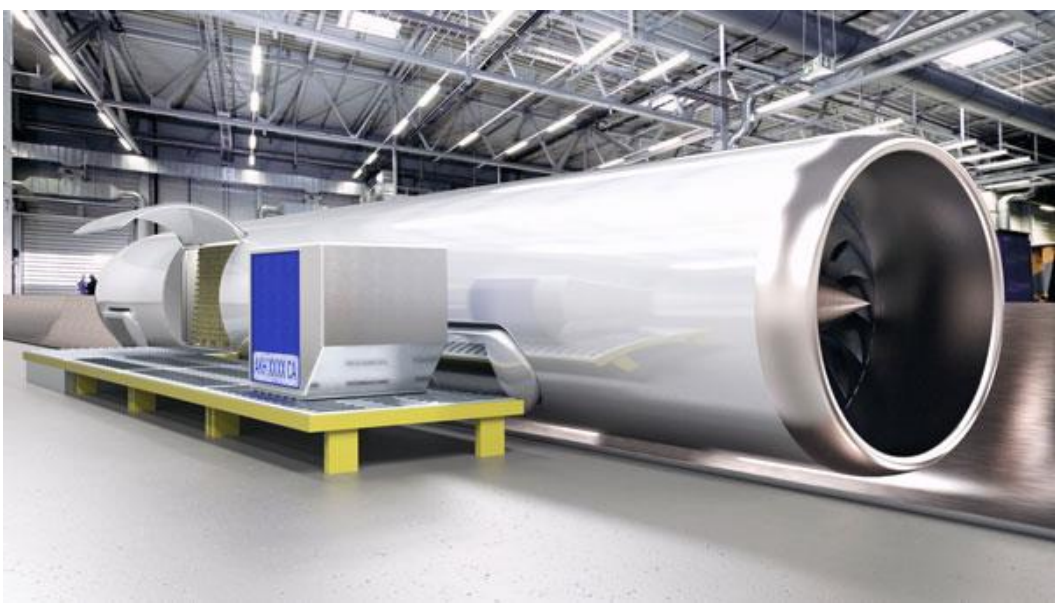
Faster than airline travel, the TransPod tube system is a fully-electric mass transportation system, to reduce carbon emissions, and provide an alternative to highway congestion, as rendered in Figure 8-21.

TransPod claims it differentiates itself from other “Hyperloop” systems by its low infrastructure and maintenance costs. This system is also based on electromagnetic propulsion of vehicles within a protected tube guideway, whose air pressure is reduced and controlled for improved performance at high speed. However, compared to Hyperloop One, there is a noteworthy difference. The coils that lift and propel the maglev pods are located in the TransPod-vehicles, rather than in the tube, requiring fewer parts.

Source: Transpod

Figure 8-21. Impression of Transpod line along Toronto's Gardiner Expressway

As shown in Figure 8-22 below, the Transpod system is initially designed for higher value, lower weight and time sensitive shipments. Compatibility with accommodating heavy weight shipping containers is unknown.



Source: Transpod

Figure 8-22. Transpod Vehicle

The Texas Triangle has been identified by TransPod as a suitable area to exploit their system, as shown in Figure 8-23.

Source: Transpod

Figure 8-23. Transpod Texas Triangle

8.6.4 Electric Cargo Conveyor/Magnetic Levitation

In 2006 General Atomics (GA) under sponsorship of the Port of Los Angeles evaluated the feasibility of a maglev cargo system.

The 4.7 miles maglev network envisioned by the Port of Los Angeles connects the port's terminals to the intermodal transportation center leading to the terminus of the Alameda corridor. The ICTF is the distribution center for long distance trucking and also the gateway to the Alameda corridor, which distributes cargo by rail from the port to locations within the country. A maglev network operating within the Port of Los Angeles, would remove from the roads over one million truck trips per year, just between Terminal Island and the ICTF.

GA indicated that it is readily feasible to design, build, and economically operate a maglev system to carry cargo that will meet the guidelines required by the Port of Los Angeles. GA named this system the Electric Cargo Conveyor (ECCO) system.

Table 8-3. Electric Cargo Conveyor Key System Parameters

System Parameter	Value
Throughput Capacity	2,500 containers per day per direction
Weather	All-weather operation
Levitation	Permanent magnet Halbach array, passive
Propulsion	Linear synchronous motor
Operation	Fully automatic train control (driverless)
Safety	Automatic control, wraparound feature of the design, and restricted access to elevated guideway
Maximum operation speed	90 mph
Vehicle size	45-ft long x 9-ft wide
Grade, operating capability	10%
Design minimum turn radius	328 ft
Container capacity	Up to 40 ft, 67400 lb
Operation hours	24 hours per day
Alignment length	4.7 miles Terminal Island to Southern California International Gateway

The system architecture is arranged to shuttle cargo vehicles back and forth through high-speed sections connected with dual loading/unloading spurs. This arrangement, coupled with 20-sec headway between vehicles in transit and 2-min dwell time for loading and unloading, meets the 5,000 container trips per day requirement. The system is driverless, using automatic train control. It is also energy-efficient and uses regenerative braking during deceleration.

Table 8-3 summarizes the key parameters.

GA's cost studies indicate that maglev will be very cost competitive with highway transportation while offering all-electric operation with many environmental and efficiency benefits. Another key advantage of the system over conventional wheeled rail systems is its quiet operation, eliminating the need to go underground for noise abatement. This benefit greatly reduces construction cost and schedule. Operation and maintenance costs are also greatly reduced since the system is levitated contact-free, resulting in reduced maintenance and life-cycle cost.

A budgetary cost estimate for the 4.7-mile maglev system from the port to the intermodal transfer facility, including engineering, construction and commissioning (excluding cargo handling equipment) is $575M (expressed in 2006 dollars).

Today, the ECCO system has not been realized. There is no maglev freight system active around the world.

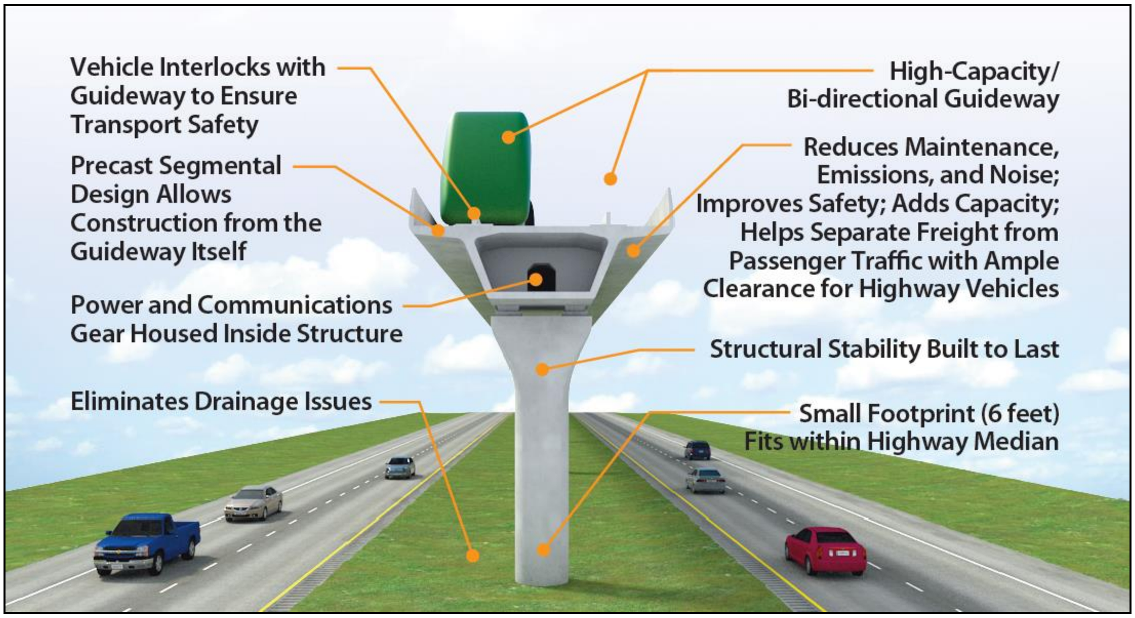
8.6.5 Freight Shuttle System

The Freight Shuttle System (FSS) is a steel-on-steel driverless transporter that can accommodate a 40-foot container or a 53-foot conventional commercial truck trailer, as shown in Figure 8-24.

Source: Freight Shuttle

Figure 8-24. Freight Shuttle Transporter

The transporter is propelled using electrical linear-induction motors. It is designed to operate between two points on dedicated guideway infrastructure (up to 500 miles apart) as shown in Figure 8-25.



Source: Freight Shuttle

Figure 8-25. Freight Shuttle Guideway

A single system could operate nonstop 24 hours a day and has the projected ability to move 17,000 trailers or containers every day. In June 2016, the first FSS transporter was completed and tested for the first time.

In 2016, the Port of Houston signed a memorandum of understanding to evaluate the feasibility and options of integrating this proposed technology between the Bayport and Barbours Cut container terminals.

Other FSS studies have assessed the benefits of using this system for cross border freight transportation. One study commissioned by the U.S. Treasury Department identified that an 11.7-mile system operating at the Zaragoza border crossing could generate $10.5 billion in economic benefits over 20 years.

For the PAMS study, different scenarios for the FSS were identified, taking into account the predominant destination of containers from the Port of Houston. As shown in Figure 8-26, Scenario 1 links the Port of Houston container terminals with a shared user transfer terminal in the Baytown area. This facility would receive and dispatch FSS transporters from/to the Port of Houston container terminals. The transporters would be unloaded, and containers loaded to trucks for final delivery to import warehouses. Export containers would be delivered to the transfer facility by truck.

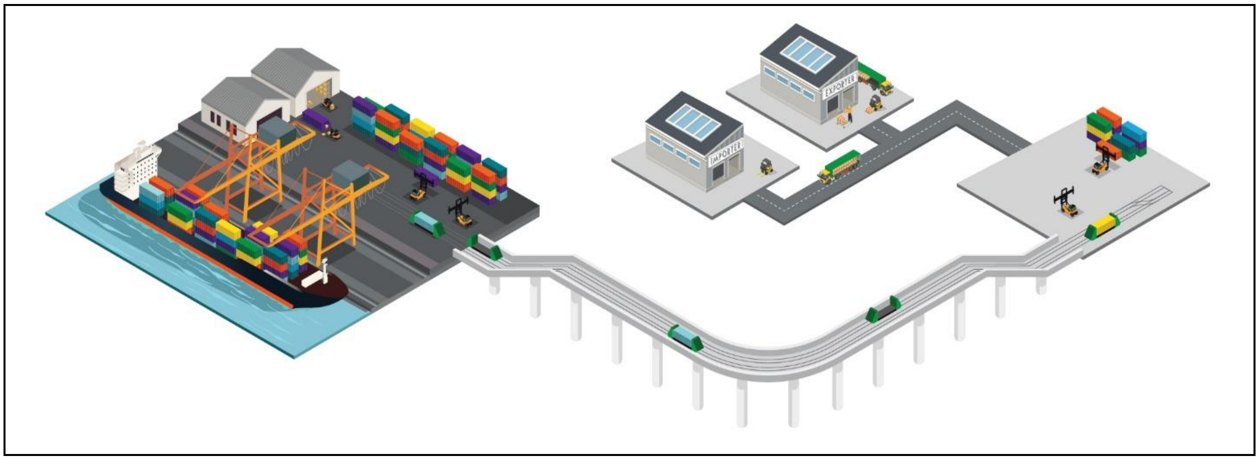


Figure 8-26. Freight Shuttle – Scenario 1 Transfer Facility

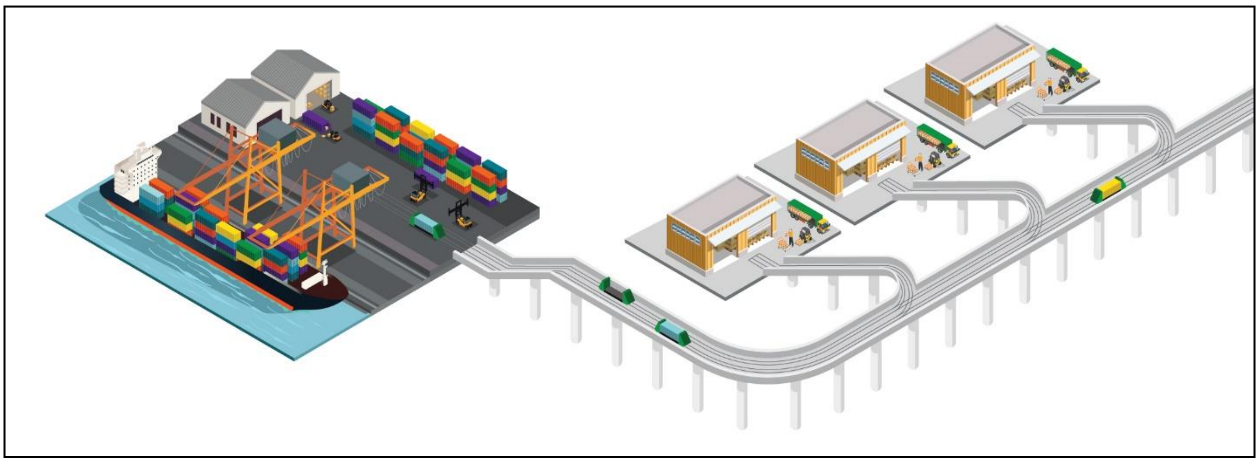


Figure 8-27. Freight Shuttle - Scenario 2 Direct to User

The second scenario (Figure 8-27) envisages Freight Shuttle directly linking the Port of Houston container terminals with the importer and exporter warehouses and packaging facilities in the Baytown area. This system would eliminate the need for any truck movement between those facilities and the port.

8.6.6 EagleRail Container Logistics

Chicago-based startup company, EagleRail Container Logistics aims to assist container terminals by providing an automated overhead shuttling option, as shown in Figure 8-28. Using an elevated all electric rail system, EagleRail would allow container terminals in the port to connect to inland facilities, bypassing congestion issues on the ground and limiting truck pollution and congestion. So far ports in Brazil, India, Bangladesh, South Africa, China and an unnamed country in the Middle East, said they want to push forward with plans.[178]

[178] https://www.freightwaves.com/news/eaglerail-an-idea-ready-to-take-flight

Source: EagleRail Container Logistics

Figure 8-28. Eagle Rail Container Logistics' elevated transportation system

According to EagleRail their system would be suitable for moving containers up to about 10 miles. This would allow Bayport and Barbours Cut container terminals to reach approximately every inland facility east of Sam Houston Tollway and south of the I-10.

8.6.7 Summary of Fixed Guideway System Opportunities

Over the years, there have been many different proposals for fixed guideway systems to serve ports. This report has addressed only the most directly relevant systems – Virgin Hyperloop One, TransPod, Electric Cargo Conveyor/MagLev, Freight Shuttle, and EagleRail. They each offer advantages and disadvantages.

Virgin Hyperloop One and TransPod both promise very high-speed point-to-point service for both passengers and freight. However, if freight has to be transloaded between conventional vehicles and their specialized vehicles, it will add considerable time and cost to the end-to-end move. This could be mitigated somewhat if Hyperloop and TransPod compatible freight containers could be shared out to shippers and receivers, but this will create substantial equipment management challenges. A second issue is that freight would still need to be drayed between the Hyperloop or TransPod terminals and freight shippers and receivers, and the local drayage time and cost will be significant. A third issue is that the services would have to run very frequently, or their speed advantage versus trucking will be meaningless – a conventional truck leaving Houston for Dallas at 8 AM will beat a Hyperloop vehicle leaving at noon. These systems will have to overcome significant challenges to beat conventional trucking.

Looking at cost comparisons between these systems and trucking, using national average trucking figures developed by WSP under contract to the US Department of Transportation, it appears that the cost of a truck service between Houston and Dallas is equivalent to the cost of two local drayage moves within Houston. The additional costs of cargo transfer and linehaul movement on the Hyperloop or TransPod would put these systems at an immediate cost disadvantage as shown in Table 8-4.

Table 8-4. Truck and Fixed Guideway Cost Comparison (Houston to Dallas)

Cost	All Truck	Hyperloop One or TransPod
Door-to-Door	$700	
Truck Drayage (< 50 miles) to Terminal		$350
Cargo Transfer		Unknown
Linehaul Service		Unknown
Cargo Transfer		Unknown
Truck Drayage (< 50 miles) to Terminal		$350

Similarly, looking at time (Table 8-5), Hyperloop and TransPod services are obviously much faster at moving between two points – unfortunately, unless the freight shipper and freight receiver are located exactly at those points, the service may not save any time compared to conventional trucking, factoring for truck drayage, schedule buffer (arriving in time to make the cutoff), and any cargo transfer time required.

Compared to Virgin Hyperloop One and TransPod, the Electric Cargo Conveyor and Freight Shuttle Systems have three significant advantages: first, they would be purpose-built for freight (meaning their origins and destinations would be centered in known high-density freight clusters, not population centers); second, they could accommodate conventional over-the-road trailers, chassis, and containers (eliminating the need for cargo handling); and third, by operating smaller platforms or vehicle sets, they could operate continuously or nearly on-demand (like trucks) instead of on fixed schedules (like trains). EagleRail has these advantages too, but cannot accommodate chassis and trailers, as it focuses on shipping containers only. These three systems would likely prove most effective in shorter-distance, very high-density transfer operations between established or emerging freight clusters – for instance, between a marine terminal complex and an off-site railyard, inland port, or warehouse/distribution complex – where the need for truck drayage could be nearly eliminated at one or both ends.

Such systems could potentially be competitive with trucking on time. The challenge will be cost. The capital costs of investment will need to be recovered at least in part from revenue streams, and revenue streams will depend on how much demand is realized. Previous work in this study (see the chapters on Supply Chain Analysis and Commodity Flows) shows that port-related traffic volumes are relatively dense within Harris County itself, but otherwise broadly dispersed primarily within South and Central Texas. This suggests that capturing a substantial amount of market demand might require a network, rather than a single corridor. This is completely analogous to passenger system planning, where the value of the initial investment in a single corridor is often not realized until a much larger system is completed.

Table 8-5 Truck and Fixed Guideway Time Comparison (Houston to Dallas)

Cost	All Truck	Hyperloop One or TransPod
Door-to-Door	5-6 hours	
Truck Drayage (< 50 miles) to Terminal		1-2 hours
Cargo Transfer		Unknown
Schedule Buffer		1-2 hours
Linehaul Service		>1 hour
Cargo Transfer		Unknown
Truck Drayage (< 50 miles) to Terminal		1-2 hours

As a result, H-GAC believes it is reasonable to advance planning investigations for these kinds of system. Focusing initially on the highest-density corridors available (such as the Port of Houston and Chambers county analysis used in the benefit analyses), but also considering at an early stage in the process the ways in which these corridors could be integrated into much larger, higher-volume service networks that would capture enough demand to warrant the system-wide investment. And again, like passenger transit systems, carrying the costs of the initial investment long enough to reach the point of substantial payback is likely to be a challenge.

One possible funding strategy to supplement direct user-based revenues could – again, like transit systems -- involve value-capture for property development at or near points served by these type of alternative transportation systems. There are many questions and challenges to overcome, but we believe these opportunities are worth the effort of exploration, especially in regions where highway congestion is expected to increase.

8.7 Automated Trucks

A potential threat to the implementation of both the alternative transportation systems identified in this study and multimodal solutions such as container on barge, is the potential use of automated trucks. In June 2019, Volvo Trucks began operations with a logistics provider, DFDS, using an electric autonomous vehicle to shuttle containers from a logistics center to a port in Gothenburg, Sweden (Figure 8-29).

Source: Volvo Trucks

Figure 8-29. Volvo Trucks Autonomous Vehicle

An increasing truck driver shortage may spur the application of driverless and automated vehicles that are specifically targeted at port-related supply chains, especially the repetitive movement of containers to nearby warehouses and distribution centers. As technology and associated regulations continue to evolve, the concentration of import warehouses and plastic resin packaging plants in close proximity to the Port of Houston container terminals, served by multi-lane highways, could present an ideal operating environment and market for automated trucks.

8.8 Operational Strategies

8.8.1 Container Logistics

Introduction and Existing Conditions

A byproduct of sea container transportation is the movement of empty containers and the need to collect a dray chassis. When an import container is received at the maritime port of entry, it is often collected by a truck and transported to the good's receiver/importer. Prior to collecting a container, the trucker may also need to collect a dray chassis. This could be at the same port terminal or another location close by. At the good's receiver, the container is unloaded, and the empty container is transported back to the location specified by the container owner or shipping line receiving empty containers. In most cases this is either the port terminal where the container originated from, or an empty container depot located near the port. A similar situation applies to export flows. An exporter who is now looking for an empty container to load with export goods, has to have an empty container delivered to their facility. This typically involves a truck collecting the empty container from the port terminal or empty container terminal and transporting the container to the exporter for it to be loaded and then transported to the port. This movement of empty containers is inefficient and costly. As shown in Figure

8-30 below, each movement of an import or export container may involve up to 4 different truck trips.

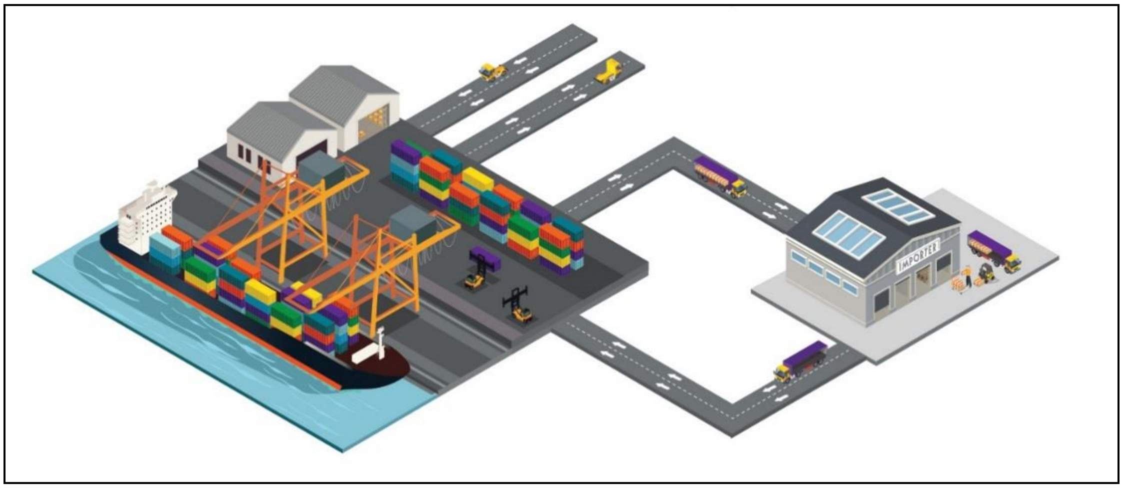


Figure 8-30. Import Container Movements

For some companies where there is a significant flow of import or export containers moving back and forth from the ports, trucks can be more fully utilized. They could collect a loaded import container from the port and deliver to an importer, return another unloaded empty container back to the port and then collect another loaded import container. While this is somewhat efficient, the truck is still transporting empty containers for two out of the four trips (see Figure 8-31).

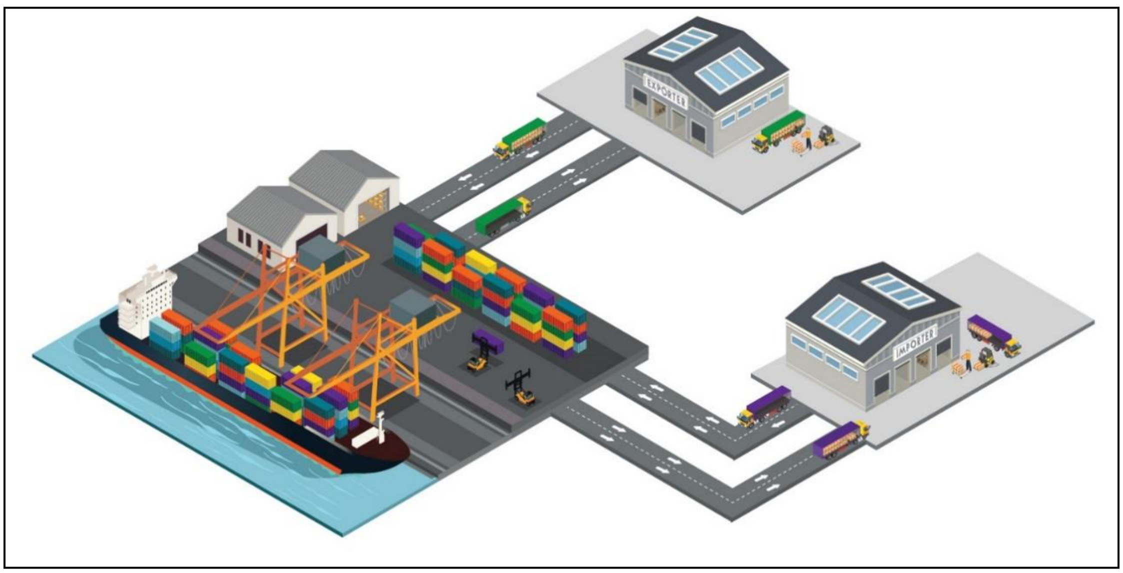


Figure 8-31. Import and Export Container Movements

To improve operations within port terminals, reduce truck movements through port terminal gates and make better use of port terminal land. Some ports including the Port of Houston, have dedicated empty container terminals or depots, which are often located in close proximity to the import/export container terminals, as shown in Figure 8-32.

Source: Google Earth

Figure 8-32. Aerial view of Barbours Cut Container Terminal and Empty Container Yard

Empty container terminals also provide other functions which may include storage, receipt and dispatch of empty containers, repair and servicing of containers and steam cleaning for food grade/USDA shipments. If empty container terminals are located some distance away from the port terminals, this can result in an increase in truck vehicle miles travelled.

Increasing Dual Transactions

Dual transactions, or double moves are when truckers drop off a container (empty or laden with exports) and then collect another one (laden with imports or empty) from the same container terminal. February 2017 data from the Port of Houston (Figure 8-33 and Figure 8-34) illustrate the number of dual transactions undertaken at the each of the container terminals. The difference in dual transactions between the terminals can be attributed to locations for empty container yards at the respective terminals. At Barbours Cut, empty containers are delivered/collected from an adjacent location just to the east of the terminal, whereas at Bayport empty container transactions occur within the terminal itself. Hence, Bayport has a higher number of dual transactions.

Increasing the number of dual transactions would reduce the number of truck trips visiting the terminals, resulting in reduced truck miles travelled and emissions. They also benefit truck drivers as the potential for carrying more revenue generating cargoes increases.

Dual transactions can be influenced by street turns and matchbacks (the exchange of an intermodal container that takes place outside of a marine or intermodal terminal) and also by using load matching systems. Load matching systems enable transportation companies to connect with organizations who have loads that need to be transported. An attraction of these type of systems is that loads can be identified and selected using smartphone technology and payment process/invoicing streamlined. While load matching systems are not new, it is only relatively recently that system developers have specifically targeted the container drayage transportation market. At this moment in time, most of the system providers are focusing on the west coast container markets and do not appear to have made any indications as to whether they would enter the Houston drayage market. H-GAC could consider applying for federal grants along with the Port of Houston to design and implement such a system that is specific to the Houston area and incorporates matchback functionality.

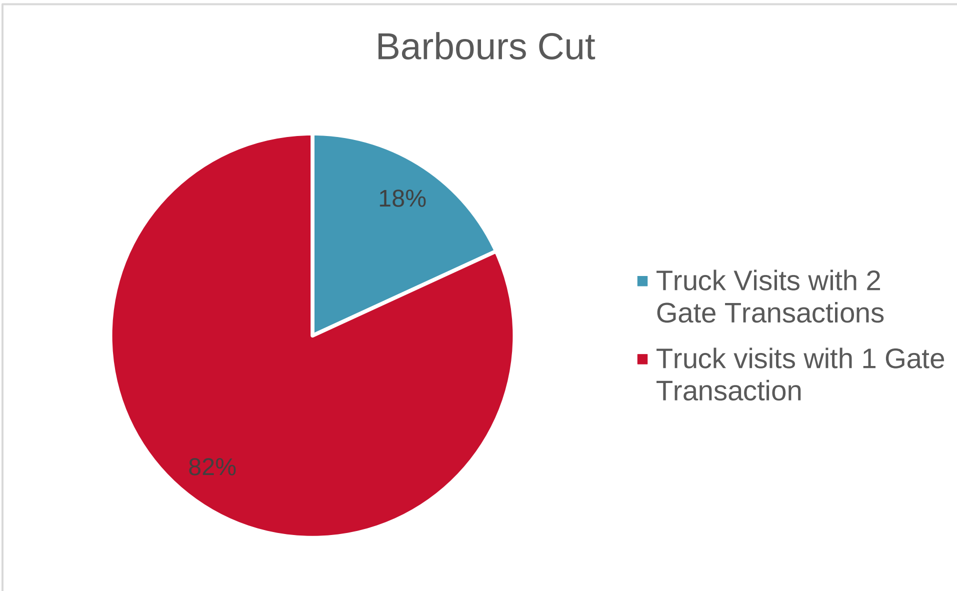


Figure 8-33. Barbours Cut Gate Transactions

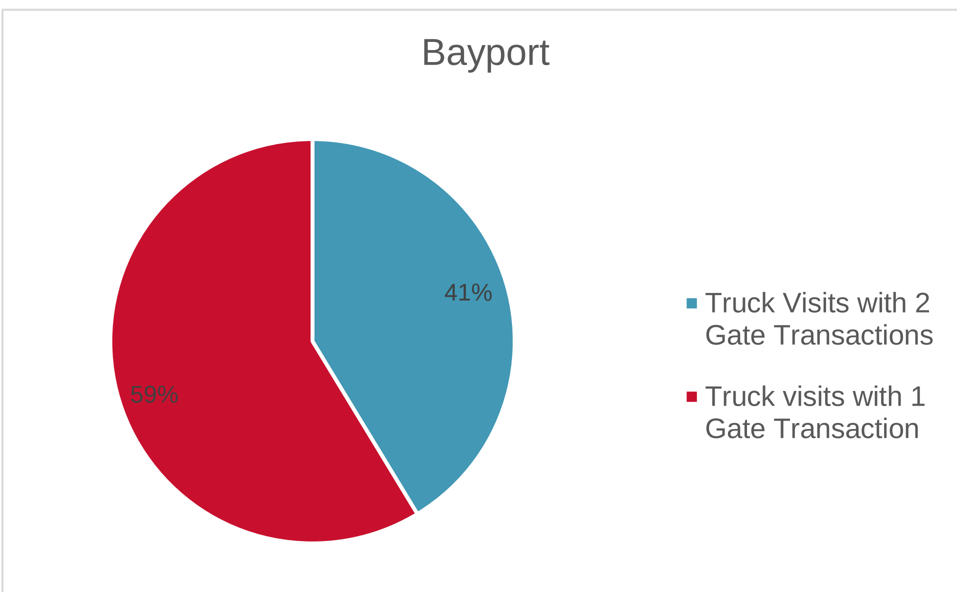


Figure 8-34. Bayport Gate Transactions

Potential considerations to improve the number of dual transactions include:

- Incentivizing truckers, such as priority treatment or processing at the container terminals.
- Ports partnering with or promoting load matching systems to allow truckers to have greater visibility as to where loads are.
- Port of Houston mandating dual transactions, potentially integrated with truck appointment systems that prioritize those truckers with dual transactions.

8.8.2 Potential Improvements for Port Operations and Facilities

Street Turns and Virtual Container Yards

In February 2017, 20,593 gate transactions at the Bayport container terminal were associated with the delivery of empty containers and 18,802 gate transactions were related to dispatching an empty container. This amounted to 44 percent of gate transactions related to the processing of empty containers and a significant number of truck trips to move those empty containers.

A street turn or matchback is effectively a transaction between an importer/transporter who has a container that would otherwise be returned empty back to a terminal, but passes it to an exporter/transporter who would load the container and transport the laden container back to the terminal as shown in Figure 8-35.

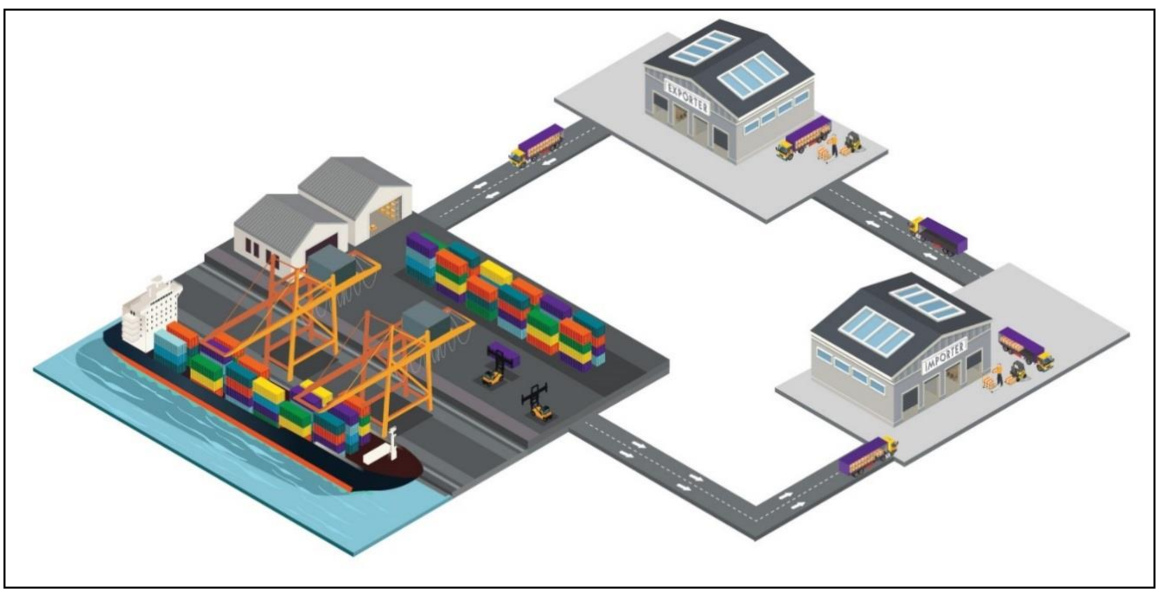


Figure 8-35. Street Turn/Matchback Schematic

More often than not, it is the transporter, trucking company or three-part logistics company who has visibility as to who has the empty import container and who needs an empty container for export. By matching these two “needs” together a street turn can have the following benefits:

- Reduces truck miles travelled, emissions, highway congestion
- Reduces the number of trucks entering port terminals/empty container depots
- Reduces space requirements at empty container depots and port terminals

- Reduces costs and increases revenue generating miles for truckers

According to JOC.com, *industry veterans believe only about 5 percent or fewer of containers are street turned,* but a survey undertaken by JOC.com identified high levels of drayage operators did undertake street turns. Evidence from the PAMS interviews also suggested street turns were undertaken within the Houston region but it was not possible to quantify the volume of street turn activity.

While the operational advantages of a street turn are readily apparent, the administrative process and other related factors can be barriers for increasing the number of street turns. However, it is recognized that a street turn requires a formal process that manages the release of the container from the importing entity to the exporter, ensuring charges related to the container are properly accounted for. Factors that can influence street turns include:

- Containers are different sizes and importers and exporters may have particular needs that can't be matched via street turns
- The street turn typically involves an administrative process for the transporter to request the container owner (typically the shipping line) to allow the container to be street turned.
- The container owner may direct or even ration containers to certain exporters or customers.
- Container owners realize revenue through container demurrage.
- In 2019, some shipping lines started to charge companies $30 to $50 for each street turn transaction, when previously there would have been no transaction charges.
- The time taken for a container owner to respond to the street turn transaction request.

Street turns can be supported by a Virtual Container Yard (VCY). A VCY is a web-based platform that allows users to share information about the location and availability of empty container equipment and automating the administrative process. Platforms include Matchback Systems and the Street Interchange Application hosted by the Intermodal Association of North America (IANA), which facilitates the Uniform Intermodal Interchange and Facilities Access Agreement.

The Baytown industrial areas represent a unique opportunity for street turns, given the concentration and proximity of high-volume container importers including Home Depot, Ikea, Red Bull/Geodis and Walmart and high volume exporters, predominately in the plastic resin packaging sector as shown in Figure 6-7.

Local Solutions

A key factor in increasing the uptake of street turns is the need to work with all interested parties and stakeholders to coordinate and promote the use of street turns while reducing administration and complexity. Two potential options include:

1. Appointing a street turn/matchback coordinator for the region, whose objective would be to work with shipping lines, equipment providers, importers, exporters,

transportation companies and system providers to increase the number of street turns. This position could potentially be funded jointly or hosted by several entities such as the Port of Houston, H-GAC and Texas Trucking Association. Given the regular and systematic nature of container movement within the Houston region by large import users such as Walmart, Ikea, Home Depot and exporters including Katoen Natie and Plantgistix, it is envisaged that this position would only be required for 12-18 months, as once the pattern and process for street turns was incorporated into day to day operations, the coordinator's role will increasingly diminish.

2. Produce a Request for Expression of Interest (RFEI) for a system provider who supplies street turn/matchback solutions and can promote the system across the import and export supply chains and amongst decision makers within the region. One advantage with this approach is that it addresses a key barrier to street turns, namely reducing the administrative burden by users of street turns. Matchback Systems are now integrated into the Port of Los Angeles Port Optimizer System. The Port Optimizer is a cloud-based system that enhances supply chain performance and predictability by sharing data amongst supply chain partners. This collaboration demonstrates that one system can be employed in a port wide and even region wide framework (linking street turns with the Port of Freeport and Port of Houston).

Both solutions would be able to identify and report on Key Performance Indicators to measure the program and quantify benefits arising from the regional street turn program.

A more detailed discussion about the benefits associated with such system is provided in Section 0 including scenarios identifying varied levels of imports and exports and their impact on the benefits.

Sources: HDR, Landsat/Copernicus, 2019 Digital Globe

Figure 8-36. Importers and Exporters in the Baytown area.

Port Centric Logistics

Port centric logistics is a process of unloading shipping containers close to, or within a port's boundaries and then distributing the goods using domestic transportation equipment. Port centric logistics have already been adopted within the region. Produce importers such as Dole and Chiquita in the Port of Freeport and Port of Galveston base their transshipment facilities within the port terminals. Gulf Winds, a transportation services provider, has a transloading facility just outside the gates of the Barbours Cut Terminal as shown in Figure 6-8.

Hutchinson Ports, a global port operator engaged in port centric logistics, has identified the following benefits associated with port centric logistics.

1. Flexible choice when goods arrive at port – gives the option to intercept the container early and delays the decision of where best to deliver the goods;

2. Reduced empty container movements – no need to transport the container inland and the cost of returning it empty back to the port;

3. Lower container handling/demurrage costs – avoids the potential delays and vehicle waiting times by live tipping container at inland warehouses

4. Increase weights per container from origin – if container is devanned “on port”, there are options to increase cargo weights beyond road limits;

5. Control/buffer to distribution centers – offers shippers the flexibility to feed into, or even bypass, the inland warehouses at a time to suit demand;

6. Improved delivery certainty/stock visibility – earliest possible visibility of stock available for call off and offer direct deliveries to end customers;

7. Reduced inland transport costs – improved backload opportunities for inland deliveries/collections using standard transportation equipment;

8. Opens value adding opportunities – potential to perform added value activities as soon as cargo has landed to meet end customer needs;

9. Lower total costs across the supply chain – devanning and palletizing on landing, improved container utilization, removal of inland container haulage and savings in direct deliveries to end customer or regional platform;

10. Improved sustainability for environment – less empty running costs as a result of "moving the goods, rather than the container".

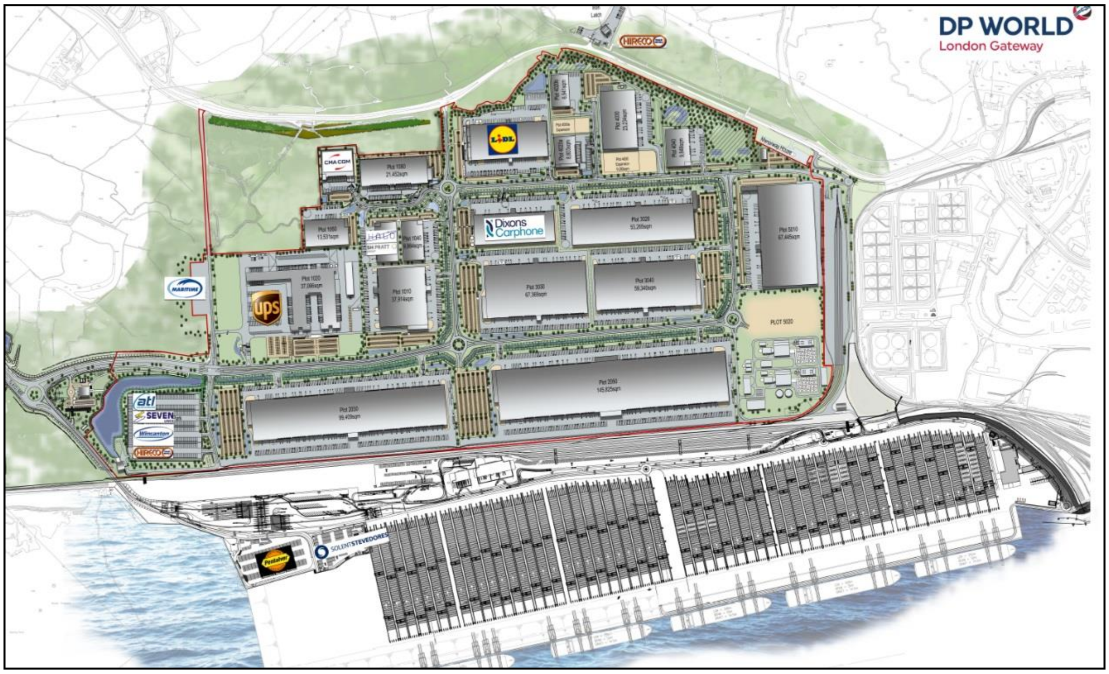
Source: 2019 Digital Globe

Figure 8-37. Gulf Winds Transloading Facility

The Port of Freeport has a development plan for property directly adjacent to the port facilities as shown in Figure 8-38. Targeted potential tenants include resin packagers to utilize container sailings or a container on barge service.

Figure 8-38. Port Freeport Developable Land

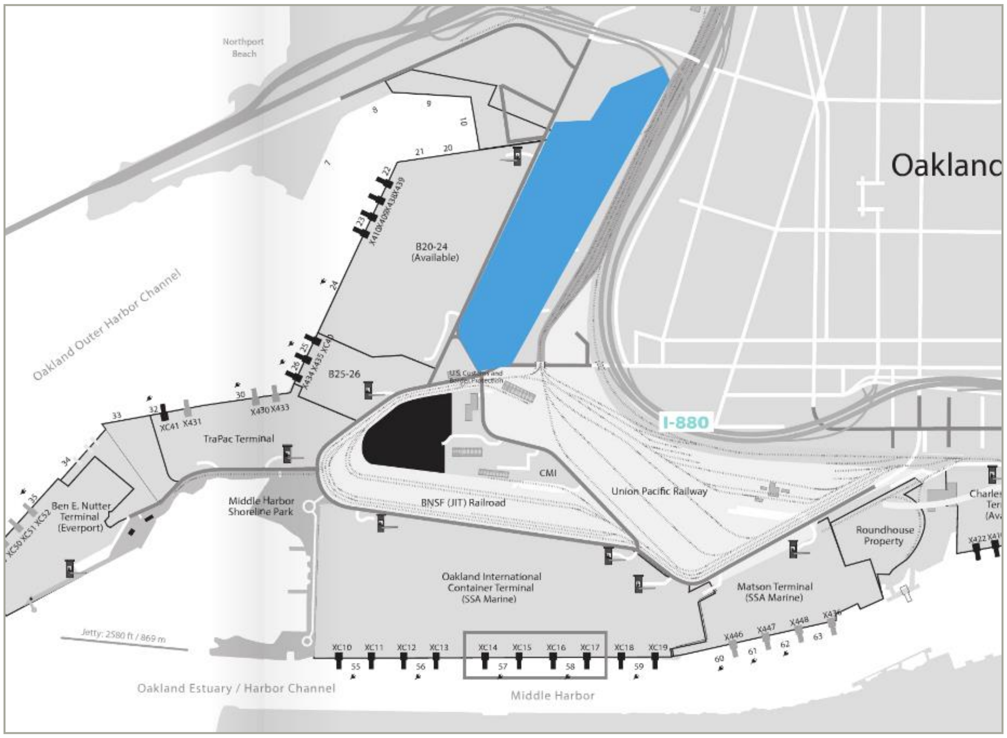
The European model for port centric logistics tends to have the distribution facilities either within port boundaries, or just outside as shown in this master plan schematic (Figure 8-39) for the London Gateway, a UK deep sea port with an adjacent logistics park and rail connections. This port started operations in 2013 and the logistics park is being developed based on market needs.



Source: DP World

Figure 8-39. London Gateway

The Port of Oakland recently issued a building permit for a Seaport Logistics Complex, a new 123-acre facility in place of the decommissioned Oakland Army Base. Its location and proximity to the port is illustrated in Figure 8-40.



Source: CenterPoint Landing

Figure 8-40. Port of Oakland location of Seaport Logistics Complex

The extent to which port centric logistic facilities can grow within the region will depend upon the availability of developable land in or near the port. There are many competing uses including keeping undeveloped land for port terminal expansion and accommodating secondary and ancillary port services. Furthermore, developable land in other industrial locations further from port terminals, including TGS Cedar Port and Ameriport in Baytown also compete and can be more attractive for potential users, than being in the immediate vicinity of a container port terminal.

Expansion of the Panama Canal and larger ships have resulted in corresponding port throughput investments. As a result, there has been a greater strain on container storage yards and streets near terminal gates.

To accommodate greater container volumes, ports began leveraging new technologies in the 1990s within and around marine terminals. Ports also began to extend gate hours and consider other practices to address the volume of trucks. The public benefit has been the reduction in truck congestion on right-of-ways near marine terminals.

Truck Reservation Systems

The objective of a truck reservation system (TRS) serving port and intermodal rail terminals is to align the capacity of the terminal operation with arriving trucks and better manage the flow of trucks through a port terminal. Truck turn times (the time taken to collect a container) have been reduced in port terminals where TRS have been deployed.

Ports with TRS systems require truckers to pre-book arrival times, with the reservation window typically being one hour, though some ports allow a grace of period of 30 minutes either side of the pre-booked time window.

Since their introduction in the mid-1990s, TRS have reduced wait times, emissions, and congestion near marine terminals. Today, these systems - including Nascent, the Ports American TOS Web Portal, and eModal – are in place in many terminals throughout the United States and have helped to improve terminal productivity. Table 8-6provides a summary of the systems for ports on the East, West, and Gulf Coasts.

There are also comprehensive gate and terminal operating systems such as Orbita and Certus that include cameras and Optical Character Recognition (OCR) and which are anticipated to provide complete terminal automation in the future. However, the challenge for increased automation associated with container terminals, has been labor concerns in the United States.

The establishment of TRS' has meant additional administration and costs to trucking companies providing long-haul and drayage through added expenditures and surcharges. Companies have had to hire additional clerical personnel to manage container terminal reservations, and trucking companies have also incurred late fees due to unexpected traffic impacts.

A truck driver, paid for each container move, and the dray company may lose money due to moving fewer containers per day. Prior to implementation, trucking companies had unfettered access to the terminals. Now they have scheduled access which can limit the number of turnaround times. This has been seen on the West Coast in LA/LB and on the East Coast in Hampton Roads at Norfolk International Terminal and Virginia International Gateway. Desirable appointment times can also be booked up quickly.

CSX Transportation (CSXT) recently began requiring truck drivers to book appointments to return empty or drop off loaded containers in high volume corridors like Chicago and Memphis, although not requiring reservations to pick up containers. The new policy is the result of containers left in valuable slots that could be otherwise used for boxes with quicker turnaround times. The impact to Beneficial Cargo Owners (BCOs) has been increased storage fees in other locations for containers waiting to be moved to a CSX terminal.

Table 8-6 Marine Terminal Gate Systems – East, West and Gulf Coasts

Region	Port	Container Terminal	Operator	System
South Atlantic	Miami	POMTOC	Port of Miami Terminal Operating Co.	PierPass
South Atlantic	Charleston	Wando Welch	SC Port Authority*	NASCENT's Advanced Gate System
North Atlantic	New York/ New Jersey	Port Newark	Ports America	Truck Reservation System**
Mid-Atlantic	Virginia Port Authority***	VA International Gateway	Virginia International Terminals	PRO-PASS
Pacific NW	NW Seaport Alliance	East Sitcum	Ports America	eModal
Central Pacific	Oakland	Oakland International	SSA Terminals	eModal
South Pacific	Los Angeles	Berths 401-406	APM Terminals	Port Optimizer
South Pacific	Long Beach	Pier T****	Total Terminals Int'l	OCR & automated gate
South Pacific	Long Beach	Pier E	Long Beach Container Terminal, Inc.	eModal
Gulf Coast	New Orleans	Napoleon Avenue	Ports America	OTS Web Portal

* The SC Port Authority is an owner-operator port authority.

** The TRS uses RFID tags on pre-registered trucks with high-speed OCR at the gate and was jointly fund and developed by a consortium of six marine terminal operators in the Port of NY/NJ.

*** Virginia will match the $1.55 million in provided by the Federal Highway Administration's receiving an Advanced Transportation and Congestion Management Technologies Deployment grant.

**** Pier T in the Port of Long Beach currently has the largest container gantry cranes at any U.S. port, allowing for largest ships and more surge or maximum practical capacity.

Even though containers are unloaded quickly from a vessel to minimize berth time (and maximize sail time), the removal of the containers from the terminal is scheduled to avoid gate surge/ congestion and arrival spans are stretched out. So, containers that might have left the terminal in the morning now wait until the evening, and containers that arrived the evening wait until the next morning.

Another problem the trucking industry has seen from operation of TRS' is the difficulty in matching import to export containers (laden or empty). Prior to complete or peak period reservation requirements, drivers showed up with a container and could leave with a container. In 2017, the Ports of LA/LB began addressing dual-load trips for its second iteration of PierPass. The result was a further reduction in roadway and gate congestion and improved terminal efficiency resulting from better staging and fewer container re-handles.

A key factor in a port's decision to implement TRS at a container facility is the capacity of the terminal and its constituent parts to handle the volume of containers without increasing truck turn times. While reducing truck queues and emissions are important, they are typically secondary considerations to the key focus of terminal efficiency for the terminal operator.

Currently, the region's two major container terminals do not have TRS'. However, as container volumes continue to grow, implementation of a TRS is a tool to help manage growth while mitigating some of the effects that increased container road transportation will have on the region's highway networks, congestion, other road users and local communities.

Extended Gate Times

Prior to 2008, port hours of operation were largely consistent (e.g., between 8 AM and 6 PM) to minimize operational costs. With the growth in vessel size, expansion of global trade, just-in-time shipping, and e-commerce (fulfillment centers), it became evident that there was a need to extend port terminal gate times. The line of trucks outside marine terminals conveyed a need to spread out gate and operating hours over a greater span of time. The benefit has been reduction in municipal congestion and emissions from Class 8 long-haul trucks and/or bobtails providing drayage to a nearby warehouse or fulfillment center. Table 8-7 and Figure 8-41 provide an overview of gate access hours for the marine terminals cited in Table 6-1.

Table 8-7 Marine Terminal Gate Hours – East, West and Gulf Coasts

Region	Port	Container Terminal	Current Gate Starting Time	Prior Gate Starting Time	Current Gate Closing Time	Prior Gate Closing Time
South Atlantic	Miami	POMTOC	7:00 AM	N/A	6:00 PM	N/A
South Atlantic	Charleston	Wando Welch[179]	5:00 AM	6:00 AM	5:30 PM	6:00 PM
North Atlantic	New York/ New Jersey	Port Newark*	6:00 AM	N/A	6:00 PM	N/A
Mid-Atlantic	Virginia Port Authority	Virginia Int'l Gateway	5:00 AM	N/A	6:00 PM	N/A
Pacific NW	NW Seaport Alliance	East Sitcum[180]	7:00 AM	N/A	4:30 PM	N/A
Central Pacific	Oakland	Oakland International	7:00 AM	N/A	3:00 AM	6:00 PM (M-Th)
South Pacific	Los Angeles	Berths 401-406	7:00 AM	N/A	2:30 AM	N/A
South Pacific	Long Beach	Total Terminals Int'l	8:00 AM**	N/A	5:00 PM	N/A
South Pacific	Long Beach	Pier E	7:00 AM***	N/A	4:15 PM	N/A
Gulf Coast	New Orleans	Napoleon Avenue	7:00 AM	N/A	5:00 PM	N/A
Gulf Coast	Houston	Bayport	7:00 AM	N/A	7:00 PM	11:00 PM
Gulf Coast	Houston	Barbours Cut	7:00 AM	N/A	7:00 PM	N/A

* Gate hours have been extended during periods of increase cargo demand.
** TTI lists two additional shifts including 6:00 PM to 3:00 AM and weekends 8:00 AM to 5:00 PM.
*** Pier E has two additional shifts listed including 5:00 PM to 2:15 AM and Saturday from 7:00 AM to 4:15 PM.

[179] Hours extended 30 minutes due to container volumes. Source: "Charleston's Wando terminal opening earlier for extra volumes," Journal of Commerce, June 4, 2019. Available at https://www.joc.com/port-news/us-ports/south-carolina-ports-authority/charlestons-wando-terminal-opening-earlier-extra-volumes_20190604.html.

[180] Hours changed effective July 1, 2019. Source: The Northwest Seaport Alliance. Available at https://www.nwseaportalliance.com/operations/trucks/6272019/east-sitcum-terminaltct-new-gate-hours.

Figure 8-41 graphically conveys the operating hours from Table 8-7 to better show the differences between gate hours.

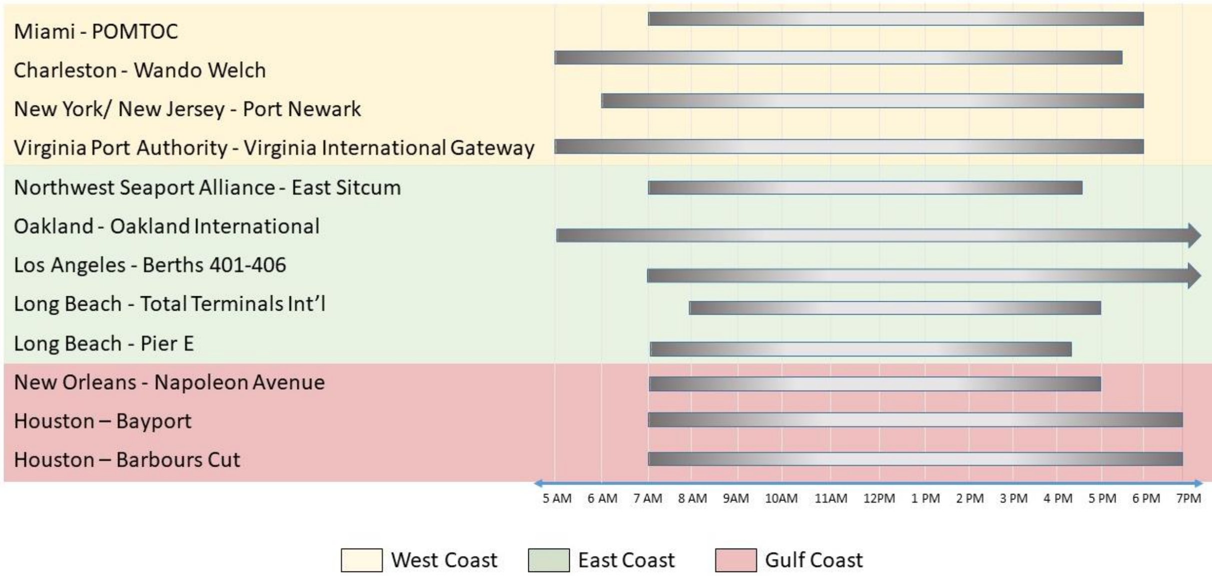


Figure 8-41. Marine Terminal Gate Hours – East, West, and Gulf Coast Ports

The gate hours for the Oakland International and APM Container Terminals extend beyond 7 PM, as noted in Table 8-7.

As Figure 8-42 and Figure 8-43 illustrate, there are periods of the day where there is little container related transportation activity, and extended gate times at both Port of Houston container terminals would assist in spreading these truck journeys throughout the day. A study undertaken by the Texas A&M Transportation Institute used GPS data from trucks participating in the H-GAC's Drayage Loan Program (DLP) to provide insight into vehicle activities and emissions.[181] The study found that most of the DLP activities (approx. 91%) occur between 6 AM and 7 PM, with over 95 percent of operations occurring on weekdays.

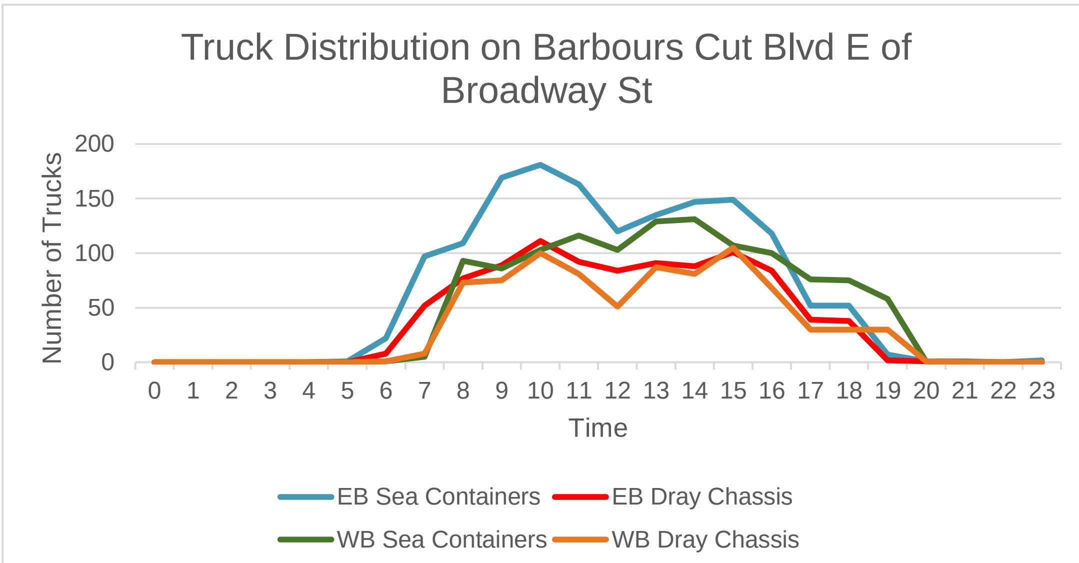


Figure 8-42. Twenty-Four Hour Profile of Barbours Cut Blvd Truck Trips

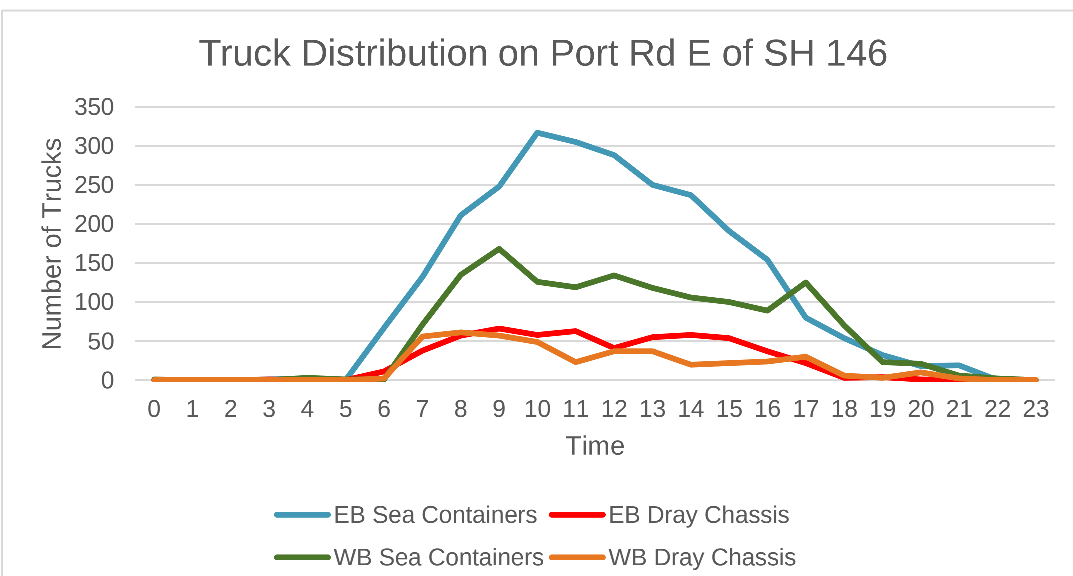


Figure 8-43. Twenty-Four Hour Profile of Port Road East Truck Trips

[181] Collection and Analysis of vehicle Activity Data to Improve Transportation and Air Quality Planning

A key challenge with extended gates is to ensure port terminals can cover their costs associated with extra labor and extended working hours. In 2005, the 12 terminal operators within the Ports of Los Angeles and Port of Long Beach implemented the Off-Peak program to help alleviate truck congestion and improve air quality. Before the Off-Peak program, 88% of containers were picked-up, or delivered between 8:00 a.m. and 5:00 p.m.[182]. The solution was based on an off-peak congestion pricing model and a Traffic Mitigation Fee (TMF) was applicable for all gate transactions between the hours of 3 a.m. and 5:59 p.m. The fee was $72.09 for twenty-foot containers and $144.18 for all other sized containers. This fee did not apply for containers collected after 6 p.m. and also didn't apply to empty containers. The Off-Peak program was immediately successful shifting 30 to 35 percent of all marine terminal gate activity to nights and weekends within the first six months of operations.[183] In 2017, $197M was collected from the TMF, though the Off-Peak program cost the terminal operators $274M.

In 2019, the Off-Peak program changed to a truck appointment system and all non-exempt containers, including those delivered between 6 p.m. and 3 a.m. are charged the TMF. However, the TMF was reduced from $72.09 to $31.52 per TEU. This is revenue neutral for the terminal operators.

In October 2017, the Port of Houston extended gate times at the Bayport container terminal from 7 p.m. to 11 p.m. with plans to also extend the gate hours at the Barbours Cut terminal. A year later, the Bayport container terminal ceased the extended gates time and reverted back to a 7 p.m. closing time and the Barbours Cut extended gates were not implemented. The Port cited a lack of customer support to make the extended gates viable. However, it has not ruled out extending gate times again. It is clearly evident that for extended gate times to work in the region's ports, it requires customer commitment as well as education and partnership with key container transporters, to realize the operational and commercial benefits of moving containers outside of the peak highway travel times.

[182] PierPass Advisory Committee and Extended Gates Subcommittee Meeting– January 29, 2019

[183] Morethanshipping.com

8.9 Benefit Cost Analyses

Several of the proposed solutions have been assessed further in order to better understand and quantify their benefits. Benefit-cost analyses were conducted on the I-69 Bypass and Independence Parkway Bridge alternatives; the Container-on-Barge, Freight Shuttle and the Virtual Container Yard alternatives. The Container-on-Barge is a multi-modal alternative in which a share of containers are transported by barges instead of trucks. The freight shuttle alternative, an advanced transportation system, would replace a share of trucks carrying containers. The Virtual Container Yard alternative is an operational strategy through which containers are more efficiently transported between the import and export warehouses to allow ease of transportation for the trucks and reduce the number of miles travelled.

The benefit-cost analyses for the first two alternatives aim to show the net benefits (total benefits net of total costs) from applying either of these alternatives. The benefits analyses of the remaining three alternatives estimate the likely potential gross benefits of each alternative, individually, if implemented. It is important to note that all alternative scenarios are discounted at seven percent in this analysis.[184]

8.9.1 Container Movement Model Scenarios

To assess the benefits associated with each of the container movement solutions, a theoretical market assessment was undertaken.

Each container movement alternative is assessed against the same No Build scenario, in which no transportation improvements are made. In the No Build scenario, all import and export containers are transported by truck between the port and the import and export warehouses. All trucks travel either a) from an export warehouse to the port with a full container and haul an empty container on the trip back, or b) to the port with an empty container or chassis and pick up a full container on the way back to drop off at the import warehouse.

The alternatives proposed as part of this study are intended to optimize the truck movements between the ports, import and export warehouses. Each alternative results in a reduction in the number of truck trips and miles driven and produces the following benefits:

- Travel time savings for the truck drivers;
- Crash cost savings; and
- Emissions cost savings.

Travel Time Savings for the Truck drivers

Travel time savings were calculated using estimates of the reduction in the hours traveled by truck as a result of the more efficient routing. This reduction in hours is multiplied by the monetary value of one hour of a truck driver's time.

[184] Discounting reduces the dollar value of costs and benefits each future year at a set rate and reflects the fact that costs and benefits in the present are valued more than those in the future. A discount rate of 7 percent is standard for many transportation BCAs and reflects USDOT recommendations.

Crash Cost Savings

With fewer miles driven each day, truck drivers also avoid crashes that would otherwise result in fatalities and serious injuries over the course of the 20-year analysis period. The fatalities and serious injuries avoided were monetized using standard values for a statistical life and the cost of a serious injury, respectively. All crash savings are generated as a result of the decrease in miles traveled by trucks.

Emission Cost Savings

Reductions in miles traveled lead to reductions in vehicle emissions. For the analysis, the reduction in Carbon Dioxide (CO_2), Nitrogen Oxide (NO_X), Fine Particulate Matter ($PM_{2.5}$), Sulfur Oxide (SO_X), and Volatile Organic Compounds (VOC) emissions were monetized. To estimate these benefits, EPA's MOVES software program (Motor Vehicle Emission Simulator) was run to estimate the emission rate for trucks in Harris County, Texas. The MOVES software produced emissions rate data for 2016 and 2025 for 16 speed bins between zero mph and 75 mph. The project team then interpolated the 2016 and 2025 MOVES output data to obtain emissions rates for all speeds between five mph and 75 mph, in one mile per hour increments, and then also interpolated between the years 2016 and 2025 to estimate an emission rate for every year between 2016 and 2019. After 2019, the project team assumes the emission rates remain constant.

When estimating benefits, the emission rate per mile and the miles traveled are multiplied in the No Build and Build Scenario and the difference in emissions for each pollutant type is calculated between both scenarios. The cost for each pollutant, as identified in *The Safer Affordable Fuel-Efficient Vehicles Rules for MY2021-MY2026 Passenger Cars and Light Trucks Preliminary Regulatory Impact Analysis* from October 2018, was then multiplied by the difference in emissions to determine the emissions cost savings.

A sensitivity analysis was also conducted for each of the scenarios in order to assess the impact of using alternative emission rate assumptions. Details associated with the assumptions made in this sensitivity analyses are included in Appendix A.

Virtual Container Yard

The Virtual Container Yard alternative is an information system-based (*such as a web portal*) operational strategy used to more efficiently allocate containers to trucks traveling between import and export warehouses. It reduces the number of empty container hauls on return truck trips, decreasing the overall number of miles travelled by the trucks.

In the Build Scenario for the Virtual Container Yard, it is assumed that all trucks will travel from the port to import warehouses with full containers. Of these containers, 90 percent (79,463 FEU containers in 2019) will be suitable to be transported by truck to an export warehouse. The remaining 10 percent of containers will be trucked back to the port from the import warehouse empty. This 10 percent reflects that not all import containers may be suitable for exporters, some may be damaged and need to be returned for repair, or are required by export customers who are located outside the Baytown area. The containers that were transported from the import warehouses to the export warehouses will then be loaded with exports and travel back to the port. To make up for the imbalance between exports and imports, additional containers will be transported by truck to the export warehouse from the port to pick up the remaining exports. These exports will then be trucked back to the port.

The consultant team estimated the number of 2019 container volumes and used those figures to derive the number of containers for imports and exports for 2020 to 2029. Import containers are estimated to grow at an annual rate of 3.2 percent between 2019 and 2029. Due to a lack of available information about future capacity expansion in the Baytown area after 2029, the number of import containers are assumed to stay constant after that year. Figure 8-44 provides the number of import FEUs between 2019 and 2039. A description of the growth of export containers at the port is provided later in this report.

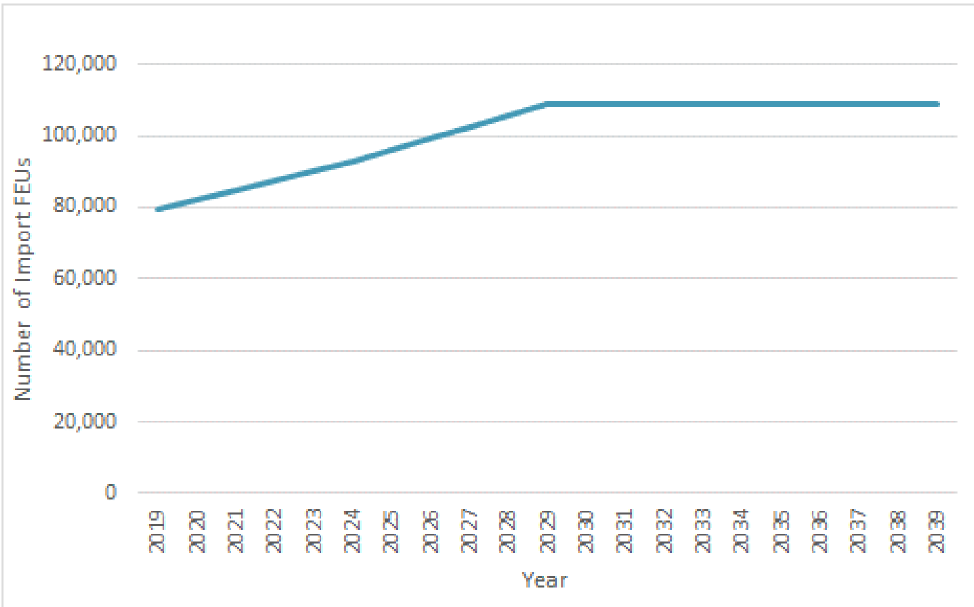


Figure 8-44. Virtual Container Yard Import Container Estimates

Due to capacity limitations within the port, the total number of export FEUs in 2019 (104,167) is estimated to be 30 percent of the total number of export FEUs in 2029 (347,223). From these two values of FEUs, the project team used a linear interpolation technique to estimate the total number of export FEUs at the port annually between 2020 and 2028. This results in an estimated annual increase in exports of 12.8 percent between 2019 and 2029. As for the import containers, the linear interpolation results in an estimated 3.2 percent annual growth of import FEUs between 2019 and 2029. There is little information about the port's capacity expansion plans, so the number of export and import containers is assumed to remain flat following 2029. The number of export FEUs between 2019 and 2039 is shown in Figure 8-45.

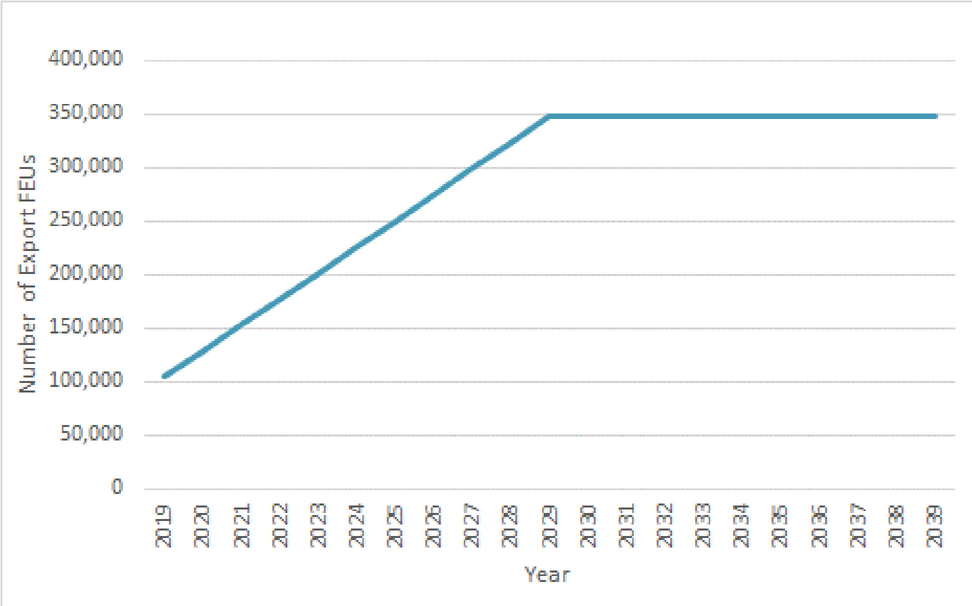


Figure 8-45. Virtual Container Yard Export Container Estimates

The Virtual Container Yard will reduce the number of trips associated with the transportation of containers between the port and the import and export warehouses. Over the course of the 20-year analysis period, truck drivers will save $17.2 million worth of travel time (discounted at 7 percent). By driving fewer miles each day, truck drivers also avoid crashes that would otherwise result in 0.70 fatalities and 3.31 serious injuries over the course of the 20-year analysis period. The savings associated with the reductions in these crashes totals $5.2 million (discounted at 7 percent). Reductions in emissions associated with using the virtual container yard is expected to save $2.8 million (discounted at 7 percent) in emissions costs over the 20-year analysis period. Cumulative benefits through to the end of 2039, discounted at 7 percent amount to $25.1 million as shown in Table 8-8 and Figure 8-46.

Table 8-8. Virtual Container Yard Benefits Analysis Results (Millions, 2017 Dollars)

Benefit Category	Undiscounted Benefits	Discounted Benefits (7%)
Travel Time Savings	$34.3	$17.2
Crash Cost Savings	$10.1	$5.2
Emissions Cost Savings	$5.5	$2.8
Total	$49.8	$25.1

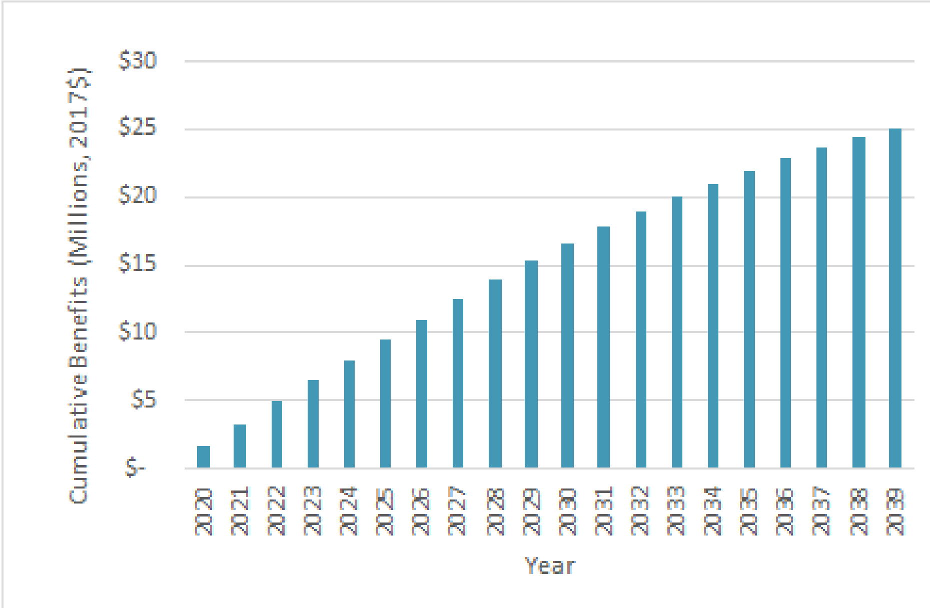


Figure 8-46. Virtual Container Yard Cumulative Benefits, Discounted at 7 Percent

Freight Shuttle Concept

The Freight Shuttle aims to replace a share of trucks traveling from warehouses to the port. In order to estimate the benefits arising from this scenario, a market potential for the Freight Shuttle was estimated.

The overall number of containers that have the potential to be transported by Freight Shuttle is presented in Table 8-9, based on estimates for 2019. Import containers are estimated to grow at an annual rate of 3.2 percent between 2019 and 2029.

Table 8-9. Market Potential for Freight Shuttle

Direction	Number of FEUs (2019)
Import	79,463
Export	158,334

Due to a lack of available information about capacity expansion in the Baytown area after 2029, the number of import containers are assumed to stay constant after 2029. Figure 8-47 presents the number of import FEUs at the port between 2019 and 2039.

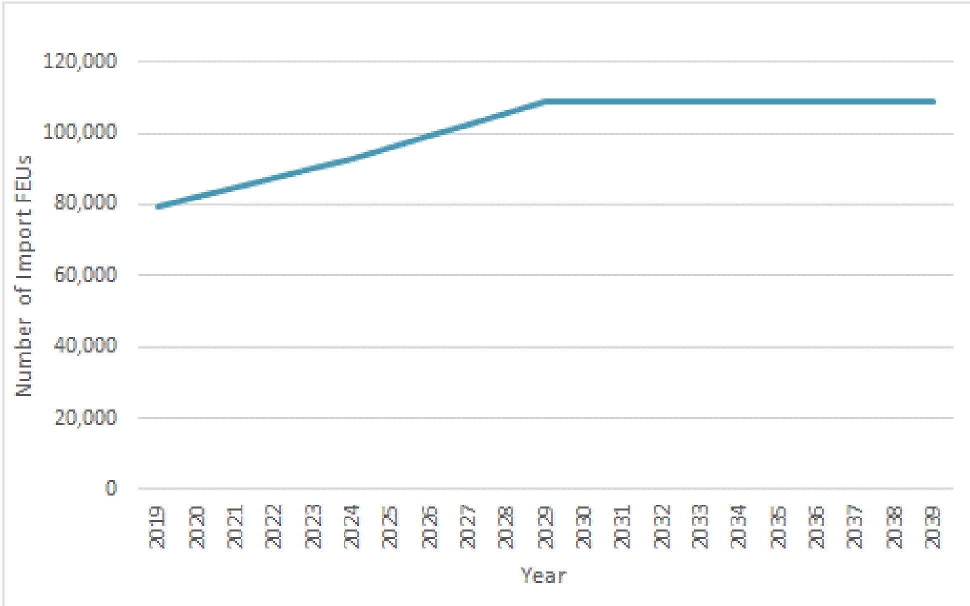


Figure 8-47. Freight Shuttle Import Container Estimates

Using assumption such as the capacity of warehouses and packaging facilities and given the high growth rates in plastic resin manufacturing, the number of export FEUs estimated in 2019 is assumed to be 30 percent of the number of FEUs in 2029. The number of FEUs between 2020 and 2028 are linearly interpolated from the 2019 and 2029 estimates. This interpolation leads to a12.8 percent annual increase in export FEUs. As with the import containers, there is a lack of available information about capacity expansion plans for the exports after 2029, so the number of export containers is assumed to remain flat following 2029. The number of export FEUs between 2019 and 2039 is shown in Figure 8-48.

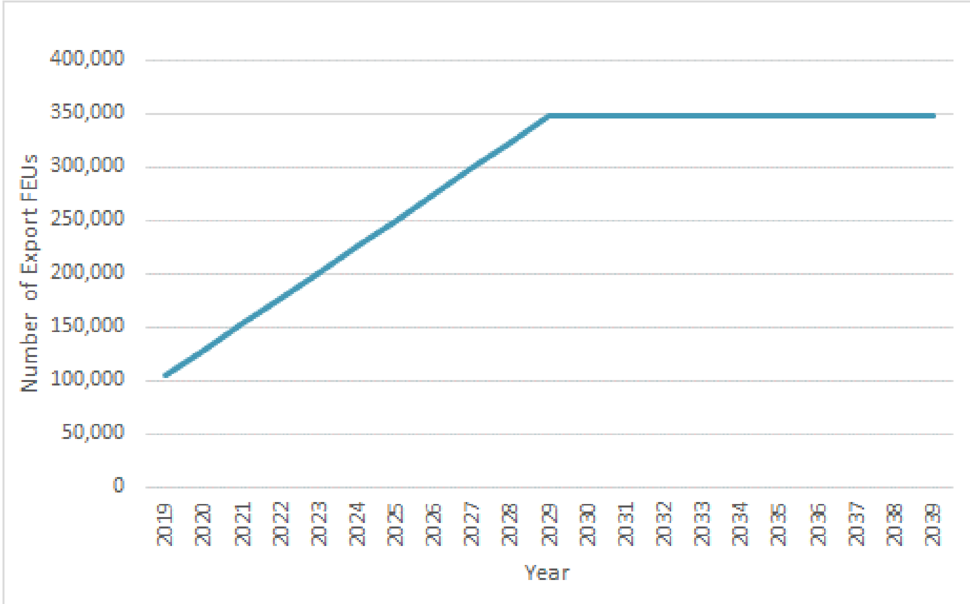


Figure 8-48. Freight Shuttle Export Container Estimates

Since the FSS is assumed to be fully electric, this mode of transportation will not produce any emissions. Additionally, the FSS will be built along the median of the existing roadway and will not interact with existing traffic. Because the Freight Shuttle avoids existing traffic, it is considered to be a safe mode of transportation that would generate zero crashes. Another unique aspect of the Freight Shuttle is that it is completely autonomous, so it does not require a driver.

For the Freight Shuttle concept, benefits were estimates for two different options. The first option assumes the Freight Shuttle transporting containers from the port terminals to a multi-user shared intermodal facility located outside the urban core, in the Baytown area. For the sake of analysis, this intermodal facility is assumed to be located about 7.5 miles from port terminals, 3.5 miles away from the concentration of import warehouses and 6.3 miles away from the concentration of export warehouses. The second option assumes Freight Shuttle transporting containers between end users (importers/exporters) and the port terminals.

In the first option described above, the average round trip distance on the Freight Shuttle is expected to total 15 miles (between the port terminals and intermodal facility), and at an average speed of 65 miles per hour (mph). The remaining distance between the intermodal facility and import or export warehouse will be traveled by truck over a distance of 7 miles round trip or 12.6 miles round trip, respectively. In the second option, the entire trip is covered by Freight Shuttle.

In the No Build scenario, the round trip distance traveled by trucks from the port to the import and export warehouses is 30 miles and 36.3 miles, respectively.[185]

[185] The routes taken by truck in the No Build and the Build scenarios are different. This is due to the existence of the FSS in the Build scenario at a point which is not directly on the truck route in the No Build scenario. For this reason, the total miles traveled by container and miles traveled by truck in the No Build and Build scenarios are not equivalent.

Option 1. Freight Shuttle Transfer Facility

Under the high demand scenario, 90 percent of import and export containers will be transported by Freight Shuttle to a multi-user shared intermodal facility. Trucks then transport the containers to/from the shared intermodal facility to importer and exporter facilities. The remaining 10 percent of import/export containers are moved by truck between the port and warehouses/packaging facilities. Under the low demand scenario, 20 percent of import and 50 percent of export containers are transported by Freight Shuttle. Exports in this scenario are higher than imports due to the operational benefits of moving heavy weight, predominately plastic resins carrying containers to the port. These are summarized in Table 8-10. The high and low demand scenarios are discussed in greater detail below.

Table 8-10. Freight Shuttle Potential Market Share (Transfer Facility Operation)

	Container Market	Annual Containers (FEU, 2019)	Estimated Freight Shuttle (Transfer Operation) Market Share (%)	Annual FEU Carried by Freight Shuttle
High Demand Scenario	Import	79,463	90	71,517
	Export	158,334	90	142,501
Low Demand Scenario	Import	79,463	20	15,893
	Export	158,334	50	79,167

HIGH DEMAND SCENARIO

By replacing a large portion of trips previously made by trucks between the warehouses and the port, Freight Shuttle will lead to considerable travel time savings for trucks. The travel time saved by truck drivers is monetized by multiplying the reduction in the number of hours travelled by truck drivers by their value of time. (Additionally, since the Freight Shuttle does not require a driver, no additional travel time for a Freight Shuttle driver is added in the Build scenario.) Over the 20-year analysis period, the Freight Shuttle intermodal yard operation is expected to result in over 5.6 million hours of travel time saved which translates into $77.4 million of truck transportation time savings (discounted at 7 percent).

It is assumed that the freight shuttle causes zero crashes. Hence, in the Build scenario the total crashes will be reduced due to the lower overall distance traveled by trucks. Over the 20-year analysis period, this FSS option is expected to avoid 3.2 fatalities and 15.3 serious injuries, which translates into $22.7 million of crash costs savings.

For the emissions cost savings analysis, the reductions in CO2, NOX, PM2.5, SOX, and VOC emissions were estimated and monetized. Emissions were monetized in the same manner as described above for the Virtual Container Yard. The Freight Shuttle is assumed to have zero emissions. Hence, in the Build Scenario there will be considerable emissions costs saved, due to the reduction in the number of miles traveled by trucks. Over the 20-year analysis period, the Freight Shuttle intermodal yard operation is expected to result in $12.3 million of emissions cost savings. Associated monetized benefits are shown in Table 8-11 and Figure 8-49.

Table 8-11. Freight Shuttle (Intermodal Facility Operation) High Demand Benefits Analysis Results (Millions, 2017 Dollars)

Benefit Category	Undiscounted Benefits	Discounted Benefits (7%)
Travel Time Savings	$162.2	$77.4
Crash Cost Savings	$46.6	$22.7
Emissions Cost Savings	$25.5	$12.3
Total	$234.3	$112.3

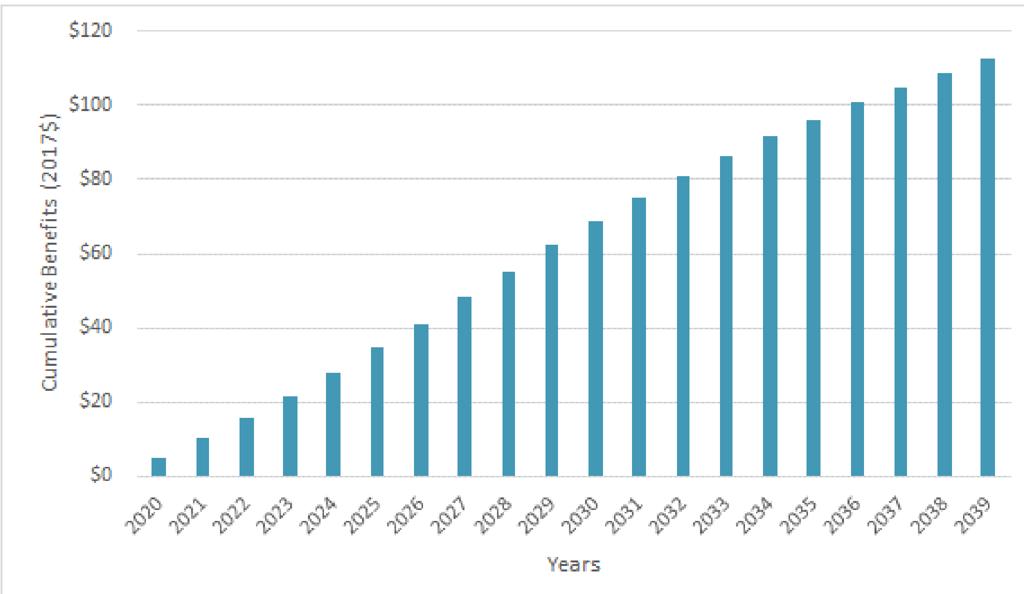


Figure 8-49. Freight Shuttle (Intermodal Facility Operation) High Demand Cumulative Benefits, Discounted at 7 Percent

LOW DEMAND SCENARIO

Under the low demand scenario, fewer volumes will be transported by Freight Shuttle and thus benefits are significantly reduced. Estimated benefits under the low demand scenario are shown in

Table 8-12 and Figure 8-50.

Table 8-12. Freight Shuttle (Transfer Facility Operation) Low Demand Benefits Analysis Results (Millions, 2017 Dollars)

Benefit Category	Undiscounted Benefits	Discounted Benefits (7%)
Travel Time Savings	$80.4	$38.1
Crash Cost Savings	$23.1	$11.2
Emissions Cost Savings	$12.6	$6.0
Total	$116.1	$55.3

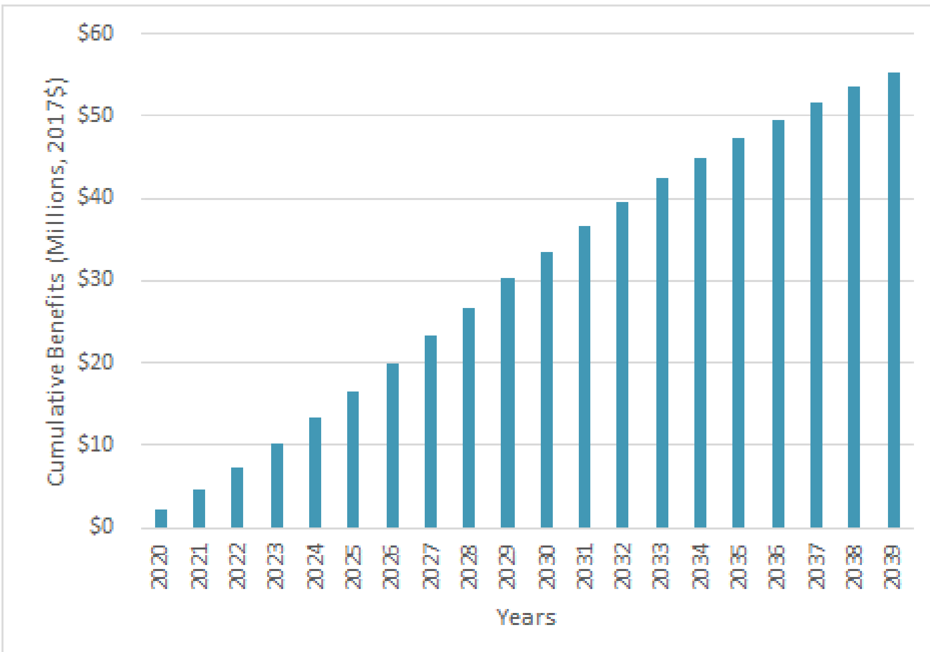


Figure 8-50. Freight Shuttle (Transfer Facility Operation) Low Demand Cumulative Benefits, Discounted at 7 Percent

Option 2. Freight Shuttle Direct to User

In the second option, Freight Shuttle will eliminate the need for trucks to transport containers between the port and the import and export warehouses providing a direct connection between the two facilities. Hence, a high demand scenario is considered assuming 100% of import/export containers moving through FSS. However, in case of a lower market adoption, a low demand scenario was also assumed with 60% of import/export containers moving through FSS.

HIGH DEMAND SCENARIO

By eliminating all truck transportation and assuming that 100% of import/export containers are moved between the warehouses and the port, the FSS Direct to User will generate considerable truck transportation time savings. The entire 9.3 million hours that truck drivers travel in the No Build scenario will be saved in the High Demand Freight Shuttle Direct to User scenario. Over the 20-year analysis period, the High Demand Freight Shuttle Direct to User operation is expected to result in $126.4 million of travel time savings (discounted at 7 percent). Note that this estimate does not consider the likelihood that the truck drivers will spend their time on other duties.

This operation will also result in a reduction in the number of crashes. As previously stated, the analysis assumes that the Freight Shuttle is a mode of transportation that does not generate any highway crashes. As a result, the difference in the projected crashes between the No Build and Build scenarios is of trucks transporting containers between the warehouses and the port. Over the course of the 20-year analysis period, the Freight Shuttle Direct to User is anticipated to eliminate 5.38 fatalities and 25.35 serious injuries, resulting in $37.5 million of crash cost savings.

As outlined previously, the analysis assumes that the Freight Shuttle generates no emissions. Therefore, replacing truck transportation at the port with Freight Shuttle transportation will result in significant emissions cost savings. Using the same methodology as described for the Virtual Container Yard project, emission savings were monetized for the following pollutants: CO2, NOX, PM2.5, SOX, and VOC. Over the 20-year analysis period, the elimination of truck miles traveled at the port is expected to achieve $20.3 million in emission cost savings (discounted at 7 percent). Associated monetized benefits are shown in Table 8-13 and Figure 8-51.

Table 8-13. Freight Shuttle (Direct to User) High Demand Benefits Analysis Results (Millions, 2017 Dollars)

Benefit Category	Undiscounted Benefits	Discounted Benefits (7%)
Travel Time Savings	$265.3	$126.4
Crash Cost Savings	$77.2	$37.5
Emissions Cost Savings	$42.2	$20.3
Total	$384.6	$184.2

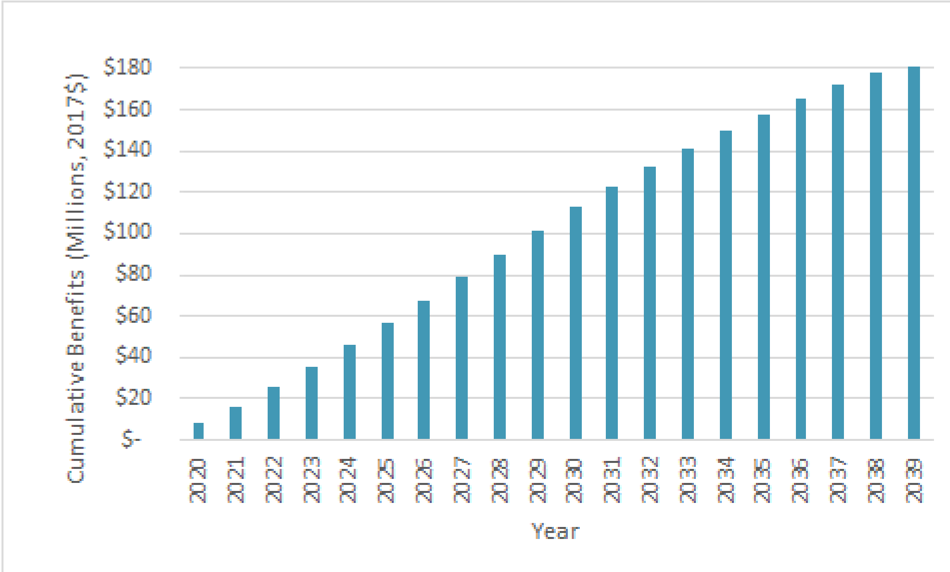


Figure 8-51. Freight Shuttle (Direct to User) High Demand Cumulative Benefits, Discounted at 7 Percent

LOW DEMAND SCENARIO

A low demand scenario estimates that 60 percent of import and export containers are transported by Freight Shuttle between the port and users in the Baytown area. Associated monetized benefits are identified in Table 8-14 and Figure 8-52.

Table 8-14. Freight Shuttle (Direct to User) Low Demand Benefits Analysis Results (Millions, 2017 Dollars)

Benefit Category	Undiscounted Benefits	Discounted Benefits (7%)
Travel Time Savings	$159.2	75.9
Crash Cost Savings	$46.3	$22.5
Emissions Cost Savings	$25.3	$12.2
Total	$230.8	$110.5

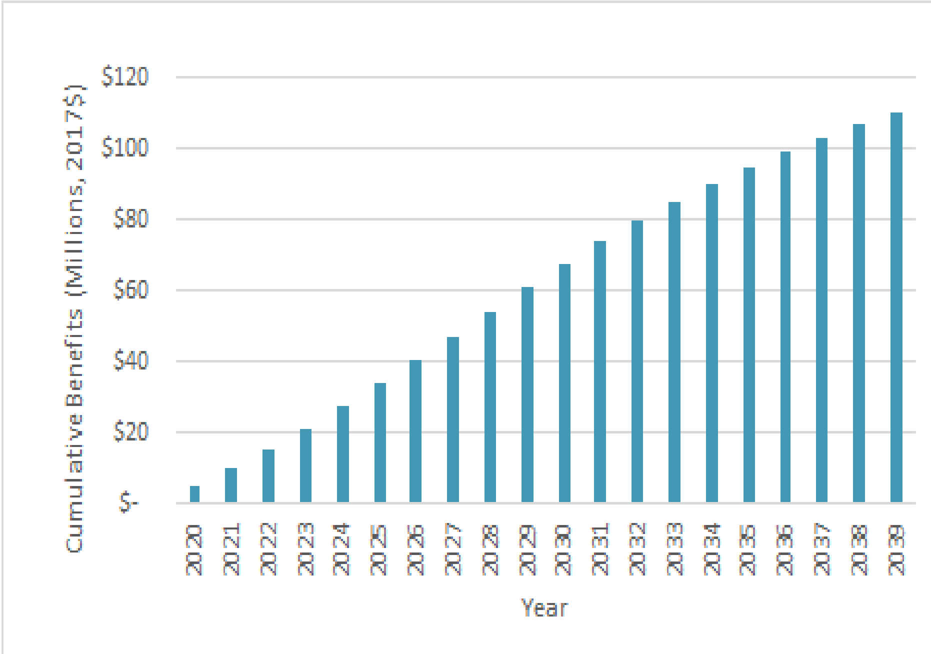


Figure 8-52. Freight Shuttle (Direct to User) Low Demand Cumulative Benefits, Discounted at 7 Percent

Container-on-Barge

The Container-on-Barge (COB) alternative is expected to transport similar number of containers as the Virtual Container Yard would. This assumption was made due to the fact that the same companies are expected to use either operation. The COB would also be utilized for fewer containers than the Freight Shuttle since some potential users, such as those to the north in Mont Belvieu located some distance from the COB offloading location, might not benefit enough from COB to use it. User projections for the COB have been refined to reflect this difference.

The emission rates for barges used in the analysis were taken from the Texas Transportation Institute report: *A Modal Comparison of Domestic Freight Transportation Effects on the General Public*. Barges are assumed to travel an average round trip distance of 9.8 miles at an average speed of 2.3 mph. Based on the location and concentration of import and export warehouses, round trip truck travel distances of 4.5 miles for imports and 9.4 miles for exports would be required to reach an intermodal container yard, where the barges would drop-off containers.

In comparison, in the No Build, the round trip distance traveled by trucks from the port to and from the import warehouses is 28.7 miles and to and from the export warehouses is 30 miles. Projected fatality and injury rates for the barge operation come from the South Carolina Port Authority. They have been calculated per billion ton-miles which are 0.01 and 0.05, respectively.

Truck transportation time savings come from reductions in truck travel time resulting from replacing a portion of the distance previously traveled by trucks with barges. The time reduction is monetized by the value of a truck driver’s time. This benefit category does not take into consideration the additional travel time required to transport the containers by barge due to a lack of a reliable value of time data for barge drivers. If the analysis included the additional time for the barge transportation, the transportation time savings would be reduced. It is possible this category would become a dis-benefit once travel time costs related to barge travel are included because of the significantly slower speeds of barges as compared to trucks.

HIGH DEMAND SCENARIO

In this scenario, the barge transports 90 percent of the exports and 60 percent of the imports from the port to the shared intermodal container facility. These containers are then transported from this facility to the respective warehouses by trucks. The remaining 10 percent of the exports and 40 percent of the imports are transported by trucks for the full distance between the port and the export and import warehouses. Exports have a larger share than imports due to the operational benefits of heavyweight containers.

Accounting only for truck-related transportation time savings, the COB scenario is estimated to result in savings of $51.0 million (discounted at 7 percent) over 20 years

The COB is also expected to result in fewer truck crashes due to the reduction in the distance traveled by trucks. Crash costs savings have been calculated as the difference between the estimated truck crashes under the No Build scenario and projected number of truck and barge crashes under the Build scenario. Over the 20-year analysis period, the COB is expected to result in $13.4 million of crash costs savings (discounted at 7 percent) from 1.9 avoided fatalities and 9.04 fewer injuries.

For the emissions cost savings analysis, the reduction in CO2, NOX, PM2.5, SOX, and VOC emissions were monetized in the same manner as described for the Virtual Container Yard project. The emission costs savings have been calculated as the difference between the No Build scenario truck emissions and the Build truck and barge emissions. Over the 20-year analysis period, the COB is expected to result in emission cost savings of $4.1 million (discounted at 7 percent). Associated monetized benefits are shown in Table 8-15 and Figure 8-53. As noted in the table and figure below, the total savings are $68.6 million (discounted at 7 percent) with majority contribution from travel time savings.

Table 8-15. Container on Barge High Demand Benefits Analysis Results (Millions, 2017 Dollars)

Benefit Category	Undiscounted Benefits	Discounted Benefits (7%)
Travel Time Savings	$107.9	$51.0
Crash Cost Savings	$27.5	$13.4
Emissions Cost Savings	$8.6	$4.1
Total	$144.0	$68.6

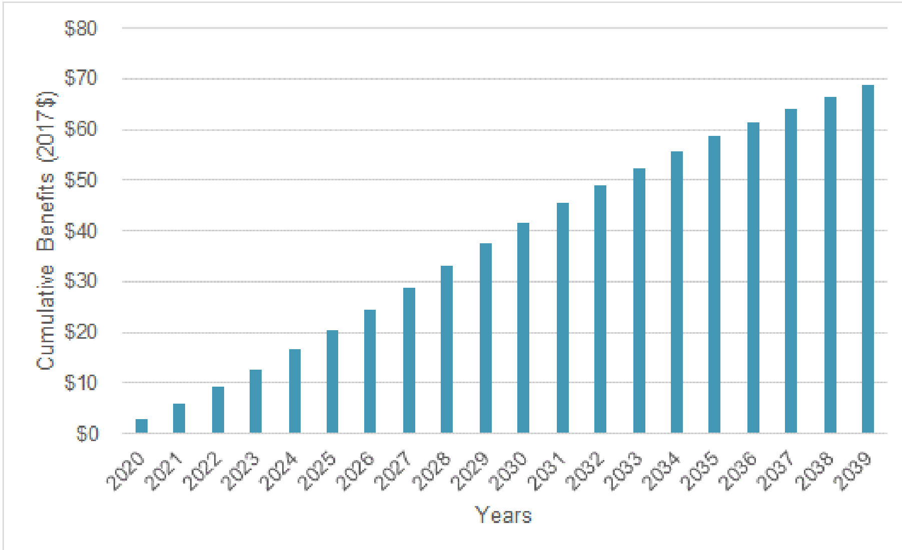


Figure 8-53. Container on Barge High Demand Cumulative Benefits, Discounted at 7 Percent

LOW DEMAND SCENARIO

The low demand COB scenario assumes 20 percent of import containers and 50 percent of export containers are transported by barge. The monetized benefits are detailed below in Table 8-16 and Figure 8-54. Total projected benefits over a 20-year period are $40.7 (discounted by 7%) with majority contributions from travel time savings.

Table 8-16. Container on Barge Low Demand Benefits Analysis Results (Millions, 2017 Dollars)

Benefit Category	Undiscounted Benefits	Discounted Benefits (7%)
Travel Time Savings	$68.7	$31.8
Crash Cost Savings	$14.0	$6.8
Emissions Cost Savings	$4.3	$2.1
Total	$87.0	$40.7

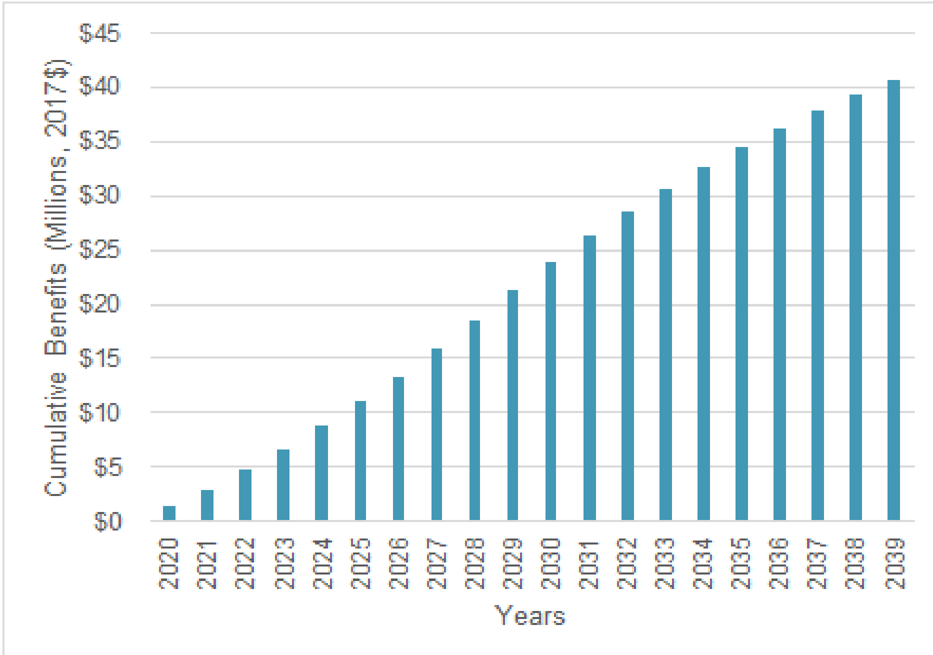


Figure 8-54. Container on Barge Low Demand Cumulative Benefits, Discounted at 7 Percent

8.9.2 Independence Parkway Bridge Alternative

A BCA was conducted to measure the cost-effectiveness of the Independence Parkway Bridge Alternative. The BCA served the purpose of monetizing, as thoroughly as possible, the benefits generated from the new bridge and comparing them against the project's total costs, including design, right-of-way (ROW) acquisition, utility relocation and construction costs.

Benefits were assessed using the regional travel demand model at two levels: First, at a port-specific level considering only the improvements associated with traffic analysis zones (TAZs) in which ports are physically located; and second, at a regional level considering improvements associated with all the TAZs located within the H-GAC eight county region.

At both the port-specific and regional levels, results show that benefits do not exceed the costs associated with this alternative.

The tables below summarize the monetization of principal benefits resulting from the proposed improvements at the port-specific and regional levels.

Table 8-17. Independence Parkway Bridge Alternative Benefit Estimates (Port-Specific), Millions of 2017 Dollars

Benefit Category	Undiscounted Benefits	Discounted Benefits (7%)
Travel Time Savings	$15.3	$4.0
Vehicle Operating Cost Savings	$3.5	$0.8
Crash Cost Savings	$0.4	$0.1
Emissions Cost Savings	$0.3	$0.1
Total*	$19.5	$5.0

*Total may not sum up due to rounding

Table 8-18. Independence Parkway Bridge Alternative Benefit Estimates (Regional), Millions of 2017 Dollars

Benefit Category	Undiscounted Benefits	Discounted Benefits (7%)
Travel Time Savings	$199.8	$61.1
Vehicle Operating Cost Savings	-$0.8	$0.1
Crash Cost Savings	-$6.5	-$1.3
Emissions Cost Savings	$1.2	$0.2
Total*	$193.7	$60.1

*Total may not sum up due to rounding

A period of 26 years was utilized for the estimation of the project's benefits and costs which include 6 years of construction, and 20 years of operation. Costs are expended during the 6 years of construction, from 2025 to 2030, and annual benefits are accrued over the 20 years of operation between 2031 and 2050.

The benefits have been estimated over the 2031 to 2050 timeframe. The regional travel demand model was used to generate vehicle miles traveled (VMT) and vehicle hours traveled (VHT) in the entire H-GAC region in addition to port-specific TAZ zones for the 2017 base case, 2045 No Build, and 2045 Build scenarios. In order to estimate 2031 No Build VMT and VHT values, the team used an exponential interpolation method between the 2017 base case and the 2045 No Build scenario. The team then applied the ratio of 2045 No Build to 2045 build to the 2031 No Build in order to estimate the 2031 Build scenario VMT and VHT.

The project's main benefit is savings from reduced travel time. The project is expected to generate significant travel time savings for passenger vehicles and trucks by reducing the miles required for travel within the H-GAC region, compared to conditions in the No Build scenario.

Total project costs are $2.01 billion (2019 dollars) which have been deflated, using the GDP deflator from the Bureau of Economic Analysis (BEA), to 2017 dollars. Project costs have also been discounted using a 7 percent discount rate, per US Department of Transportation (USDOT) BCA guidance.

With respect to the port-specific analysis, and using a 7 percent discount rate, the project would result in a net present value of -$1,094.9 million and a benefit-cost ratio of 0.00.

Considering all monetized benefits and costs for the regional analysis, with a 7 percent discount rate, the project would result in a net present value of -$1,039.7 million and a benefit-cost ratio of 0.05.

Table 8-19. Overall Results of the Independence Parkway Bridge Alternative BCA (Port-Specific), Millions of 2017 Dollars

	Discounted Benefits (7%)
Total Discounted Benefits	$5.0
Total Discounted Costs	$1,099.8
Net Present Value	-$1,094.9
Benefit-Cost Ratio	0.00
Payback Period	20+ years

Table 8-20. Overall Results of the Independence Parkway Bridge Alternative BCA (Regional), Millions of 2017 Dollars

	Discounted Benefits (7%)
Total Discounted Benefits	$60.1
Total Discounted Costs	$1,099.8
Net Present Value	-$1,039.7
Benefit-Cost Ratio	0.05
Payback Period	20+ years

8.9.3 I-69 Bypass Alternative

A BCA was conducted to measure the cost-effectiveness of the I-69 Bypass alternative. The BCA estimates and monetizes, as thoroughly as possible, the benefits generated from the construction of the bypass in comparison to the project's total costs including design, right-of-way (ROW) acquisition, utility relocation and construction costs.

Similar to the Independence Parkway Bridge alternative, benefits were assessed using the regional travel demand model at: port-specific level considering only the improvements associated with traffic analysis zones (TAZs) where ports are physically located and at a regional level considering improvements associated with all the TAZs located within the H-GAC eight county region.

At both the port-specific and regional levels, results in the tables below show that benefits do not exceed the costs for this project.

Table 8-21. I-69 Bypass Alternative Benefit Estimates (Port-Specific), Millions of 2017 Dollars

Benefit Category	Undiscounted Benefits	Discounted Benefits (7%)
Travel Time Savings	$6.2	$1.5
Vehicle Operating Cost Savings	-$3.8	-$0.8
Crash Cost Savings	-$1.6	-$0.4
Emissions Cost Savings	$0.2	$0.0
Total*	$0.9	$0.3

*Total may not sum up due to rounding

Table 8-22. I-69 Bypass Alternative Benefit Estimates (Regional), Millions of 2017 Dollars

Benefit Category	Undiscounted Benefits	Discounted Benefits (7%)
Travel Time Savings	$1,095.4	$251.3
Vehicle Operating Cost Savings	-$859.4	-$209.9
Crash Cost Savings	-$404.9	-$97.6
Emissions Cost Savings	$0.01	-$0.1
Total*	-$169.0	-$56.3

*Total may not sum up due to rounding

A period of 26 years was used for the estimation of this alternative's benefits and costs which include 6 years of construction, and 20 years of operation. Annual costs are expended during the 6 years of construction, from 2025 to 2030, and annual benefits are accrued over the 20 years of operation between 2031 and 2050.

The benefits have been estimated over the 2031 to 2050 timeframe. The team performed travel demand model runs to generate VMT and VHT in the entire H-GAC region in addition to port-specific TAZ zones for the 2017 base case, 2045 No Build, and 2045 Build scenarios. In order to estimate 2031 No Build VMT and VHT values, the team used an exponential interpolation method between the 2017 base case and the 2045 No Build scenario. The team then applied the ratio of 2045 No Build to 2045 build to the 2031 No Build in order to estimate the 2031 Build scenario VMT and VHT.

The project's main benefit is savings from reduced travel time. The Bypass is expected to generate significant travel time savings for passenger vehicles and trucks by reducing the hours required for travel within the H-GAC region, compared to conditions in the No Build scenario. At the port-specific analysis level, savings of 8,137 person hours per year, or 31 person hours per day, would be generated. For the regional analysis, larger travel time savings of approximately 3.2 million person hours per year, or 12,326 person hours saved per day are expected.

Due to limits in available information, the BCA indicates that crash cost savings could be negative (in other words, the project may generate additional crashes). This is due to the fact that the Bypass would increase the total miles traveled, even though overall travel time declines, and no reliable estimate could be made regarding a change in the rate of crashes with the Bypass.

Specifically, given the uncertainty at this time regarding specific details about how the project will be constructed, it is not possible to incorporate a crash reduction factor (CRF) into the BCA. The travel demand model (TDM) data projects an increase in vehicle miles traveled from the No Build to the Build scenario due to the longer travel route associated with a Bypass. With no change in crash rates, an increase in VMT will result in an increase in crashes. If a CRF were incorporated in the BCA, it is possible that the positive benefits associated with a lower rate of crashes would at least offset the negative benefits attributed to the increase in VMT.

Total project costs are $2.29 billion (2019 dollars) which have been deflated, using the GDP deflator from the BEA, to 2017 dollars. Project costs have also been discounted using a 7 percent discount rate, per USDOT BCA guidance.

Under the port-specific analysis, the Bypass would result in a net present value of -$1,326.5 million (using a 7 percent discount rate) and a benefit-cost ratio of 0.00. Under the regional analysis, the project would result in a net present value of -$1,383.0 million (using a 7 percent discount rate) and a benefit-cost ratio of -0.04.

Table 8-23. Overall Results of the I-69 Bypass Alternative BCA (Port-Specific), Millions of 2017 Dollars

	Discounted Benefits (7%)
Total Discounted Benefits	$0.3
Total Discounted Costs	$1,326.8
Net Present Value	-$1,326.5
Benefit-Cost Ratio	0.00
Payback Period	20+ years

*Total may not sum up due to rounding

Table 8-24. Overall Results of the I-69 Bypass Alternative BCA (Regional), Millions of 2017 Dollars

	Discounted Benefits (7%)
Total Discounted Benefits	-$56.3
Total Discounted Costs	$1,326.8
Net Present Value	-$1,383.0
Benefit-Cost Ratio	-0.04
Payback Period	20+ years

*Total may not sum up due to rounding

8.10 Summary

Given the degree of trucking activity associated with commodity flows through the region's ports, investment in highway infrastructure on roads directly serving the ports and in the wider region are necessary to accommodate growing numbers of road users. As part of this study, the I-69 bypass alternative and an additional crossing of the Houston Ship Channel were investigated and benefit cost analyses produced. With respect to the port-specific analysis for the Independence Parkway Bridge Alternative, and using a 7 percent discount rate, this project would result in a net present value of -$1,094.9 million and a benefit-cost ratio of 0.00. Under the port-specific analysis, the Bypass would result in a net present value of -$1,326.5 million (using a 7 percent discount rate) and a benefit-cost ratio of 0.00. These projects would not significantly benefit port users.

The solutions outlined in this chapter range from dedicated freight infrastructure such as Freight Shuttle and EagleRail, through to multi modal solutions including container-on-barge and operational solutions that address some of the inbuilt inefficiencies with container transport. Each of these strategies and solutions have their own strengths but also challenges. Dedicated freight systems deliver significant benefits in reduced emissions, safety and congestion, but the cost of new infrastructure combined with operational costs, when compared with the flexibility and cost of trucking, suggests the development and acceptance of a business case is challenging.

Where there is a commercial benefit and market opportunity, these operational solutions will be relatively easy to implement and stand a good chance of success. Where benefits are limited, or administration too complex, the chance of success is low. Operational improvements including measures to increase matchbacks/streetturns and increasing dual transactions require collaboration and leadership by ports, H-GAC and the freight industry to instigate change. No one party or organization can solely deliver these types of innovative solutions on their own.

9 Public Workshop

On Wednesday, January 24, 2018, the H-GAC hosted the Ports Area Mobility Study Workshop at the H-GAC office at 3555 Timmons Lane, Suite 120, Houston, Texas 77027, from 1:30 p.m. to 3:30 p.m. The invitation-only workshop provided attendees the opportunity to identify and evaluate a range of viable freight-oriented improvement alternatives designed to improve current and future travel performance between and through the region's ports. Workshop invitations were distributed to regional port and railroad representatives, manufacturing and distribution companies, state and federal agencies, and local elected officials, among others.

Individual feedback was recorded in the Individual Feedback Forms during the workshop, and group feedback was recorded in the Group Feedback Forms by each group during the workshop's group brainstorming session. In addition to the Group Feedback Forms completed by each of the three workshop groups, an additional Group Feedback Form was completed by a single attendee.

While the workshop was attended by representatives of agencies and organized stakeholder groups, comments received are not representative of the entire agency or organization. Individual and Group Feedback Databases, the original Individual Feedback Forms/Emails, and the original Group Feedback Forms are included in Appendix H.

The feedback received during the workshop was taken into consideration by the study team to identify additional regional infrastructure issues and develop locally approved improvement alternatives.

9.1 Feedback Tabulation

A tabulation of feedback received from the workshop is included below.

Table 9-1. Feedback Tabulation

Comment Type	Quantity
Individual Feedback Forms submitted at the workshop	6
Individual Feedback submitted to study team representatives via mail or email	2
Group Feedback Forms submitted at the workshop	4

9.2 Individual Feedback Summary

Individual feedback categories recorded for each question/prompt presented (tally of associated comments/sticker number[s] associated with the proposed project)

- ***Please provide information about additional, potential projects for consideration for each sticker dot placed on the map.***

- Attendees provided information about the following additional projects for consideration by the study:
  - Rail grade separation at Farm-to-Market (FM) 565 and FM 1405 in Baytown, Chambers County
  - Increase the gross-vehicle-weight capacity to 80,000 pounds for State Highway (SH) 99 in Mont Belvieu
  - Add connector from SH Spur 330 to Interstate Highway (IH) 10 East
- Attendees provided additional information/comments for the following projects already identified by the study:
  - Red Bluff Road **(2)**
  - Broadway Second Main Track
  - Clinton Drive
  - Fairmont Parkway
  - Federal Road
  - Federal Road Grade Separation
  - Jacintoport Boulevard
  - SH 288
  - Sheldon Road
  - Southern IH 69 Connection Route Around Houston

This information is located in the Individual Feedback Forms/Emails and Individual Feedback Database included in Appendix H.

➢ ***Is there any additional information or feedback that you would like to provide to the study team?***

- Address technological and economic drivers and trends.
- Raise three to four bridges over IH 10 that are causing vehicle strikes.
- Reduce tolls for night operations on SH 99.
- Discuss issues with freight truck drivers.
- Contact the West Chambers County Economic Development Foundation for additional project information.
- Incorporate the findings of the Texas Freight Mobility Plan into the study.
- Create separate roads/lanes for freight trucks.
- Increase wages for freight truck drivers.
- Increase the number of trucks carrying freight.
- Charge fees to top-off diminishing gasoline tax revenue.
- Rethink specialized lanes.

- Identify preserved trucks.
- Construct or re-route toll roads and create a partnership.
- Explore projects that yield maximum benefits for a minimal cost.
- Incorporate new and established freight transportation methods used in Europe.
- Consider a broader range of potential solutions.
- Analyze the impacts of growth scenarios on traffic and transportation on regional infrastructure.
- Group solutions into larger, overarching strategies.
- Develop a mindful and objective decision process.
- Incorporate scenario planning that is in alignment with the ports and their distributors.

9.3 Group Feedback Summary

Group feedback categories recorded for each question/prompt presented (tally of associated comments)

➢ ***Is there any additional screening/prioritization criterion not considered in the outlined methodology that you believe would be important to include? If so, please describe it and provide ideas for indicators that could be used to quantify it.***

- Consider larger, more impactful projects **(3)**.
- Consider volume of truck/cargo per transportation route **(2)**.
- Consider interdependence among projects.
- Select projects based on effectiveness demonstrated in simulation models.
- Focus on demand instead of capacity.
- Consider the prioritization process used in the Texas Freight Mobility Plan.
- The study needs to answer how each action will serve what volume where and when.
- Uberize freight.
- Consider strategic fit with corridors and growth segments.
- Explore cost reduction opportunities in the logistics chain.
- Consider reduction to negative impacts (i.e. pollution, congestion).
- Regional significance
- Connectivity
- Viability
- Safety

- Economics
- Coordinated policy
- Technology

Due to inconsistency in the feedback received for the following prompts, please reference the original Group Feedback Forms or Group Feedback Database in Appendix H.

- ***From the list of criteria used in the Initial/Universe of Project Screening, please rank each one of them based on their importance relative to the other criteria listed.***
- ***Please circle the importance of each criterion in the matrix (1 represents highest, 3 represents lowest)***
- ***Please identify and rank other potential criteria not provided in the matrix***.
- ***Please provide additional feedback.***
  - Define the role of the ports (local, state leader, mid-continent leader).
  - Cost is critical.
  - Explore ways to reduce costs through technology (i.e. autonomous driving, electric vehicles).
  - Consider 24-hour operations to reduce costs.
  - Begin to move truck freight during nighttime hours only.
  - Technology could potentially reduce trucking costs by 20 to 30 percent.
  - Create dedicated truck lanes on high-traffic transportation routes.
  - Develop tractor leasing program and install battery charging stations for electric trucks to reduce pollution and costs.
  - Develop automated customs and bill of lading at ports.
  - Consider projects or policies that obtain more data and information.
  - Use pilot projects to test electric and autonomous driving projects.
  - Provide truck transportation routes and vehicle count information to stakeholders to better inform feedback.
  - Provide analysis of cost blocks to stakeholders to better inform feedback.
  - Provide port/freight-logic competitive cost information to stakeholders to better inform feedback.

9.4 Noticing

Individuals and/or organizations were notified of the workshop via email invitations. A list of the 92 individuals and organizations invited to participate in the workshop is included in Appendix H.

9.5 Workshop Format

The workshop was organized in a classroom style (Appendix H) and structured in the following five parts to facilitate discussion and encourage individual and group feedback:

- Study overview presentation
- Individual feedback session (written only)
- Open discussion (oral only)
- Screening criteria/project prioritization process overview presentation
- Group brainstorming session (written only)

Upon arrival, workshop attendees were welcomed to sign in on the sign-in sheets provided and were assigned to color-coded groups according to their individual expertise and study interests to establish equal representation within each group. A total of 22 attendees, forming three groups, were recorded on January 24, 2018. The original workshop sign-in sheets and a list of workshop attendees and group assignments are included in Appendix H.

Each attendee was provided with a Workshop Agenda, Workshop Ground Rules, a Project Overview Form, Individual and Group Feedback Forms, and a study Contact Card. Maps containing projects identified by the study were also displayed on easels around the workshop space. The materials and maps provided at the workshop are included in Appendix H. Study representatives from H-GAC, HDR, Inc., and Crouch Environmental Services were available throughout the workshop to discuss the study one-on-one with attendees.

The workshop began promptly at 1:30 p.m., facilitated by Leslie Hollaway of Crouch Environmental Services, with an introduction from the study team, followed by an explanation of the workshop's structure and ground rules by Ms. Hollaway. Joseph Dack, Project Manager for HDR Inc., led a study overview PowerPoint presentation (Appendix H) that provided the purpose and goals of the study, the purpose of the workshop, and study progress to date.

Following the overview presentation, attendees were asked to utilize the available maps, along with their Individual Feedback Form, to provide information about additional projects that could be included in the study. Attendees were asked to place numbered sticker dots on the maps in locations where additional projects should be included and record, on their Individual Feedback Form, a description, location, and potential sponsor for the project, as well as the project's corresponding sticker number. The Individual Feedback Form also solicited any additional feedback related to the study.

Open discussion among study representatives and workshop attendees to identify regional infrastructure issues and concerns preceded the next presentation by the study team. Study representatives from HDR Inc., Stephen Decker and Alejandro Solis provided an overview PowerPoint presentation (Appendix H) about the study's screening criteria and project prioritization process.

Workshop attendees were then tasked to join their assigned group, select a group scribe, and brainstorm to complete a single Group Feedback Form. Each group was asked to identify additional screening and project prioritization criteria, as well as rank the study's currently outlined screening and project prioritization criteria by level of importance. The Group Feedback Form also solicited any additional feedback related to the study.

The workshop concluded with closing remarks by the study team and the collection of the completed Individual and Group Feedback Forms. Workshop photographs are included in Appendix H.

9.6 Summary

Based on the feedback received at the workshop, a traditional approach of project selection, ranking and prioritization was replaced with studying unique and out-of-the box ideas. The ideas investigated included multi-modal options such as Freight Shuttle and Container-on-Barge operations, technological solutions including ‘Matchback/Streeturn’ system, and mega projects including the I-69 Bypass and new bridge across the Houston Ship Channel along Independence Parkway. Further, other innovative solutions and strategies being implemented across Ports in and outside the Country were investigated and their feasibility was evaluated.

The smaller projects displayed and discussed during the workshop will address the last mile connections at the port terminals and port related industries, thus removing the bottleneck situations. These projects are essential for the safety, connectivity, air quality, and cost reduction in the logistics chain as recommended by the workshop attendees in their feedback. Based on the feedback received, the 121 projects displayed at the workshop are categorized into six categories spanning from low capital to high capital projects and provided in Appendix H. The smaller and easy to implement projects are categorized into low or medium capital projects for consideration by H-GAC, TxDOT and other regional entities.

Some of the high capital projects such as the I-69 Bypass and additional bridge across the Houston Ship Channel; along with multi-modal options including Freight Shuttle and Container-on-barge, as well as technological solutions such as ‘Matchback/Streeturn’ system are studied in more detail as part of the solutions analysis.

10 Recommendations

1. H-GAC to continue dialogue and engagement with the region’s ports, port users and other key stakeholders to identify funding, implementation and support mechanisms enabling the deployment of solutions and strategies identified in this study. This dialogue could be through existing forums the Greater Houston Freight Committee, Transportation Policy Council, and Transportation Advisory Committee.
2. Continue to plan for volume growth and corresponding advances in infrastructure, technology, and logistics by the region’s ports and recognize that key events, such as completion of channel expansion projects, will lead to larger vessels and therefore greater tonnage moving on the region’s surface transportation system.
3. Identify funding sources, including Federal grant programs, to fund a matchback/streeturn system or manager to reduce vehicle miles travelled by empty containers in the region, as well as discretionary grant programs for which port access projects may score well.
4. Continue to monitor progress with dedicated freight alternative system providers, including but not limited to Freight Shuttle and Eaglerail, as they develop their respective systems and business cases, to identify implementable opportunities for these systems within the Houston region.
5. Work with the Port of Houston to advance and enhance container-on-barge operations to promote port development, business development and location decisions, and reduced reliance on trucking over congested roads, especially heavyweight containers.
6. In liaison with the Port of Houston and Port of Freeport, identify mechanisms to grow the number of vehicles completing dual transactions at the port’s container terminals.
7. Conduct an Inland Port Study, primarily focused on rail connections between Houston and the Dallas-Fort Worth area to better understand the success factors and potential public and private benefit value of a Houston-Dallas container rail link.
8. Work with pipeline operators, the Texas Railroad Commission and Pipeline and Hazardous Materials Safety Administration to ensure pipelines serving the region’s port facilities are operated to the required regulations, ensuring pipelines are safe for both the region’s population and the environment.
9. Identify improvements to the process of selecting, funding, planning, designing and constructing highway projects, to keep up with the pace of development and growth at the region’s ports and integrated with other operational solutions including extended gates, truck reservation systems and improving the efficiency of container movement to deliver cost effective highway capacity enhancements.
10. This study has primarily focused on the transportation arrangements of moving goods to and from the region’s ports. However, it is recognized that there is other significant transportation activity in the region associated with these goods once they have passed through import facilities, such as the final mile distribution to retail stores, other warehouses and end users. Ongoing and future regional planning

should consider the growth of these secondary and final mile trips to, from and within the region.

Appendix A. H-GAC Regional Port Commodities

All Trades (Shipments and Receipts, Domestic and Foreign)

All Traffic Types (Domestic & Foreign), All Traffic Directions								
All Ports								
Commodity	2010	2011	2012	2013	2014	2015	2016	2017
Crude Petroleum	107,176,555	96,668,803	101,554,470	84,238,490	81,647,574	70,393,527	68,151,643	66,392,182
Distillate Fuel Oil	42,836,742	52,148,084	47,187,669	43,819,274	42,305,404	43,562,151	44,734,365	49,272,875
Gasoline	24,484,293	24,767,651	23,940,161	19,678,151	16,663,441	21,289,003	25,130,504	26,451,111
Hydrocarbon & Petrol Gases, Liquefied and Gaseou	5,283,420	5,468,467	6,649,343	10,679,636	15,656,691	16,682,658	20,334,610	24,837,209
Residual Fuel Oil	23,424,381	24,210,686	23,892,546	20,364,156	18,332,831	18,299,323	19,816,700	19,676,469
Naphtha & Solvents	9,430,755	10,509,029	11,161,792	15,016,137	17,032,608	18,519,111	16,641,530	17,183,305
Alcohols	10,185,931	10,986,833	10,013,691	9,026,252	8,817,069	9,000,872	8,853,160	9,377,428
Petroleum Coke	9,828,225	9,433,245	8,314,412	7,873,034	8,515,736	8,329,845	8,507,364	8,260,205
Other Hydrocarbons	7,980,581	8,780,883	9,193,874	8,656,141	8,369,280	7,933,156	7,931,243	7,886,740
Benzene & Toluene	8,342,581	7,954,357	7,196,277	7,233,616	6,963,520	8,213,281	7,343,042	6,717,386
Lube Oil & Greases	2,433,484	5,467,208	2,923,028	3,604,205	5,348,178	6,982,542	6,523,771	6,161,810
Organic Comp. NEC	4,326,453	4,262,767	4,116,268	4,182,449	4,127,879	4,522,322	5,007,765	5,169,653
I&S Pipe & Tube	3,426,408	4,342,901	5,474,774	4,905,992	5,172,866	4,847,764	2,178,869	4,971,869
Acyclic Hydrocarbons	2,559,191	2,997,070	2,276,221	2,002,328	1,929,935	2,296,014	2,618,993	4,757,087
Wheat	6,741,351	7,440,774	3,515,120	5,709,659	4,100,260	2,091,189	4,295,227	4,578,011
Unknown or NEC	997,488	936,859	1,158,400	1,928,927	4,060,248	3,256,269	2,979,431	4,231,342
Plastics	4,160,428	4,148,844	4,209,383	3,963,662	3,361,761	3,893,045	4,066,653	3,777,085
Carboxylic Acids	4,272,527	4,213,024	4,780,859	4,704,283	4,376,730	4,250,670	4,183,184	3,696,608
Petro. Products NEC	1,591,845	1,470,388	1,734,908	1,719,159	1,933,518	2,544,368	3,333,550	3,533,605
Asphalt, Tar & Pitch	1,865,906	2,613,222	3,456,182	2,960,184	2,649,233	3,276,470	3,425,023	3,336,356
Sodium Hydroxide	1,971,090	1,966,069	2,149,058	2,286,342	2,183,376	2,567,356	3,069,595	3,324,412
Cement & Concrete	1,038,720	1,092,801	1,433,085	1,699,137	2,248,178	3,047,782	2,423,353	2,724,393
Kerosene	194,047	271,608	168,316	255,749	327,835	313,843	2,161,135	2,165,547
Sulphur (Liquid)	3,079,362	3,318,786	3,005,929	3,191,869	3,329,584	3,015,544	2,871,132	2,160,533
Manufac. Prod. NEC	941,499	1,124,090	1,302,254	1,406,060	1,918,514	1,661,003	1,800,536	2,101,830
Grand Total	324,348,825	332,611,710	328,610,128	310,043,672	315,185,809	315,370,926	318,758,244	330,142,703

Source: USACE Waterborne Commerce Statistics

Foreign Trade Receipts and Shipments Combined

All Ports Foreign Trade Commodity	2010	2011	2012	2013	2014	2015	2016	2017
Crude Petroleum	105,605,903	93,219,517	88,833,232	66,618,420	64,680,763	56,287,084	58,237,885	56,459,318
Distillate Fuel Oil	29,878,986	37,757,329	34,856,487	33,036,735	28,369,856	30,639,062	29,661,534	29,103,540
Hydrocarbon & Petrol Gases, Liquefied and Gaseou	4,146,762	4,742,277	5,717,140	9,839,842	14,434,914	15,978,164	19,320,708	23,780,862
Gasoline	13,508,913	13,973,097	12,861,037	11,583,327	8,939,431	12,235,750	12,790,795	14,151,074
Petroleum Coke	9,115,018	8,707,571	7,741,056	7,192,880	7,946,926	8,019,279	8,176,121	7,895,922
Naphtha & Solvents	1,025,220	1,356,644	1,108,059	4,348,964	6,804,507	7,698,963	6,295,136	6,545,331
I&S Pipe & Tube	3,391,891	4,295,948	5,361,364	4,838,496	5,136,558	4,831,907	2,173,293	4,931,851
Alcohols	4,888,032	5,914,178	5,761,943	4,772,538	4,631,357	4,790,970	4,324,613	4,701,156
Wheat	6,628,068	7,388,467	3,502,201	5,694,125	4,027,852	2,048,215	4,259,834	4,520,960
Unknown or NEC	993,023	934,307	1,157,582	1,928,927	4,060,246	3,256,265	2,979,431	4,231,342
Organic Comp. NEC	3,448,383	3,322,256	3,187,180	3,259,995	3,149,087	3,447,657	3,991,968	4,068,590
Plastics	4,012,519	4,022,939	4,049,291	3,835,957	3,207,869	3,721,986	3,897,797	3,599,204
Residual Fuel Oil	3,613,467	3,103,698	2,834,487	3,343,105	2,660,475	3,650,604	2,655,996	3,491,311
Acyclic Hydrocarbons	1,140,445	1,403,712	954,700	811,708	600,646	996,280	1,389,530	3,457,080
Other Hydrocarbons	2,859,549	3,197,147	3,452,961	3,892,864	3,794,630	3,568,764	3,672,451	3,266,646
Lube Oil & Greases	263,212	3,107,792	502,609	1,372,758	2,811,336	3,756,489	3,415,501	3,178,624
Sodium Hydroxide	1,186,144	1,294,663	1,566,370	1,696,924	1,578,264	1,852,184	2,382,128	2,518,009
Carboxylic Acids	2,534,792	2,469,212	2,771,773	2,879,838	2,584,089	2,603,047	2,530,861	2,228,828
Cement & Concrete	674,982	779,581	1,017,183	1,260,907	1,678,697	2,481,223	2,124,117	2,151,982
Manufac. Prod. NEC	807,918	905,296	976,678	1,204,611	1,621,192	1,655,134	1,713,701	2,097,149
Limestone	1,387,585	1,116,847	1,090,365	1,799,048	3,780,969	3,843,528	2,547,450	2,076,294
Machinery (Not Elec)	1,492,332	1,698,945	1,866,925	1,730,910	1,832,752	2,035,988	1,455,721	1,756,165
Rubber & Plastic Pr.	888,463	968,049	966,945	1,134,999	1,259,636	1,569,681	1,438,303	1,576,164
Sorghum Grains	1,818,712	1,111,509	682,648	638,827	2,834,075	4,290,345	3,061,672	1,550,630
Fab. Metal Products	650,549	819,067	1,037,388	1,002,449	973,885	1,190,398	1,020,968	1,277,813
Grand Total	229,979,291	231,816,365	219,646,875	206,714,185	210,801,309	212,805,774	210,539,642	218,543,696

Source: USACE Waterborne Commerce Statistics

Foreign Trade Receipts

All Ports Foreign Receipts Commodity	2010	2011	2012	2013	2014	2015	2016	2017
Crude Petroleum	105,605,903	93,130,882	88,752,823	66,367,519	61,927,755	50,353,623	53,071,320	47,630,371
Distillate Fuel Oil	9,286,960	11,171,699	8,168,217	9,017,308	7,359,963	8,114,671	7,723,497	7,678,460
I&S Pipe & Tube	3,155,775	4,056,202	5,099,104	4,540,344	4,920,872	4,694,845	2,049,213	4,799,901
Cement & Concrete	673,666	778,983	1,016,041	1,260,223	1,678,182	2,480,100	2,122,599	2,150,771
Limestone	1,387,509	1,116,794	1,090,340	1,799,025	3,780,953	3,843,448	2,547,421	2,072,464
Unknown or NEC	294,708	363,549	425,326	716,665	1,954,039	1,246,054	1,028,659	1,744,361
Manufac. Prod. NEC	524,068	584,088	628,483	794,004	1,114,752	1,247,412	1,363,662	1,673,949
Residual Fuel Oil	633,364	812,688	963,390	1,238,840	603,256	1,073,710	1,086,472	1,527,268
Alcohols	3,003,693	2,746,498	2,975,396	2,717,078	2,280,624	2,120,147	1,178,419	1,245,291
Gasoline	2,895,254	3,186,693	1,379,995	1,025,627	254,215	892,280	962,386	1,209,352
Naphtha & Solvents	236,361	437,151	90,713	535,580	566,411	196,762	1,511,540	1,172,230
Fab. Metal Products	444,824	610,799	814,087	804,520	754,575	956,131	877,010	1,106,112
Lube Oil & Greases	27,179	2,933,855	437,855	394,222	711,682	647,390	1,014,430	1,064,652
Machinery (Not Elec)	541,782	683,818	731,577	727,457	854,145	1,163,651	838,230	1,009,798
I&S Bars & Shapes	326,732	592,397	848,939	826,502	1,116,217	1,137,333	1,045,559	1,003,126
I&S Plates & Sheets	456,309	663,492	745,059	609,899	1,601,010	1,118,443	687,795	976,684
Organic Comp. NEC	262,477	200,073	298,769	462,886	432,121	483,353	893,741	926,790
Benzene & Toluene	1,318,387	1,113,265	1,212,677	1,377,691	1,245,721	1,881,466	1,414,359	903,250
Misc. Mineral Prod.	631,196	590,493	549,792	563,686	643,984	799,867	771,785	897,783
Bananas & Plantains	623,468	636,307	641,958	694,094	704,063	718,435	729,198	668,822
Ammonia	786,190	805,636	803,559	846,663	819,538	863,003	746,753	660,175
Rubber & Plastic Pr.	222,545	242,500	266,495	331,235	447,768	498,235	572,999	624,435
Non-Metal. Min. NEC	734,153	959,179	995,062	587,037	606,196	483,355	323,162	603,416
Nitrogenous Fert.	466,177	464,950	878,752	684,583	982,832	903,358	689,152	583,459
Vehicles & Parts	193,518	221,929	295,853	301,533	358,260	459,740	417,733	510,063
Lumber	126,129	119,817	144,866	181,024	213,689	291,845	392,439	507,041
Electrical Machinery	215,569	247,538	290,707	269,831	350,386	432,513	438,822	506,994
I&S Primary Forms	468,711	780,946	659,738	718,893	995,334	769,905	523,671	500,289
Aluminum	135,207	171,036	204,405	245,793	284,057	268,962	352,867	478,519
Plastics	219,981	241,488	325,521	303,100	318,527	335,694	353,519	450,201
Alcoholic Beverages	348,075	349,984	350,703	324,845	323,459	427,321	407,064	429,733
Grand Total	143,022,346	137,618,032	127,723,469	107,558,011	106,962,879	97,699,611	94,265,999	94,086,553

Source: USACE Waterborne Commerce Statistics

Foreign Trade Shipments

All Ports Foreign Shipments Commodity	2010	2011	2012	2013	2014	2015	2016	2017
Hydrocarbon & Petrol Gases, Liquefied and Gaseou	3,537,782	4,137,877	5,484,219	9,598,859	14,185,185	15,798,370	19,200,577	23,672,053
Distillate Fuel Oil	20,592,026	26,585,630	26,688,270	24,019,427	21,009,893	22,524,391	21,938,037	21,425,080
Gasoline	10,613,659	10,786,404	11,481,042	10,557,700	8,685,216	11,343,470	11,828,409	12,941,722
Crude Petroleum		88,635	80,409	250,901	2,753,008	5,933,461	5,166,565	8,828,947
Petroleum Coke	8,538,181	8,615,452	7,713,045	7,142,075	7,946,759	8,016,823	8,175,423	7,894,012
Naphtha & Solvents	788,859	919,493	1,017,346	3,813,384	6,238,096	7,502,201	4,783,596	5,373,101
Wheat	6,627,796	7,388,284	3,501,679	5,693,356	4,024,718	2,046,153	4,258,042	4,519,093
Alcohols	1,884,339	3,167,680	2,786,547	2,055,460	2,350,733	2,670,823	3,146,194	3,455,865
Plastics	3,792,538	3,781,451	3,723,770	3,532,857	2,889,342	3,386,292	3,544,278	3,149,003
Organic Comp. NEC	3,185,906	3,122,183	2,888,411	2,797,109	2,716,966	2,964,304	3,098,227	3,141,800
Acyclic Hydrocarbons	738,494	747,677	540,127	515,500	302,216	708,458	1,116,117	3,092,418
Other Hydrocarbons	2,626,704	2,809,987	3,058,937	3,492,986	3,422,758	3,199,542	3,338,257	2,967,752
Unknown or NEC	698,315	570,758	732,256	1,212,262	2,106,207	2,010,211	1,950,772	2,486,981
Sodium Hydroxide	1,156,312	1,270,072	1,537,053	1,651,396	1,524,981	1,837,176	2,372,912	2,446,543
Lube Oil & Greases	236,033	173,937	64,754	978,536	2,099,654	3,109,099	2,401,071	2,113,972
Residual Fuel Oil	2,980,103	2,291,010	1,871,097	2,104,265	2,057,219	2,576,894	1,569,524	1,964,043
Carboxylic Acids	2,270,724	2,174,788	2,538,988	2,502,667	2,250,960	2,202,860	2,031,386	1,905,829
Sorghum Grains	1,818,631	1,110,564	680,222	638,238	2,833,839	4,290,337	3,061,613	1,550,540
Kerosene	64,865	112,020	118,029	166,800	104,040	211,902	1,015,832	983,494
Rubber & Plastic Pr.	665,918	725,549	700,450	803,764	811,868	1,071,446	865,304	951,729
Machinery (Not Elec)	950,550	1,015,127	1,135,348	1,003,453	978,607	872,337	617,491	746,367
Nitrogen Func. Comp.	979,197	932,563	892,938	818,850	755,495	801,622	749,430	615,585
Chem. Products NEC	472,198	465,430	749,626	722,527	722,159	769,079	822,266	599,154
Manufac. Prod. NEC	283,850	321,208	348,195	410,607	506,440	407,722	350,039	423,200
Cotton	298,052	383,664	157,185	179,328	164,349	227,734	264,164	418,006
Grand Total	86,956,945	94,198,333	91,923,406	99,156,174	103,838,430	115,106,163	116,273,643	124,457,143

Source: USACE Waterborne Commerce Statistics

Non-Containerized Imports

	Trade	Imports								
	Port	(All)								
	World Region	(All)								
	Commodity	2010	2011	2012	2013	2014	2015	2016	2017	2018
1	2709 Crude Oil From Petroleum And Bituminous Minerals	107,486,952	97,267,932	88,985,893	66,920,142	61,966,321	50,184,061	53,801,248	47,946,378	35,755,662
2	2710 Oil (not Crude) From Petrol & Bitum Mineral Etc.	11,365,697	13,861,144	9,192,586	11,608,827	9,039,491	11,272,377	12,628,994	12,952,818	13,719,092
3	2517 Pebbles, Gravel Etc; Macadam Of Slag, Dross Etc.	1,320,782	925,298	995,406	1,989,222	3,719,258	4,053,792	2,633,079	2,046,539	2,685,431
4	2523 Portland Cement, Aluminous Cement, Slag Cement Etc	643,109	732,411	904,184	1,191,572	1,639,555	2,394,786	1,969,307	1,972,468	2,187,656
5	7304 Tubes, Pipes Etc, Seamless, Iron Nesoi & Steel	1,464,586	1,952,820	2,271,900	1,882,808	2,258,432	1,627,676	838,267	1,913,786	1,979,315
6	2902 Cyclic Hydrocarbons	1,474,272	1,266,044	1,400,924	2,204,353	2,420,596	2,380,047	1,615,297	1,470,208	1,686,513
7	7306 Tubes, Pipes & Hollow Profiles Nesoi, Iron & Steel	1,117,966	1,663,437	2,225,405	2,193,390	2,567,604	1,544,084	748,355	2,317,028	1,576,648
8	3102 Mineral Or Chemical Fertilizers, Nitrogenous	479,440	435,974	733,920	613,589	933,461	899,920	725,369	647,255	695,161
9	2207 Ethyl Alcohol, Undenat, Nun80% Alc; Alcohol, Denat	45,304	4,293	91,785	39,861	437,346	560,514	519,250	561,246	563,126
10	7208 Fl-rl Iron & Na Steel Nun600mm Wd Hot-rl, Not Clad	221,825	488,874	701,079	425,856	1,451,079	805,215	347,031	400,582	533,873
11	7210 Fl-rl Iron & Na Steel Nun600mm Wd, Clad Etc	237,932	251,407	366,947	313,826	622,242	670,181	596,729	744,690	518,909
12	2905 Acyclic Alcohols & Halogenat, Sulfonatd Etc Derivs	2,298,727	2,292,564	2,293,152	2,442,196	1,910,659	1,439,431	588,402	494,151	496,064
13	2909 Ethers, Ether-alcohols, Alcohol Peroxides Etc.	57,445	70,036	67,391	48,167	56,857	146,806	549,635	566,694	488,905
14	2707 Oils Etc From High Temp Coal Tar; Sim Aromatic Etc	395,540	596,838	376,376	464,882	353,839	368,198	321,577	286,786	466,488
15	2814 Ammonia, Anhydrous Or In Aqueous Solution	932,700	884,396	828,467	817,875	811,126	804,462	754,747	734,346	418,614
16	7214 Bars & Rods, Iron & Na Steel Nesoi, H-r Etc	91,255	145,193	252,501	297,520	451,984	785,905	738,365	541,955	391,758
17	7207 Semifinished Products Of Iron Or Nonalloy Steel	171,018	319,490	424,921	429,908	477,085	264,639	182,186	297,104	371,239
18	2511 Natural Barium Sulfate; Nat Barium Carbonate Nesoi	550,395	418,063	529,907	416,521	375,757	205,533	42,154	277,147	354,111
19	7305 Tubes & Pipes Nesoi, Ext Dia Ov406-4mm, Ir & Steel	192,017	248,103	379,605	381,371	353,755	494,552	240,725	307,744	333,864
20	0803 Bananas, Including Plantains, Fresh Or Dried	147,773	158,184	174,550	135,403	259,882	244,669	238,286	295,386	285,427
21	8703 Motor Cars & Vehicles For Transporting Persons	105,031	114,987	164,830	130,576	144,846	197,352	240,591	250,333	285,420
22	2914 Ketones & Quinones & Halogenatd, Sulfonatd Der Etc	30,989	48,893	78,445	77,836	133,873	140,180	119,267	194,121	211,297
23	1703 Molasses From The Extraction Or Refining Of Sugar	90,193	151,822	166,291	125,719	163,997	172,423	167,595	112,467	199,502
24	7224 Alloy Steel Nesoi In Ingots, Oth Pr Frm & Semif Pr	2,909	10,058	7,955	26,394	28,795	17,346	14,977	46,136	182,997
25	3105 M Or Ch Fertiliz, Nun2of3el; Fert Nesoi; Fert Pack	27,836	28,660	0	0	105,063	0	0	0	167,707
	Grand Total	134,464,135	128,006,861	116,463,136	98,395,250	96,119,041	84,934,081	83,630,139	80,823,371	69,794,675

Source: US Census: USA Trade Online

Non-Containerized Exports

	Trade	Imports								
	Port	(All)								
	World Region	(All)								
	Commodity	2010	2011	2012	2013	2014	2015	2016	2017	2018
1	2709 Crude Oil From Petroleum And Bituminous Minerals	107,486,952	97,267,932	88,985,893	66,920,142	61,966,321	50,184,061	53,801,248	47,946,378	35,755,662
2	2710 Oil (not Crude) From Petrol & Bitum Mineral Etc.	11,365,697	13,861,144	9,192,586	11,608,827	9,039,491	11,272,377	12,628,994	12,952,818	13,719,092
3	2517 Pebbles, Gravel Etc; Macadam Of Slag, Dross Etc.	1,320,782	925,298	995,406	1,989,222	3,719,258	4,053,792	2,633,079	2,046,539	2,685,431
4	2523 Portland Cement, Aluminous Cement, Slag Cement Etc	643,109	732,411	904,184	1,191,572	1,639,555	2,394,786	1,969,307	1,972,468	2,187,656
5	7304 Tubes, Pipes Etc, Seamless, Iron Nesoi & Steel	1,464,586	1,952,820	2,271,900	1,882,808	2,258,432	1,627,676	838,267	1,913,786	1,979,315
6	2902 Cyclic Hydrocarbons	1,474,272	1,266,044	1,400,924	2,204,353	2,420,596	2,380,047	1,615,297	1,470,208	1,686,513
7	7306 Tubes, Pipes & Hollow Profiles Nesoi, Iron & Steel	1,117,966	1,663,437	2,225,405	2,193,390	2,567,604	1,544,084	748,355	2,317,028	1,576,648
8	3102 Mineral Or Chemical Fertilizers, Nitrogenous	479,440	435,974	733,920	613,589	933,461	899,920	725,369	647,255	695,161
9	2207 Ethyl Alcohol, Undenat, Nun80% Alc; Alcohol, Denat	45,304	4,293	91,785	39,861	437,346	560,514	519,250	561,246	563,126
10	7208 Fl-rl Iron & Na Steel Nun600mm Wd Hot-rl, Not Clad	221,825	488,874	701,079	425,856	1,451,079	805,215	347,031	400,582	533,873
11	7210 Fl-rl Iron & Na Steel Nun600mm Wd, Clad Etc	237,932	251,407	366,947	313,826	622,242	670,181	596,729	744,690	518,909
12	2905 Acyclic Alcohols & Halogenat, Sulfonatd Etc Derivs	2,298,727	2,292,564	2,293,152	2,442,196	1,910,659	1,439,431	588,402	494,151	496,064
13	2909 Ethers, Ether-alcohols, Alcohol Peroxides Etc.	57,445	70,036	67,391	48,167	56,857	146,806	549,635	566,694	488,905
14	2707 Oils Etc From High Temp Coal Tar; Sim Aromatic Etc	395,540	596,838	376,376	464,882	353,839	368,198	321,577	286,786	466,488
15	2814 Ammonia, Anhydrous Or In Aqueous Solution	932,700	884,396	828,467	817,875	811,126	804,462	754,747	734,346	418,614
16	7214 Bars & Rods, Iron & Na Steel Nesoi, H-r Etc	91,255	145,193	252,501	297,520	451,984	785,905	738,365	541,955	391,758
17	7207 Semifinished Products Of Iron Or Nonalloy Steel	171,018	319,490	424,921	429,908	477,085	264,639	182,186	297,104	371,239
18	2511 Natural Barium Sulfate; Nat Barium Carbonate Nesoi	550,395	418,063	529,907	416,521	375,757	205,533	42,154	277,147	354,111
19	7305 Tubes & Pipes Nesoi, Ext Dia Ov406-4mm, Ir & Steel	192,017	248,103	379,605	381,371	353,755	494,552	240,725	307,744	333,864
20	0803 Bananas, Including Plantains, Fresh Or Dried	147,773	158,184	174,550	135,403	259,882	244,669	238,286	295,386	285,427
21	8703 Motor Cars & Vehicles For Transporting Persons	105,031	114,987	164,830	130,576	144,846	197,352	240,591	250,333	285,420
22	2914 Ketones & Quinones & Halogenatd, Sulfonatd Der Etc	30,989	48,893	78,445	77,836	133,873	140,180	119,267	194,121	211,297
23	1703 Molasses From The Extraction Or Refining Of Sugar	90,193	151,822	166,291	125,719	163,997	172,423	167,595	112,467	199,502
24	7224 Alloy Steel Nesoi In Ingots, Oth Pr Frm & Semif Pr	2,909	10,058	7,955	26,394	28,795	17,346	14,977	46,136	182,997
25	3105 M Or Ch Fertiliz, Nun2of3el; Fert Nesoi; Fert Pack	27,836	28,660	0	0	105,063	0	0	0	167,707
	Grand Total	134,464,135	128,006,861	116,463,136	98,395,250	96,119,041	84,934,081	83,630,139	80,823,371	69,794,675

Source: US Census: USA Trade Online

Appendix B. Port of Houston Commodities

All Trades (Shipments and Receipts, Domestic and Foreign)

All Traffic Types (Domestic & Foreign), All Traffic Directions (Tons)								
Houston								
Commodity	2010	2011	2012	2013	2014	2015	2016	2017
Crude Petroleum	56,961,811	50,892,083	57,079,809	48,999,430	49,735,310	45,338,068	45,780,894	45,290,239
Distillate Fuel Oil	34,793,858	44,094,891	38,655,991	34,685,608	31,643,666	33,387,446	34,279,672	38,390,694
Gasoline	18,725,296	18,932,565	18,422,505	14,740,062	11,954,033	15,987,286	20,107,989	22,967,376
Hydrocarbon & Petrol Gases, Liquefied and Gaseou	4,634,253	4,334,087	5,935,624	9,871,458	13,997,287	16,205,005	19,268,275	20,320,982
Residual Fuel Oil	18,023,059	17,890,969	16,952,368	15,017,178	13,848,245	14,746,784	15,379,313	15,684,301
Naphtha & Solvents	6,582,769	7,443,053	7,946,378	10,587,903	12,607,166	14,789,327	14,286,315	13,899,189
Petroleum Coke	7,906,707	7,576,589	7,001,551	6,252,826	7,094,577	6,567,046	7,003,192	6,896,773
Alcohols	7,825,465	8,211,330	7,838,447	7,133,024	6,870,771	6,852,287	6,501,815	6,724,022
Lube Oil & Greases	2,267,732	5,281,676	2,848,985	3,343,705	4,646,738	6,439,418	6,217,250	5,900,526
Benzene & Toluene	6,864,623	6,493,470	5,982,985	5,978,485	5,782,459	6,945,332	6,207,552	5,417,428
I&S Pipe & Tube	3,401,924	4,304,194	5,452,175	4,873,028	5,147,092	4,786,910	2,137,719	4,856,182
Other Hydrocarbons	4,911,639	5,324,686	5,842,249	5,580,915	5,238,261	5,038,082	4,976,262	4,839,016
Organic Comp. NEC	3,858,565	3,790,513	3,654,009	3,720,562	3,677,816	3,979,886	4,378,990	4,587,996
Acyclic Hydrocarbons	2,263,869	2,667,606	1,999,464	1,765,381	1,623,695	1,948,190	2,357,737	4,405,283
Wheat	4,588,855	4,539,791	2,599,675	5,076,352	3,671,102	1,731,344	3,684,101	4,071,838
Unknown or NEC	889,721	827,122	1,020,924	1,729,691	3,651,426	2,875,937	2,634,163	3,753,241
Plastics	3,829,459	3,866,307	3,905,377	3,697,935	3,052,880	3,455,574	3,645,705	3,408,070
Asphalt, Tar & Pitch	1,650,555	2,174,036	2,868,645	2,667,724	2,344,349	2,967,712	3,057,996	3,059,975
Carboxylic Acids	3,664,431	3,579,157	3,961,817	4,052,843	3,570,310	3,351,623	3,311,288	2,920,200
Cement & Concrete	1,036,211	1,092,801	1,432,813	1,697,699	2,246,252	3,043,906	2,421,247	2,715,549
Petro. Products NEC	1,381,984	1,180,647	1,402,125	1,295,665	1,315,735	1,713,946	2,550,416	2,613,526
Kerosene	130,282	134,960	93,590	179,397	281,777	313,809	2,124,678	2,039,536
Manufac. Prod. NEC	904,773	1,069,176	1,257,468	1,354,148	1,850,132	1,580,343	1,712,874	1,999,549
Rubber & Plastic Pr.	865,434	948,341	943,421	1,113,570	1,244,756	1,479,931	1,420,319	1,553,995
Machinery (Not Elec)	1,214,868	1,452,578	1,626,850	1,482,966	1,535,417	1,737,497	1,241,640	1,463,487
Sorghum Grains	1,441,816	1,068,338	685,905	642,215	1,855,231	2,577,615	2,390,199	1,403,343
Iron & Steel Scrap	1,441,638	2,058,739	2,108,390	1,834,767	1,761,323	1,468,796	1,142,736	1,387,222
Sodium Hydroxide	875,179	1,015,970	1,158,368	1,228,547	1,123,957	1,265,824	1,208,166	1,384,201
Fab. Metal Products	885,762	1,170,279	1,508,128	1,299,816	1,180,291	1,333,655	1,013,194	1,275,617
Limestone	1,164,726	1,022,861	870,242	1,398,040	2,575,020	2,316,514	1,384,065	1,238,894
Chem. Products NEC	668,388	754,914	1,041,112	1,052,602	997,553	959,681	1,197,591	1,159,242
Sulphuric Acid	1,054,636	1,141,602	1,134,527	1,195,507	1,402,678	1,312,810	1,588,023	1,106,722
I&S Bars & Shapes	386,289	618,717	901,588	877,008	1,173,310	1,168,290	1,071,049	1,034,171
I&S Plates & Sheets	812,285	1,032,737	1,079,174	940,736	1,916,132	1,354,376	744,070	1,025,384
Grand Total	227,133,231	237,798,639	238,185,582	229,246,833	234,304,391	240,933,410	247,981,663	260,070,837

Source: USACE Waterborne Commerce Statistics

Foreign Trade Receipts and Shipments Combined

Houston Foreign Trade Commodity	2010	2011	2012	2013	2014	2015	2016	2017
Crude Petroleum	56,498,748	49,829,206	49,589,932	40,053,323	39,585,524	34,380,379	37,313,503	36,719,088
Distillate Fuel Oil	24,886,027	33,130,518	29,325,174	26,791,439	22,134,180	24,100,784	23,205,407	23,348,388
Hydrocarbon & Petrol Gases, Liquefied and Gaseou	3,579,589	3,713,750	5,096,952	9,097,318	13,060,289	15,627,863	18,442,169	19,433,570
Gasoline	11,275,135	12,002,163	11,566,099	9,603,416	6,272,051	8,857,483	9,936,829	12,040,534
Petroleum Coke	7,634,304	7,146,207	6,611,321	5,876,636	6,743,555	6,259,546	6,820,341	6,605,640
Naphtha & Solvents	870,578	1,263,177	1,029,509	3,298,402	5,410,348	6,752,238	6,068,148	6,286,132
I&S Pipe & Tube	3,367,407	4,257,241	5,338,765	4,807,144	5,110,784	4,771,053	2,132,143	4,816,164
Wheat	4,502,451	4,487,484	2,586,756	5,060,818	3,598,694	1,688,370	3,648,708	4,014,787
Organic Comp. NEC	3,172,176	3,005,905	2,973,331	3,029,292	2,924,830	3,101,180	3,583,880	3,763,435
Unknown or NEC	889,260	827,122	1,020,924	1,729,691	3,651,424	2,875,933	2,634,163	3,753,241
Plastics	3,756,101	3,803,767	3,826,768	3,634,545	2,976,357	3,371,903	3,561,565	3,320,472
Acyclic Hydrocarbons	1,063,528	1,330,156	877,500	753,433	521,590	897,189	1,273,343	3,286,332
Residual Fuel Oil	3,161,289	2,733,999	2,580,415	3,080,809	2,557,200	3,294,950	2,312,082	3,270,996
Alcohols	4,210,470	4,585,669	4,767,672	3,957,587	3,675,131	3,737,298	2,978,887	3,046,541
Lube Oil & Greases	182,900	3,034,410	489,887	1,188,476	2,155,830	3,341,325	3,211,024	2,996,281
Other Hydrocarbons	2,105,397	2,324,820	2,777,056	3,160,939	2,607,176	2,541,780	2,628,653	2,336,410
Cement & Concrete	674,793	779,581	1,016,911	1,259,517	1,676,771	2,479,668	2,122,011	2,143,138
Manufac. Prod. NEC	774,995	859,382	931,892	1,154,789	1,552,810	1,574,565	1,626,280	1,994,868
Carboxylic Acids	2,313,832	2,261,397	2,492,766	2,609,525	2,138,849	2,084,776	1,946,747	1,759,182
Rubber & Plastic Pr.	865,434	948,341	943,421	1,113,570	1,244,756	1,479,931	1,420,319	1,553,995
Machinery (Not Elec)	1,206,786	1,449,328	1,621,172	1,473,938	1,528,999	1,735,071	1,238,248	1,459,104
Sorghum Grains	1,429,711	1,065,093	682,648	638,827	1,853,213	2,567,108	2,390,199	1,403,343
Fab. Metal Products	636,597	793,569	1,015,558	951,252	950,463	1,173,919	989,954	1,260,152
Limestone	1,164,726	1,022,861	870,042	1,392,638	2,570,045	2,290,818	1,384,065	1,227,189
I&S Bars & Shapes	381,439	612,700	876,834	867,603	1,164,673	1,156,962	1,065,819	1,015,941
Grand Total	159,560,593	167,077,367	162,443,322	159,550,991	160,536,797	163,411,016	163,985,687	173,210,955

Source: USACE Waterborne Commerce Statistics

Non-Containerized Imports

	Trade	Imports								
	Port	Houston								
	World Region	(All)								
	Commodity	2010	2011	2012	2013	2014	2015	2016	2017	2018
1	2709 Crude Oil From Petroleum And Bituminous Minerals	58,225,931	54,325,534	49,246,584	40,752,230	37,619,227	30,198,451	33,969,478	30,911,643	26,329,026
2	2710 Oil (not Crude) From Petrol & Bitum Mineral Etc.	10,004,020	12,544,784	8,405,063	10,794,413	8,273,808	10,694,612	12,220,793	11,894,243	13,246,130
3	2523 Portland Cement, Aluminous Cement, Slag Cement Etc	643,109	732,411	904,184	1,191,572	1,639,555	2,394,786	1,969,307	1,972,468	2,187,656
4	7304 Tubes, Pipes Etc, Seamless, Iron Nesoi & Steel	1,464,257	1,952,105	2,271,672	1,878,410	2,246,748	1,598,157	788,391	1,798,138	1,920,956
5	2517 Pebbles, Gravel Etc; Macadam Of Slag, Dross Etc.	1,056,276	827,498	764,978	1,460,396	2,428,933	2,388,906	1,424,967	1,188,513	1,798,120
6	7306 Tubes, Pipes & Hollow Profiles Nesoi, Iron & Steel	1,117,962	1,663,437	2,225,405	2,193,366	2,567,562	1,544,068	748,303	2,317,028	1,576,643
7	2902 Cyclic Hydrocarbons	1,409,553	1,182,836	1,324,417	2,005,981	2,273,462	2,097,762	1,527,307	1,359,193	1,539,491
8	2207 Ethyl Alcohol, Undenat, Nun80% Alc; Alcohol, Denat	45,304	4,293	91,785	29,238	422,809	550,722	512,575	561,246	561,396
9	7208 Fl-rl Iron & Na Steel Nun600mm Wd Hot-rl, Not Clad	221,825	488,874	692,263	425,856	1,451,079	805,215	347,031	400,582	533,873
10	7210 Fl-rl Iron & Na Steel Nun600mm Wd, Clad Etc	237,932	251,407	366,947	313,826	622,242	670,181	596,459	744,690	518,909
11	2909 Ethers, Ether-alcohols, Alcohol Peroxides Etc.	50,593	63,360	64,097	44,869	53,867	145,702	549,635	566,694	488,905
12	2905 Acyclic Alcohols & Halogenat, Sulfonatd Etc Derivs	2,125,617	2,035,232	2,022,205	2,133,310	1,609,160	1,288,400	559,915	428,219	486,388
13	2707 Oils Etc From High Temp Coal Tar; Sim Aromatic Etc	395,540	596,838	373,206	435,902	353,839	366,068	313,073	281,275	414,784
14	7214 Bars & Rods, Iron & Na Steel Nesoi, H-r Etc	91,255	145,193	252,501	297,520	451,984	785,905	738,365	541,955	391,758
15	7207 Semifinished Products Of Iron Or Nonalloy Steel	171,018	308,230	424,921	429,908	477,085	264,639	182,186	296,897	371,239
16	2511 Natural Barium Sulfate; Nat Barium Carbonate Nesoi	411,884	418,063	529,907	242,982	375,757	205,533	42,154	277,147	354,111
17	7305 Tubes & Pipes Nesoi, Ext Dia Ov406-4mm, Ir & Steel	192,017	248,103	379,605	381,371	353,495	494,070	240,725	307,744	333,555
18	8703 Motor Cars & Vehicles For Transporting Persons	105,008	114,959	164,783	130,513	144,670	190,801	183,585	193,246	213,705
19	3102 Mineral Or Chemical Fertilizers, Nitrogenous	61,113	0	21	18,238	93,015	82,755	89,878	165,842	210,300
20	2914 Ketones & Quinones & Halogenatd, Sulfonatd Der Etc	27,800	48,868	76,130	77,836	133,542	140,180	119,267	186,426	201,682
21	1703 Molasses From The Extraction Or Refining Of Sugar	90,193	151,822	166,291	125,719	163,997	172,423	167,595	112,467	199,502
22	2814 Ammonia, Anhydrous Or In Aqueous Solution	332,343	317,544	291,215	266,170	291,943	293,190	264,942	205,139	182,967
23	2618 Granulated Slag Fr Iron Or Steel Manufacture		66,910	153,949	152,670	188,484	141,916	51,456	183,327	152,494
24	7225 Fl-rl Alloy Steel Nesoi Nun 600mm Wide	103,759	188,914	142,484	152,524	189,860	165,341	129,442	182,337	145,382
25	7209 Fl-rl Iron & Na Steel Nun600mm Wd Cold-rl, No Clad	43,348	76,099	64,538	52,810	156,794	141,901	126,293	143,222	128,075
1168	Grand Total	81,137,362	81,061,893	73,312,606	68,337,213	66,964,032	59,939,887	60,211,063	59,811,954	56,716,130

Source: US Census: USA Trade Online

Non-Containerized Exports

	Trade	Exports								
	Port	Houston								
	World Region	(All)								
	Commodity	2010	2011	2012	2013	2014	2015	2016	2017	2018
1	2710 Oil (not Crude) From Petrol & Bitum Mineral Etc.	27,572,566	32,185,545	35,225,981	32,918,537	29,447,883	37,615,146	35,123,583	38,568,145	39,814,957
2	2709 Crude Oil From Petroleum And Bituminous Minerals	325,864	147,474	176,825	713,101	1,884,046	4,382,062	3,367,444	8,048,094	25,929,534
3	2711 Petroleum Gases & Other Gaseous Hydrocarbons	3,349,633	3,529,224	4,256,473	7,376,205	13,833,074	15,479,850	19,695,219	20,002,448	20,948,668
4	2713 Petroleum Coke, Petroleum Bitumen & Other Residues	6,896,464	7,308,991	6,038,681	5,919,877	7,226,872	6,375,619	7,143,385	7,168,382	6,969,123
5	2901 Acyclic Hydrocarbons	684,311	722,228	673,805	739,462	520,995	735,495	901,766	1,273,004	4,434,695
6	2909 Ethers, Ether-alcohols, Alcohol Peroxides Etc.	2,317,922	2,100,470	2,111,377	2,305,120	2,151,292	2,480,282	2,818,326	2,689,236	2,641,751
7	2902 Cyclic Hydrocarbons	2,200,538	1,906,465	2,341,202	2,702,073	2,176,597	2,126,116	2,329,067	2,136,320	2,562,848
8	1001 Wheat And Meslin	4,832,275	4,749,515	2,494,555	4,969,486	4,050,111	1,719,987	3,647,771	4,128,059	2,245,420
9	2915 Sat Acyclic Nonocarbox Acid & Anhyd, Halogon Etc	1,608,400	1,405,310	1,594,024	1,581,769	1,532,658	1,435,606	1,336,693	1,295,637	1,264,045
10	2707 Oils Etc From High Temp Coal Tar; Sim Aromatic Etc	2,229,568	2,186,437	1,374,498	1,335,247	937,689	1,031,076	1,025,214	986,590	1,233,121
11	1007 Grain Sorghum	1,353,480	1,156,179	491,121	580,636	2,184,051	2,686,163	2,270,885	1,675,064	1,204,435
12	2815 Sodium Hydrox; Potass Hydrox; Sod Or Potass Perox	539,838	494,091	348,745	321,522	336,939	386,525	749,002	1,059,002	1,037,092
13	2701 Coal; Briquettes, Ovoids Etc. Mfr From Coal	1,202	483,743	1,803,768	3,193,343	2,118,857	523,973	51,603	395,637	903,498
14	2905 Acyclic Alcohols & Halogenat, Sulfonatd Etc Derivs	673,364	761,482	701,437	717,881	621,498	758,800	777,581	795,187	880,499
15	2207 Ethyl Alcohol, Undenat, Nun80% Alc; Alcohol, Denat	213,830	1,017,532	443,075	231,607	463,573	532,015	406,656	523,289	451,804
16	2926 Nitrile-function Compounds	650,085	651,287	210,184	271,159	255,884	257,942	275,059	239,392	359,917
17	7204 Ferrous Waste & Scrap; Remelt Scr Iron/steel Ingot	747,174	1,020,735	1,071,157	789,468	409,564	469,982	148,227	276,778	222,368
18	1502 Fats Of Bovines, Sheep/goats Other Than Head 1503	489,117	352,008	296,613	209,568	205,815	155,366	170,607	235,193	187,005
19	2921 Amine-function Compounds	109,767	224,595	141,399	185,156	207,496	131,019	135,471	114,212	179,207
20	1005 Corn (maize)	310,621	346,764	226,211	228,878	607,062	528,076	748,703	286,523	143,637
21	2830 Sulfides; Polysulfides	71,754	23,726	1,954	1,392	86	8,139	60,075	96,176	113,452
22	2903 Halogenated Derivatives Of Hydrocarbons	21,062	7,060	4,269	35,211	90,389	11,219	39,320	39,085	110,631
23	3907 Polyethers, Expoxides & Polyesters, Primary Forms	120,070	94,837	102,183	134,490	107,559	100,945	90,846	106,168	95,388
24	2907 Phenols; Phenol-alcohols	177,977	193,583	206,063	162,606	173,287	214,641	173,594	158,627	87,989
25	1501 Pig Fat And Poultry Fat Other Than Head 0209, 1503	106,316	116,947	50,119	37,921	35,143	21,326	7,275	11,992	81,779
1202	Grand Total	62,951,636	68,020,681	67,039,416	71,864,322	75,427,776	83,278,783	86,249,029	94,081,845	115,499,045

Source: US Census: USA Trade Online

Appendix C. Port of Galveston Commodities

All Trades (Shipments and Receipts, Domestic and Foreign)

All Traffic Types (Domestic & Foreign), All Traffic Directions (Tons) Galveston Commodity	2010	2011	2012	2013	2014	2015	2016	2017
Residual Fuel Oil	3,218,009	3,230,480	2,579,661	2,258,145	1,701,713	1,259,325	2,027,225	1,541,625
Sulphur (Liquid)	2,019,572	2,112,835	1,840,821	2,132,754	2,123,228	2,168,205	2,046,597	1,426,122
Distillate Fuel Oil	1,374,846	1,105,093	897,155	767,465	829,491	339,986	645,563	736,959
Wheat	2,152,496	2,900,983	915,445	633,307	429,158	359,845	573,649	506,173
Nitrogenous Fert.	509,632	616,254	1,059,833	797,944	1,002,750	934,751	724,669	505,202
Alcohols	16,946	1,316	3,189	24,561	8,495	9,665	40,161	471,061
Metallic Salts	26,114	113,153	170,593	208,115	323,237	495,113	304,207	330,693
Machinery (Not Elec)	480,227	329,503	288,611	430,209	320,546	396,551	311,053	282,476
Bananas & Plantains	217,040	224,396	198,804	260,414	298,067	322,304	322,806	278,359
Sand & Gravel	135,580	187,212	203,949	230,106	98,227	102,115	177,060	192,000
Potassic Fert.	8,637	41,266	87,318	121,396	53,749	58,332	50,622	182,751
Non-Metal. Min. NEC	144,004	368,681	258,233	242,135	160,612	130,245	174,955	174,252
Vehicles & Parts	92,016	78,453	82,300	81,203	90,870	92,816	91,116	147,579
Sorghum Grains	389,001	46,416			980,862	1,723,237	671,473	147,277
Soybeans	210,962	26,388		180,586	117,963	523,765	648,109	140,979
Unknown or NEC	78,539	94,349	125,823	107,168	137,044	84,775	54,350	135,063
Sulphur, (Dry)	491,673	331,557	168,494	70,394	174,536	123,415	74,538	130,552
Fruit & Nuts NEC	87,975	92,016	84,439	110,926	134,874	119,608	144,362	106,188
Grand Total	13,948,896	13,743,671	11,618,368	11,406,750	10,669,437	10,380,588	9,880,157	7,836,405

Source: USACE Waterborne Commerce Statistics

Foreign Trade Receipts and Shipments Combined

Galveston Foreign Trade Commodity	2010	2011	2012	2013	2014	2015	2016	2017
Wheat	2,125,617	2,900,983	915,445	633,307	429,158	359,845	573,649	506,173
Alcohols	14,278	1,316	3,189	24,561	8,495	9,665	40,161	447,077
Nitrogenous Fert.	463,837	576,032	993,358	741,513	979,238	876,305	651,528	436,215
Metallic Salts	188	91,265	149,919	188,930	307,161	481,524	299,996	327,894
Bananas & Plantains	217,040	224,396	198,804	260,414	298,067	322,304	322,806	278,359
Machinery (Not Elec)	174,346	238,562	244,067	249,627	279,273	262,074	160,042	231,022
Non-Metal. Min. NEC	130,844	311,862	225,662	167,705	141,262	102,497	116,206	173,852
Potassic Fert.	8,637	41,266	87,318	121,396	35,849	56,964	50,622	167,337
Vehicles & Parts	92,016	78,453	82,300	81,203	90,870	92,816	91,116	147,579
Sorghum Grains	389,001	46,416			980,862	1,723,237	671,473	147,277
Soybeans	210,962	26,388		180,586	117,963	523,765	648,109	140,979
Unknown or NEC	75,868	91,797	125,019	107,168	137,044	84,775	54,350	135,063
Sulphur, (Dry)	480,584	331,557	168,494	70,394	174,536	123,415	74,538	130,552
Fruit & Nuts NEC	87,975	92,016	84,439	110,926	134,874	119,608	144,362	106,188
Distillate Fuel Oil	1,095,196	746,116	643,111	660,637	565,241	80,413	109,872	82,648
I&S Pipe & Tube	12,762	9,819	7,634	15,141	12,225	16,535	19,686	72,789
Grand Total	8,014,469	7,270,766	4,767,020	4,285,877	5,144,698	6,069,089	4,909,608	3,808,424

Source: USACE Waterborne Commerce Statistics

Non-Containerized Imports

	Trade	Imports								
	Port	Galveston								
	World Region	(All)								
	Commodity	2010	2011	2012	2013	2014	2015	2016	2017	2018
1	3102 Mineral Or Chemical Fertilizers, Nitrogenous	418,327	435,974	733,899	595,352	840,446	817,165	635,491	481,413	484,861
2	0803 Bananas, Including Plantains, Fresh Or Dried	8,816	16,110	58,170	86,119	234,973	244,210	226,189	218,661	246,119
3	3105 M Or Ch Fertiliz, Nun2of3el; Fert Nesoi; Fert Pack	27,836	28,660			105,063				167,707
4	8429 Self-propelled Bulldozers, Graders, Scrapers Etc	29,929	71,255	116,201	91,821	105,160	105,194	52,577	73,205	123,170
5	2902 Cyclic Hydrocarbons	1,125	6,704				17,467	3,515	16,943	47,299
6	7308 Structures Nesoi & Parts Thereof, Of Iron Or Steel	14,460	232	13,735	1,504	190	14,649	4,681	15,788	41,083
7	2621 Ash&slag Nesoi, Inc Seaweed Ash; Ash Fm Muncp Wst							3,786		36,381
8	8701 Tractors (other Than Works Trucks Of Heading 8709)	16,824	27,406	38,184	20,251	31,283	29,873	28,538	28,313	35,616
9	2707 Oils Etc From High Temp Coal Tar; Sim Aromatic Etc							0	0	33,040
10	8703 Motor Cars & Vehicles For Transporting Persons	23	29	47	63	175	410	30,586	33,366	30,281
11	2710 Oil (not Crude) From Petrol & Bitum Mineral Etc.	350,919	260,452	192,710	78,769	99,248	112,301	33,590	74,465	22,643
12	8705 Special Purpose Motor Vehicles Nesoi	8,266	12,865	22,537	22,427	23,639	14,291	9,874	8,660	19,413
13	9801 Expts Of Repaired Impts; Impts Of Returned Expts	1,250	1,905	7,366	2,480	4,231	10,392	7,996	8,546	18,652
14	8412 Engines And Motors Nesoi, And Parts Thereof	568	438	653	161	439	4,281	154	8,234	17,326
15	8704 Motor Vehicles For Transport Of Goods	1,793	4,702	12,795	7,621	15,210	18,804	12,068	15,025	16,208
16	8502 Electric Generating Sets And Rotary Converters	222	0	3	435	152	436		1,588	15,682
17	8426 Ship's Derricks; Cranes; Mobile Lifting Frames Etc	10,302	14,144	28,106	25,474	18,084	14,188	14,714	10,586	13,394
403	Grand Total	3,333,938	3,823,413	4,673,657	4,694,608	3,041,088	1,613,652	1,232,447	1,092,702	1,414,246

Source: US Census: USA Trade Online

Non-Containerized Exports

	Trade	Exports								
	Port	Galveston								
	World Region	(All)								
	Commodity	2010	2011	2012	2013	2014	2015	2016	2017	2018
1	2710 Oil (not Crude) From Petrol & Bitum Mineral Etc.	1,015,638	912,892	771,122	811,179	1,881,490	515,314	116,419	796,861	1,440,863
2	2709 Crude Oil From Petroleum And Bituminous Minerals					1,215,696	183,771	90,817	249,130	1,055,541
3	2207 Ethyl Alcohol, Undenat, Nun80% Alc; Alcohol, Denat								447,792	674,622
4	1007 Grain Sorghum	357,739	19,821			929,682	1,960,645	611,091	168,768	303,584
5	2836 Carbonates; Peroxocarbonates; Comm Amm Carbonate		67,813	161,310	227,898	341,535	516,645	364,032	303,861	243,192
6	3104 Mineral Or Chemical Fertilizers, Potassic	8,713	134,561	369,525	440,054	204,929	250,604	185,189	259,513	170,445
7	1001 Wheat And Meslin	1,854,617	2,820,812	842,056	669,116	427,794	371,992	481,268	505,869	140,436
8	2707 Oils Etc From High Temp Coal Tar; Sim Aromatic Etc	167,145	268,701			6,673	175,420	243,163	102,430	103,438
9	1005 Corn (maize)	1,562,190	676,319	160,795	32,849	53,151	112,463	280,469		88,185
10	1201 Soybeans, Whether Or Not Broken	208,389	26,388		180,140	117,964	524,187	746,417	138,830	63,337
11	2503 Sulfur Of All Kinds Nesoi	45,746	30,756	147,788	81,696	108,004	47,424	74,593	116,394	44,344
12	8703 Motor Cars & Vehicles For Transporting Persons	32,897	27,809	22,847	23,083	26,206	16,152	10,977	21,988	25,049
13	8429 Self-propelled Bulldozers, Graders, Scrapers Etc	40,315	39,384	32,663	28,479	22,115	11,721	12,465	17,367	21,397
14	8701 Tractors (other Than Works Trucks Of Heading 8709)	10,256	11,903	16,642	8,877	17,840	4,082	3,605	4,236	10,943
15	8708 Parts & Access For Motor Vehicles (head 8701-8705)	6,562	5,985	7,764	8,791	10,310	8,872	6,118	8,454	10,352
16	8433 Harvest Etc Machines, Cleaning Eggs Etc Nesoi, Pts	1,437	4,823	13,457	3,661	5,034	2,833	2,163	1,883	6,604
17	8704 Motor Vehicles For Transport Of Goods	6,247	6,655	13,403	4,724	2,927	4,404	570	2,782	6,140
484	Grand Total	5,474,829	5,323,936	3,584,051	2,764,912	5,573,642	4,955,249	3,307,061	3,189,778	4,429,185

Source: US Census: USA Trade Online

Appendix D. Port of Texas City Commodities

All Trades (Shipments and Receipts, Domestic and Foreign)

All Traffic Types (Domestic & Foreign), All Traffic Directions (Tons)								
Texas City								
Commodity	2010	2011	2012	2013	2014	2015	2016	2017
Crude Petroleum	31,994,094	30,953,558	28,596,225	21,404,145	17,864,941	13,927,679	13,339,723	11,479,711
Distillate Fuel Oil	6,656,434	6,772,886	7,515,444	8,323,261	9,665,732	9,691,714	9,748,679	9,540,816
Gasoline	5,328,179	5,379,175	5,208,067	4,616,075	4,272,629	5,010,269	4,602,771	3,162,750
Naphtha & Solvents	2,268,926	2,326,688	2,834,119	3,744,892	3,518,418	2,927,669	1,860,277	2,418,840
Residual Fuel Oil	1,951,154	2,920,081	4,257,291	3,007,878	2,654,372	2,249,856	2,340,133	2,312,309
Alcohols	1,896,400	2,293,558	1,652,772	1,446,649	1,605,530	1,739,700	1,845,534	1,817,583
Other Hydrocarbons	1,801,675	2,189,410	2,172,409	2,221,370	1,832,293	1,617,467	1,735,234	1,779,305
Petroleum Coke	1,847,702	1,821,463	1,252,580	1,612,988	1,421,159	1,762,784	1,504,172	1,363,432
Petro. Products NEC	189,539	266,433	303,216	329,290	554,729	804,117	669,181	861,642
Benzene & Toluene	1,025,038	949,463	789,154	766,293	700,883	842,171	793,540	840,333
Carboxylic Acids	486,210	503,999	578,235	483,336	671,354	725,219	714,011	632,438
Organic Comp. NEC	117,814	130,822	190,812	251,951	244,418	286,922	260,389	240,119
Lube Oil & Greases	102,424	55,147	38,738	222,032	665,621	260,140	263,170	223,941
Asphalt, Tar & Pitch	153,555	367,039	487,028	197,544	155,424	233,274	231,212	163,190
Acyclic Hydrocarbons	70,653	67,410	34,939	12,166	34,812	65,070	78,436	139,837
Nitrogen Func. Comp.	131,197	100,025	138,205	108,248	190,476	183,245	187,011	128,115
Coal Coke		55,116		1,729				121,533
Unknown or NEC	1,685	2,517	3,571	42,228	191,588	149,406	123,122	112,250
Kerosene	63,765	121,797	68,335	75,346	45,459		34,739	109,467
Grand Total	56,590,856	57,757,532	56,721,627	49,674,036	47,884,949	42,923,997	41,260,475	37,751,062

Source: USACE Waterborne Commerce Statistics

Foreign Trade Receipts and Shipments Combined

Texas City Foreign Trade Commodity	2010	2011	2012	2013	2014	2015	2016	2017
Crude Petroleum	30,930,199	29,179,138	26,493,182	18,096,566	14,052,143	12,452,870	12,248,618	10,610,964
Distillate Fuel Oil	3,888,375	3,736,580	4,775,389	5,543,943	5,670,226	6,337,640	6,325,058	5,084,292
Gasoline	1,897,743	1,639,634	1,165,548	1,788,061	2,503,296	3,288,313	2,836,149	2,107,238
Petroleum Coke	1,406,898	1,526,171	1,069,454	1,316,244	1,203,371	1,759,718	1,355,780	1,290,282
Alcohols	443,880	1,104,388	789,618	672,297	870,519	913,244	1,059,923	1,070,793
Carboxylic Acids	202,603	191,790	221,032	220,877	403,536	454,509	516,532	430,166
Other Hydrocarbons	452,058	631,623	492,703	551,776	705,340	473,920	508,101	370,459
Organic Comp. NEC	71,545	74,653	102,639	154,192	147,306	219,012	202,856	178,560
Residual Fuel Oil	68,118	113,605	124,533	43,105	96,602	135,787	108,338	161,202
Lube Oil & Greases	46,053	1,345		169,271	623,035	187,286	173,854	158,996
Acyclic Hydrocarbons	36,987	43,149	32,539	10,325	33,393	38,179	78,436	139,487
Unknown or NEC	1,685	2,517	3,571	42,228	191,588	149,406	123,122	112,250
Grand Total	40,075,782	38,890,500	35,959,857	30,392,075	29,046,145	27,596,740	26,843,908	22,169,173

Source: USACE Waterborne Commerce Statistics

Non-Containerized Imports

	Trade	Imports								
	Port	Texas City								
	World Region	(All)								
	Commodity	2010	2011	2012	2013	2014	2015	2016	2017	2018
1	2709 Crude Oil From Petroleum And Bituminous Minerals	29,463,643	26,525,811	23,563,612	14,250,439	12,727,639	11,090,546	11,908,391	10,451,100	4,442,884
2	2710 Oil (not Crude) From Petrol & Bitum Mineral Etc.	851,577	652,502	559,788	638,668	617,885	421,469	339,943	315,439	38,485
3	2902 Cyclic Hydrocarbons	47,860	16,569	28,283	144,082	106,756	204,905	37,925	34,453	27,649
4	2915 Sat Acyclic Nonocarbox Acid & Anhyd, Halogon Etc		13,220	7,633	49,158	14,292	6,740			26,109
5	2707 Oils Etc From High Temp Coal Tar; Sim Aromatic Etc			3,170	28,980	0	2,130	8,504	5,512	18,664
6	2905 Acyclic Alcohols & Halogenat, Sulfonatd Etc Derivs	173,110	257,332	270,948	297,906	295,639	128,574	28,487	65,932	9,676
7	2914 Ketones & Quinones & Halogenatd, Sulfonatd Der Etc	3,189		2,315						2,197
8	2207 Ethyl Alcohol, Undenat, Nun80% Alc; Alcohol, Denat				10,623	14,537	9,792	6,675		1,730
	Grand Total	30,548,487	27,475,394	24,450,546	15,430,259	13,791,475	11,953,988	12,338,310	10,877,668	4,567,394

Source: US Census: USA Trade Online

Non-Containerized Exports

	Trade	Exports								
	Port	Texas City								
	World Region	(All)								
	Commodity	2010	2011	2012	2013	2014	2015	2016	2017	2018
1	2710 Oil (not Crude) From Petrol & Bitum Mineral Etc.	5,761,707	4,878,591	5,940,235	8,703,323	8,213,763	10,722,062	8,629,141	7,968,558	8,531,530
2	2709 Crude Oil From Petroleum And Bituminous Minerals					197,335	207,785		231,596	4,030,105
3	2713 Petroleum Coke, Petroleum Bitumen & Other Residue	1,020,439	1,446,517	1,131,525	1,225,853	1,195,340	1,833,634	1,323,642	1,377,092	1,319,640
4	2207 Ethyl Alcohol, Undenat, Nun80% Alc; Alcohol, Denat	247,926	822,087	668,462	561,854	784,853	706,250	1,005,688	1,128,716	1,170,448
5	2902 Cyclic Hydrocarbons	419,544	740,955	500,152	872,797	479,878	253,664	223,194	118,916	180,884
6	2915 Sat Acyclic Nonocarbox Acid & Anhyd, Halogon Etc	143,833	172,652	219,117	263,072	149,684	74,425	66,721	81,912	80,679
7	2707 Oils Etc From High Temp Coal Tar; Sim Aromatic Etc	4,963	11,169	5,800			0			36,467
8	2905 Acyclic Alcohols & Halogenat, Sulfonatd Etc Derivs	102,194	84,713	109,660	147,678	50,294	11,694	29,212	27,945	14,373
9	2916 Unsat Acyclic & Cyclic Monocarbox Acid & Anhyd Etc	0		1,190	6,855				551	5,456
10	3826 Biodiesel And Mixes Contain Lt 70% Petrol Oils Etc								235	2,125
11	2909 Ethers, Ether-alcohols, Alcohol Peroxides Etc.	100,823	108,881	113,877	131,833	72,494	2,004	1,878	3,532	1,673
	Grand Total	7,984,152	8,390,012	8,867,090	12,101,444	11,253,913	13,850,675	11,314,062	10,959,051	15,374,644

Source: US Census: USA Trade Online

Appendix E. Port of Freeport Commodities

All Trades (Shipments and Receipts, Domestic and Foreign)

All Traffic Types (Domestic & Foreign), All Traffic Directions (Tons)								
Freeport								
Commodity	2010	2011	2012	2013	2014	2015	2016	2017
Crude Petroleum	18,206,996	14,416,799	14,187,785	11,764,138	13,024,153	10,844,508	9,002,594	9,580,316
Hydrocarbon & Petrol Gases, Liquefied and Gaseou	452,806	842,377	358,292	138,455	271,444	327,302	517,040	4,416,436
Sodium Hydroxide	1,068,665	943,136	946,412	1,043,412	1,021,192	1,264,927	1,783,446	1,919,085
Other Hydrocarbons	1,232,550	1,266,751	1,177,537	837,325	1,281,137	1,276,430	1,219,335	1,264,226
Naphtha & Solvents	568,425	732,361	372,895	676,297	896,610	793,047	456,558	864,077
Limestone	222,859	93,986	220,323	406,410	1,210,924	1,552,710	1,163,385	849,105
Distillate Fuel Oil	11,604	175,214	119,079	42,940	166,515	143,005	60,451	604,406
Ammonia	497,970	514,181	504,908	606,497	544,098	581,810	470,817	455,938
Benzene & Toluene	452,920	511,424	424,138	488,838	480,178	425,778	341,950	454,692
Sulphuric Acid	495,802	474,768	515,233	520,137	523,395	467,590	454,535	448,625
Alcohols	447,120	480,629	519,283	422,018	332,273	399,220	465,650	364,762
Organic Comp. NEC	347,887	341,218	269,699	203,654	196,982	251,815	341,928	341,487
Gasoline	337,831	379,817	290,979	241,287	394,744	235,598	391,907	317,392
Plastics	323,284	273,101	293,835	253,878	281,208	410,133	375,287	302,433
Sand & Gravel	23			60,666	59	255,975	579,193	286,368
Bananas & Plantains	305,923	280,835	329,072	357,676	299,543	301,281	285,868	262,568
Nitrogen Func. Comp.	356,455	317,991	331,089	393,322	248,546	307,755	341,456	231,962
Unknown or NEC	27,543	12,871	8,082	49,840	80,190	146,151	167,796	230,788
Acyclic Hydrocarbons	224,644	262,052	241,811	224,731	266,718	282,605	177,860	210,055
Carboxylic Acids	121,879	129,427	211,986	167,941	130,961	173,767	155,368	142,690
Residual Fuel Oil	232,159	169,156	103,226	80,955	128,501	43,358	70,029	138,234
Rice	160,467	120,674	163,764	139,710	63,973	115,033	90,604	115,660
Grand Total	26,675,842	23,311,868	22,084,551	19,716,053	22,327,032	21,132,931	19,635,949	24,484,399

Source: USACE Waterborne Commerce Statistics

Foreign Trade Receipts and Shipments Combined

Freeport Foreign Trade Commodity	2010	2011	2012	2013	2014	2015	2016	2017
Crude Petroleum	18,176,956	14,211,173	12,750,118	8,468,531	11,043,096	9,453,835	8,675,764	9,129,266
Hydrocarbon & Petrol Gases, Liquefied and Gaseou	446,502	823,195	339,034	138,455	260,707	301,595	375,487	4,296,298
Sodium Hydroxide	752,955	737,576	826,105	907,917	868,177	1,101,370	1,622,747	1,625,653
Limestone	222,859	93,986	220,323	406,410	1,210,924	1,552,710	1,163,385	849,105
Distillate Fuel Oil	9,388	144,115	112,813	40,716	209	120,225	21,197	588,212
Other Hydrocarbons	267,377	240,668	181,523	163,618	464,525	551,887	535,285	555,584
Ammonia	497,970	514,181	504,908	606,497	544,098	581,810	470,817	455,938
Bananas & Plantains	305,923	280,835	329,072	357,676	299,543	301,281	285,868	262,568
Unknown or NEC	26,210	12,871	8,068	49,840	80,190	146,151	167,796	230,788
Plastics	248,733	209,736	212,352	189,563	205,439	322,745	292,056	213,710
Naphtha & Solvents	19,869	35,213	110	121,966	287,672	274,689	4,657	165,363
Alcohols	219,404	222,805	201,464	118,093	77,212	130,763	245,642	136,745
Organic Comp. NEC	202,475	241,484	109,462	70,229	68,288	123,766	178,774	126,544
Rice	84,556	51,497	74,722	66,042	49,885	82,760	37,791	85,150
Vehicles & Parts	9,724	5,834	6,236	5,043	7,350	41,339	82,715	80,230
Manufac. Prod. NEC	15,457	28,358	3,694	27,675	48,462	52,639	50,867	71,696
Machinery (Not Elec)	64,396	3,785	1,683	7,113	23,594	32,206	56,036	64,044
Grand Total	22,328,447	18,577,732	16,476,676	12,485,242	16,073,669	15,728,929	14,800,439	19,355,144

Source: USACE Waterborne Commerce Statistics

Non-Containerized Imports

	Trade	Imports								
	Port	Freeport, TX								
	World Region	All								
	Commodity	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**
1	2709 Crude Oil From Petroleum And Bituminous Minerals	17,833,219	13,765,762	12,806,548	8,387,947	10,159,338	8,894,906	7,869,916	6,583,635	4,983,752
2	2517 Pebbles, Gravel Etc; Macadam Of Slag, Dross Etc.	264,506	97,800	230,428	528,827	1,290,324	1,664,886	1,208,112	858,026	887,311
3	2710 Oil (not Crude) From Petrol & Bitum Mineral Etc.	159,182	403,407	35,025	96,976	48,551	43,995	34,668	668,671	411,835
4	2814 Ammonia, Anhydrous Or In Aqueous Solution	600,357	566,852	537,253	551,705	519,183	511,271	489,805	529,208	235,647
5	7224 Alloy Steel Nesoi In Ingots, Oth Pr Frm & Semif Pr									152,899
6	2902 Cyclic Hydrocarbons	15,733	59,935	48,224	54,289	40,379	59,913	46,550	59,618	72,074
7	7304 Tubes, Pipes Etc, Seamless, Iron Nesoi & Steel				1,896	11,596	29,210	49,495	115,625	58,340
8	8703 Motor Cars & Vehicles For Transporting Persons						6,140	26,420	23,722	41,435
9	2903 Halogenated Derivatives Of Hydrocarbons	87,744	78,630	58,988	42,618	56,645	25,450	28,009	46,574	41,127
10	2921 Amine-function Compounds			2,194		2,285		2,285	7,807	40,432
11	0803 Bananas, Including Plantains, Fresh Or Dried	138,957	142,067	116,381	49,283	24,278	0	9,402	51,344	37,845
12	2901 Acyclic Hydrocarbons	3,288	6,700	16,670	25,198	23,250	30,771	21,567	8,459	27,658
13	8426 Ship's Derricks; Cranes; Mobile Lifting Frames Etc				0	3,069	5,030	10,385	12,530	25,505
14	8429 Self-propelled Bulldozers, Graders, Scrapers Etc						8,502	23,901	27,464	25,426
15	3909 Amino-resins, Phenolics & Polyurethanes, Prim Form					7,412			3,472	14,531
	Grand Total	19,444,349	15,646,162	14,026,327	9,933,170	12,322,447	11,426,554	9,848,318	9,041,048	7,096,905

Source: US Census: USA Trade Online

Non-Containerized Exports

	Trade	Exports								
	Port	Freeport, TX								
	World Region	All								
	Commodity	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**
1	2711 Petroleum Gases & Other Gaseous Hydrocarbons	271,572	205,865	248,752	19,470	61,544	259,738	344,008	4,240,854	5,859,999
2	2709 Crude Oil From Petroleum And Bituminous Minerals			99,662	267,666	1,720,628	1,545,000	1,269,725	2,955,521	4,634,721
3	2815 Sodium Hydrox; Potass Hydrox; Sod Or Potass Perox	360,972	519,636	691,906	832,150	857,398	523,899	923,166	776,689	531,668
4	2903 Halogenated Derivatives Of Hydrocarbons	66,091	100,006	110,553	139,305	531,426	530,792	493,773	492,313	374,678
5	2710 Oil (not Crude) From Petrol & Bitum Mineral Etc.	72,473	61,399	148,355	197,319	417,323	347,573	112,102	172,449	360,494
6	2901 Acyclic Hydrocarbons				685			34,983	11,046	141,232
7	8703 Motor Cars & Vehicles For Transporting Persons	4	197	50	1	0	71,513	95,767	72,214	88,050
8	1006 Rice	80,954	47,929	59,710	63,090	67,501	76,849	47,879	94,657	59,158
9	2907 Phenols; Phenol-alcohols	65,673	73,313	78,552	44,145	12,196	14,062	20,677	9,772	40,662
10	8704 Motor Vehicles For Transport Of Goods	0	0		41		5,879	6,401	6,397	12,146
11	6309 Worn Clothing And Other Worn Textile Articles	984	597	831	655	494	2,704	4,949	4,887	7,727
12	2910 Epoxides With A 3-memb Ring & Halog, Sulfon Etc	156,153	129,895	58,584	46,229	38,451	5,555	5,235	3,507	7,036
13	2914 Ketones & Quinones & Halogenatd, Sulfonatd Der Etc	16,047	42,061	9,847	6,975		4,285	1,653	6,409	6,700
14	8429 Self-propelled Bulldozers, Graders, Scrapers Etc	117	120	171	25		2,440	4,056	5,417	4,319
15	8426 Ship's Derricks; Cranes; Mobile Lifting Frames Etc			84	0	9,062	833	2,363	3,261	3,271
	Grand Total	1,538,116	1,535,439	1,922,797	1,921,789	3,974,731	3,494,327	3,415,031	8,931,915	12,152,629

Source: US Census: USA Trade Online

Appendix F. Benefit Analyses Model Assumptions

Table F- 1: Benefit Analyses Model Assumptions

Variable	Value	Unit	Source
Base Year	2019	Year	H-GAC
Project Opening Year	2020	Year	H-GAC
Analysis Period	20	Years	H-GAC
Annual Growth Rate Of Import Containers (2019-2029)[186]	3.2	Percent	HDR, Martin Associates, and WSP, Port Profiles Draft Report Houston-Galveston Area Council, October 2017. Table 3-7.
Annual Growth Rate Of Export Containers (2019-2029)	12.8	Percent	H-GAC; Export container level in 2019 assumed to be 30% of capacity. Capacity estimated to be reached by 2029.
Truck Capacity	1	Forty-foot equivalent unit (FEU)	H-GAC
Average Truck Speed	49.5	Mile per Hour	TxDOT Maritime Division, Port Connectivity Report 2020-2021 Texas Port Mission Plan, November 2018. Average of the average speeds on Table 3-3.
Annual Average Truck Speed Reduction (2019-2029)[187]	1	Mile per Hour per Year	H-GAC
Average Vehicle Occupancy for Trucks	1.00	Person	USDOT, BCA Guidance, December 2018.
Value of Time (Truck Drivers)	28.60	Dollars (2017) per Hour	USDOT, BCA Guidance, December 2018.
Fatality Rate of Project Area	1.4	Fatalities per Hundred Million Vehicle Miles Travelled	H-GAC, State of Safety Report, 2017. Page 2.
Serious Injury Rate of Project Area	6.6	Serious Injuries per Hundred Million Vehicle Miles Travelled	H-GAC, State of Safety Report, 2017. Page 2.

[186] Import and export containers remain constant after 2029. Due to capacity limitations of the port and a lack of available information about capacity expansion prior to 2029, the number of import and export containers are assumed to stay constant after 2029.

[187] As the number of containers at the Port increases between 2019 and 2029, traffic in the area will increase to transport the containers. Therefore, it is assumed that truck travel speeds will decrease during this timeframe. Once the number of containers remains constant after 2029, speed is held constant.

Variable	Value	Unit	Source
Value of Statistical Life (Fatality)	9,600,000	Dollars (2017)	USDOT, BCA Guidance, December 2018.
Average Cost Per Serious Injury	1,008,000	Dollars (2017)	USDOT, BCA Guidance, December 2018.
Volatile Organic Compounds (VOCs)	2,000	Dollars (2017) per Short Ton	USDOT, BCA Guidance, December 2018.
Nitrogen Oxides (NOx)	8,300	Dollars (2017) per Short Ton	USDOT, BCA Guidance, December 2018.
Fine Particulate Matter ($PM_{2.5}$)	377,800	Dollars (2017) per Short Ton	USDOT, BCA Guidance, December 2018.
Sulfur Oxide (SO_2)	48,900	Dollars (2017) per Short Ton	USDOT, BCA Guidance, December 2018.
Carbon Dioxide (CO_2)	Range from 0.91 in 2019 to 1.81 in 2039	Dollars (2017) per Short Ton	USDOT, BCA Guidance, December 2018.

Container Movement Assumptions

To assess the benefits associated with each of the shortlisted container movement solutions, a theoretical market assessment was undertaken. This was based on the transportation of both import and export containers which originate in and destined for various users in the Baytown area – predominately in the industrial parks east of Baytown and in Mont Belvieu. Importers such as for Ikea, Walmart, Home Depot, and Red Bull and exporters including Vinmar, Revago, KTN, Plantgistix, PBP and ExxonMobil Chemical Company were identified and the annual number of containers they exported and imported on an annual basis was estimated using a variety of data sources and assumptions. For some solutions, the number of containers was assessed against a high demand scenario and a lower demand scenario.

Sensitivity Analysis Assumptions

MOVES assumes an aggressive increase in fuel efficiency for trucks. Within the MOVES software, the emission rates for trucks for NOx, PM2.5, and SOx are assumed to decrease at a rapid rate especially between 2016 and 2025. NOx emission rates between 2016 and 2025, at 50 mph, for trucks are decreasing by approximately 11.2 percent annually. Between 2025 and 2035, the reduction in the emission rate is still high at 5.3 percent annually. For the sensitivity analysis, emission rate data from MOVES is provided for 2016, 2025, 2035, and 2045 for 16 speed bins between zero mph and 75 mph. From the raw data, emissions rates for every one mile per hour speed between five mph and 75 mph were interpolated. The raw data is also interpolated between the years provided to estimate an emission rate for every year between 2016 and 2045. After 2045, the emission rates are assumed to remain constant.

Appendix G. Annual Benefits by Solution

Table G- 1: Virtual Container Yard Total Benefits by Category by Year, Discounted at 7 Percent

Year	Project Year	Travel Time Savings	Crash Cost Savings	Emissions Cost Savings	Total Benefits
2020	1	$1,100,262	$378,762	$185,799	$1,664,823
2021	2	$1,083,293	$365,310	$182,225	$1,630,829
2022	3	$1,067,050	$352,336	$178,672	$1,598,057
2023	4	$1,051,529	$339,824	$175,141	$1,566,495
2024	5	$1,036,720	$327,754	$171,636	$1,536,110
2025	6	$1,022,632	$316,116	$167,439	$1,506,186
2026	7	$1,009,253	$304,890	$163,323	$1,477,466
2027	8	$996,586	$294,062	$159,288	$1,449,936
2028	9	$984,632	$283,617	$155,332	$1,423,581
2029	10	$973,403	$273,544	$151,458	$1,398,405
2030	11	$909,723	$255,649	$141,549	$1,306,921
2031	12	$850,208	$238,924	$132,622	$1,221,754
2032	13	$794,587	$223,293	$124,256	$1,142,137
2033	14	$742,605	$208,685	$116,418	$1,067,708
2034	15	$694,023	$195,033	$109,073	$998,130
2035	16	$648,620	$182,274	$102,191	$933,085
2036	17	$606,187	$170,349	$95,506	$872,042
2037	18	$566,530	$159,205	$89,258	$814,993
2038	19	$529,467	$148,790	$83,419	$761,675
2039	20	$494,829	$139,056	$77,961	$711,846
Total		**$17,162,139**	**$5,157,474**	**$2,762,567**	**$25,082,179**

Table G- 2: Freight Shuttle Transfer Operation, Total Benefits by Category by Year, Discounted at 7 Percent, High Demand Scenario

Year	Project Year	Truck Transportation Time Savings	Crash Cost Savings	Emissions Cost Savings	Total Benefits
2020	1	$3,232,834	$1,101,538	$540,425	$4,874,798
2021	2	$3,528,415	$1,177,464	$587,428	$5,293,307
2022	3	$3,792,741	$1,239,026	$628,403	$5,660,170
2023	4	$4,028,581	$1,287,769	$663,790	$5,980,140
2024	5	$4,238,507	$1,325,096	$693,978	$6,257,581
2025	6	$4,424,905	$1,352,283	$716,334	$6,493,523
2026	7	$4,589,993	$1,370,488	$734,205	$6,694,687
2027	8	$4,735,831	$1,380,762	$747,998	$6,864,591
2028	9	$4,864,339	$1,384,055	$758,090	$7,006,484
2029	10	$4,977,302	$1,381,228	$764,849	$7,123,379
2030	11	$4,651,684	$1,290,868	$714,812	$6,657,364
2031	12	$4,347,368	$1,206,418	$669,742	$6,223,529
2032	13	$4,062,961	$1,127,494	$627,510	$5,817,965
2033	14	$3,797,160	$1,053,733	$587,937	$5,438,830
2034	15	$3,548,748	$984,797	$550,856	$5,084,401
2035	16	$3,316,587	$920,371	$516,111	$4,753,069
2036	17	$3,099,614	$860,160	$482,347	$4,442,120
2037	18	$2,896,835	$803,888	$450,791	$4,151,514
2038	19	$2,707,323	$751,297	$421,300	$3,879,920
2039	20	$2,530,208	$702,147	$393,739	$3,626,093
Total		**$77,371,936**	**$22,700,881**	**$12,250,646**	**$112,323,463**

Table G- 3: Freight Shuttle Direct To User, Total Benefits by Category by Year, Discounted at 7 Percent, High Demand Scenario

Year	Project Year	Truck Transportation Time Savings	Crash Cost Savings	Emissions Cost Savings	Total Benefits
2020	1	$5,210,625	$1,793,744	$879,905	$7,884,274
2021	2	$5,710,623	$1,925,747	$960,609	$8,596,979
2022	3	$6,157,610	$2,033,220	$1,031,060	$9,221,890
2023	4	$6,556,235	$2,118,784	$1,091,999	$9,767,018
2024	5	$6,910,865	$2,184,838	$1,144,139	$10,239,842
2025	6	$7,225,527	$2,233,555	$1,183,058	$10,642,141
2026	7	$7,503,937	$2,266,898	$1,214,327	$10,985,163
2027	8	$7,749,600	$2,286,668	$1,238,644	$11,274,912
2028	9	$7,965,720	$2,294,475	$1,256,647	$11,516,842
2029	10	$8,155,342	$2,291,799	$1,268,939	$11,716,080
2030	11	$7,621,815	$2,141,869	$1,185,924	$10,949,608
2031	12	$7,123,191	$2,001,746	$1,111,127	$10,236,065
2032	13	$6,657,188	$1,870,791	$1,041,041	$9,569,020
2033	14	$6,221,671	$1,748,403	$975,370	$8,945,444
2034	15	$5,814,646	$1,634,021	$913,835	$8,362,503
2035	16	$5,434,249	$1,527,123	$856,178	$7,817,549
2036	17	$5,078,737	$1,427,217	$800,166	$7,306,121
2037	18	$4,746,483	$1,333,848	$747,819	$6,828,150
2038	19	$4,435,966	$1,246,587	$698,896	$6,381,449
2039	20	$4,145,762	$1,165,035	$653,174	$5,963,971
Total		**$126,425,793**	**$37,526,368**	**$20,252,857**	**$184,205,019**

Table G- 4: Container on Barge Total Benefits by Category by Year, Discounted at 7 Percent – High Demand Scenario

Year	Project Year	Truck Transportation Time Savings	Crash Cost Savings	Emissions Cost Savings	Total Benefits
2020	1	$1,996,610	$665,898	$176,052	$2,838,561
2021	2	$2,196,705	$707,420	$192,148	$3,096,273
2022	3	$2,382,420	$740,858	$206,770	$3,330,048
2023	4	$2,554,757	$767,085	$219,960	$3,541,802
2024	5	$2,714,679	$786,894	$231,763	$3,733,336
2025	6	$2,863,105	$801,007	$240,392	$3,904,504
2026	7	$3,000,920	$810,078	$247,699	$4,058,697
2027	8	$3,128,976	$814,699	$253,771	$4,197,446
2028	9	$3,248,089	$815,409	$258,695	$4,322,193
2029	10	$3,359,050	$812,693	$262,554	$4,434,297
2030	11	$3,139,299	$759,527	$245,377	$4,144,203
2031	12	$2,933,924	$709,838	$229,324	$3,873,087
2032	13	$2,741,985	$663,400	$214,322	$3,619,707
2033	14	$2,562,603	$620,000	$200,301	$3,382,904
2034	15	$2,394,956	$579,439	$187,197	$3,161,593
2035	16	$2,238,277	$541,532	$174,951	$2,954,759
2036	17	$2,091,848	$506,105	$163,505	$2,761,457
2037	18	$1,954,998	$472,995	$152,809	$2,580,801
2038	19	$1,827,101	$442,051	$142,812	$2,411,964
2039	20	$1,707,571	$413,132	$133,469	$2,254,172
Total		**$51,037,872**	**$13,430,059**	**$4,133,872**	**$68,601,803**

Table G- 5: Freight Shuttle Transfer Operation, Total Benefits by Category by Year, Discounted at 7 Percent, Low Demand Scenario

Year	Project Year	Truck Transportation Time Savings	Crash Cost Savings	Emission Cost Savings	Total Benefits
2020	1	$1,484,525	$505,829	$248,165	$2,238,518
2021	2	$1,653,474	$551,779	$275,278	$2,480,532
2022	3	$1,804,853	$589,616	$299,038	$2,693,508
2023	4	$1,940,202	$620,202	$319,688	$2,880,092
2024	5	$2,060,951	$644,321	$337,443	$3,042,715
2025	6	$2,168,425	$662,686	$351,040	$3,182,151
2026	7	$2,263,856	$675,946	$362,122	$3,301,924
2027	8	$2,348,390	$684,688	$370,915	$3,403,993
2028	9	$2,423,089	$689,444	$377,630	$3,490,163
2029	10	$2,488,946	$690,696	$382,470	$3,562,112
2030	11	$2,326,118	$645,510	$357,448	$3,329,077
2031	12	$2,173,942	$603,281	$334,911	$3,112,134
2032	13	$2,031,722	$563,814	$313,792	$2,909,327
2033	14	$1,898,805	$526,929	$294,003	$2,719,737
2034	15	$1,774,584	$492,457	$275,461	$2,542,502
2035	16	$1,658,490	$460,240	$258,086	$2,376,816
2036	17	$1,549,991	$430,131	$241,202	$2,221,323
2037	18	$1,448,589	$401,991	$225,422	$2,076,003
2038	19	$1,353,822	$375,693	$210,675	$1,940,190
2039	20	$1,265,254	$351,115	$196,893	$1,813,262
Total		**$38,118,029**	**$11,166,368**	**$6,031,682**	**$55,316,079**

Table G- 6: Freight Shuttle Direct to User Total Benefits by Category by Year, Discounted at 7 Percent, Low Demand Scenario

Year	Project Year	Truck Transportation Time Savings	Crash Cost Savings	Emissions Cost Savings	Total Benefits
2020	1	$3,126,375	$1,076,246	$527,943	$4,730,565
2021	2	$3,426,374	$1,155,448	$576,365	$5,158,187
2022	3	$3,694,566	$1,219,932	$618,636	$5,533,134
2023	4	$3,933,741	$1,271,271	$655,199	$5,860,211
2024	5	$4,146,519	$1,310,903	$686,483	$6,143,905
2025	6	$4,335,316	$1,340,133	$709,835	$6,385,284
2026	7	$4,502,362	$1,360,139	$728,596	$6,591,098
2027	8	$4,649,760	$1,372,001	$743,186	$6,764,947
2028	9	$4,779,432	$1,376,685	$753,988	$6,910,105
2029	10	$4,893,205	$1,375,080	$761,363	$7,029,648
2030	11	$4,573,089	$1,285,121	$711,555	$6,569,765
2031	12	$4,273,915	$1,201,048	$666,676	$6,141,639
2032	13	$3,994,313	$1,122,475	$624,625	$5,741,412
2033	14	$3,733,003	$1,049,042	$585,222	$5,367,266
2034	15	$3,488,788	$980,413	$548,301	$5,017,502
2035	16	$3,260,549	$916,274	$513,707	$4,690,529
2036	17	$3,047,242	$856,330	$480,100	$4,383,672
2037	18	$2,847,890	$800,309	$448,691	$4,096,890
2038	19	$2,661,579	$747,952	$419,338	$3,828,869
2039	20	$2,487,457	$699,021	$391,904	$3,578,382
Total		**$75,855,476**	**$22,515,821**	**$12,151,714**	**$110,523,011**

Table G- 7: Container on Barge Total Benefits by Category by Year, Discounted at 7 Percent, Low Demand Scenario

Year	Project Year	Truck Transportation Time Savings	Crash Cost Savings	Emission Cost Savings	Total Benefits
2020	1	$997,048	$320,548	$83,567	$1,401,163
2021	2	$1,148,770	$345,370	$92,617	$1,586,757
2022	3	$1,296,335	$365,639	$100,860	$1,762,834
2023	4	$1,439,631	$381,841	$108,316	$1,929,788
2024	5	$1,578,601	$394,420	$115,010	$2,088,031
2025	6	$1,713,247	$403,778	$120,043	$2,237,068
2026	7	$1,843,615	$410,282	$124,342	$2,378,239
2027	8	$1,969,799	$414,261	$127,955	$2,512,015
2028	9	$2,091,930	$416,018	$130,930	$2,638,878
2029	10	$2,210,177	$415,823	$133,313	$2,759,312
2030	11	$2,065,586	$388,619	$124,591	$2,578,797
2031	12	$1,930,454	$363,196	$116,440	$2,410,090
2032	13	$1,804,163	$339,435	$108,823	$2,252,421
2033	14	$1,686,134	$317,229	$101,704	$2,105,066
2034	15	$1,575,826	$296,476	$95,050	$1,967,352
2035	16	$1,472,734	$277,080	$88,832	$1,838,646
2036	17	$1,376,387	$258,953	$83,020	$1,718,361
2037	18	$1,286,343	$242,013	$77,589	$1,605,945
2038	19	$1,202,190	$226,180	$72,513	$1,500,883
2039	20	$1,123,542	$211,383	$67,769	$1,402,694
Total		**$31,812,510**	**$6,788,544**	**$2,073,286**	**$40,674,340**

Appendix H. Ports Area Mobility Study Workshop

Ports Area Mobility Study Workshop
Workshop Invitation List

Name	Organization
	ACM Logistics and Consulting
Rich Campbell	Air Liquide
Robin Parhat	Air Liquide
Sean Morris	Air Liquide
Traci Keonig	Anthem Advocacy
	Argosy Transportation Group
	Atkins Global
B.J. Simon	Baytown Economic Development Foundation
Hugh McCulley	BNSF Railway
James W. O'Donley	BNSF Railway
Lindsay Mullins	BNSF Railway
Paul Cristina	BNSF Railway
Gary Basinger	Brazosport Economic Development Center
Commissioner Rusty Senac	Chambers County
	Chambers County
Tim Tietjens	City of Galveston
Mayor Michel Bechtel	City of Morgan's Point
Trent Epperson	City of Pearland
Danny Clark	Clark Freight
Kim Sachtleben	Costello
Randy Parsons	Dunavant Trans Gulf Transportation
Craig Beskid	East Harris County Chemical Manufactures Association
Sean Stockard	Econonmic Development Alliance for Brazoria County
Marcia H. Faschingbauer	Excargo
Perry Padden	ExxonMobil
Georgi Ann Jasenovec	Federal Highway Administration
Dan Croft	First State Bank
Chris Debaillon	Fort Bend County
Richard Stolleis	Fort Bend County
Gordon Dorsey	Freight Shuttle International
	Frontier Logistics
Michael Shannon	Galveston County
Evelio Fernandez	Goya Foods
Bob Pertierra	Greater Houston Partnership
Josh Davis	Greater Houston Partnership
Capt. Bill Diehl	Greater Houston Port Bureau
Maureen Crocker	Gulf Coast Rail District
Jim Stark	Gulf Intracoastal Canal Association
Gabriel Allen	Gulf Winds International
Barbara Koslov	Harris County

Ports Area Mobility Study Workshop
Workshop Invitation List

Name	Organization
Clif Edwards	Harris County
Jeremy Phillips	Harris County
Leanna Abbott	Harris County
Gary Trietsch	Harris County Toll Road Authority
Robert Sakowitz	Hazak Corporation
	Igloo Products Corporation
Brian Fielkow	Jetco Delivery
Dustin Aaron	Katoen Natie Gulf Coast Inc.
Frank Vingerhoets	Katoen Natie Gulf Coast Inc.
Willem DePesseroey	Katoen Natie Gulf Coast Inc.
Matt Woodruff	Kirby Marine
	Lake Houston Area Chamber of Commerce
	Lake Houston Area Chamber of Commerce
Scott Campbell	LyondellBasell Industries
Bryan Ruth	McCord Development
Melissa Carter	North Houston Association
Michael Siwierka	Perdue Brandon Fielder Collins & Mott LLP
Mike Gehrig	Pier Communications
Jason Miura	Port Freeport
Mike Wilson	Port Freeport
Bruce Mann	Port Houston
John Moseley	Port Houston
Roger Guenther	Port Houston
Spencer Chambers	Port Houston
Peter Simons	Port of Galveston
Rainer Lilienthal	Richardson Companies
Scott Spyker	Scott Sheldon
Michelle Hundley	Stratus Public Relations, LLC
Shaun Leone	Sunburst Truck Lines, Inc
Andrew Mao	Texas Department of Transportation
Arielle Carcihidi	Texas Department of Transportation
Bill Brudnick	Texas Department of Transportation
Mary Aparicio	Texas Department of Transportation
Pat Henry	Texas Department of Transportation
Raquelle Lewis	Texas Department of Transportation
Stephanie Cribbs	Texas Department of Transportation
Caroline Mays	Texas Department of Transportation - FIT
Kale Driemeier	Texas Department of Transportation - FIT
	Texas International Freight
	Trans-Global Solutions, Inc.

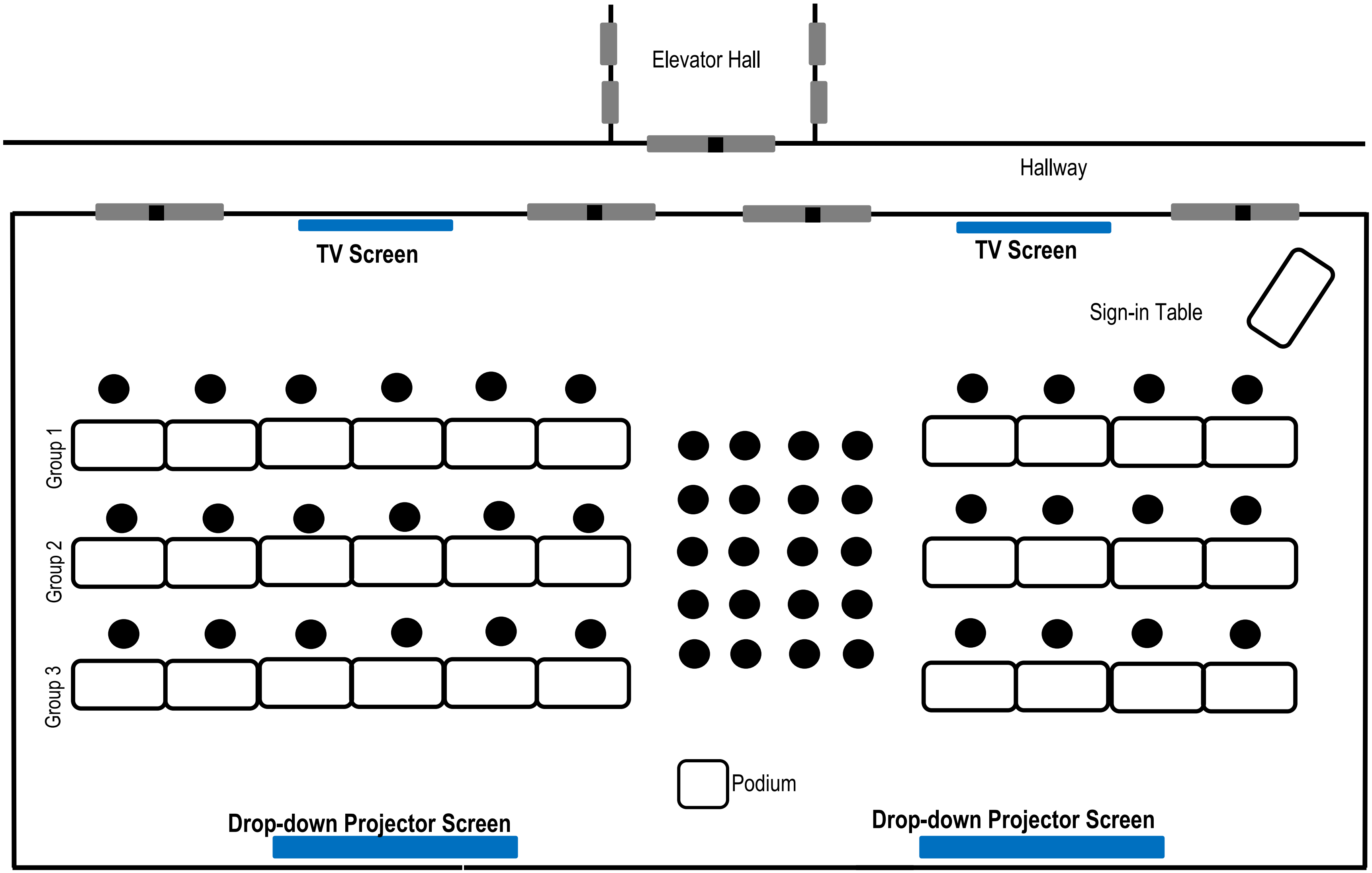
Ports Area Mobility Study Workshop
Workshop Invitation List

Name	Organization
Doug Sturgis	Dow Chemical Company
Zack Bell	Dow Chemical Company
Charles Herd	The Lanier Law Firm PC
	The Plank Companies
Jon Prewitt	TidePort Distributing
Brenda Mainwaring	Union Pacific
Richard Zientek	Union Pacific
Tyson O. Moeller	Union Pacific
	US - Mexico Chamber of Commerce
Vince Yokom	Waller County
Augustus Campbell	West Houston Association
John Vogt	WWBC LLC Consulting

Ports Area Mobility Study Workshop

Houston Galveston Area Council, 3555 Timmons Ln, Houston, TX 77027

Conference Rooms B & C



Houston-Galveston Area Council

Wednesday, January 24, 2018
1:30 p.m. – 3:30 p.m.
Houston-Galveston Area Council
3555 Timmons Ln.
Houston, TX 77027

Ports Area Mobility Study Workshop

#	Name	Organization	Email	Are you an elected official? If yes, position:	Group Color
1	Clif Edwards	Harris County Precinct 4	cedwards@hcp4.net	Representative for Commissioner R. Jack Cagle	Light Blue
2	Mike Wilson	Port Freeport	wilson@portfreeport.com	No	Orange
3	David R. Milner	Greater Houston Partnership – Dannenbaum	david.milner@dannenbaum.com	No	Light Blue
4	Charles Nunu	Chorus Logistics	clnunu@protonmail.ch	No	Orange
5	Jennifer Almonte	Harris County Precinct 2	jennifer.almonte@pct2.hctx.net	No	Light Blue
6	Andrew DeCandis	Houston-Galveston Area Council	andrew.decandis@h-gac.com	No	
7	Norman Whitton	Electric Interstate Highway Standards Association Inc.	president@sunrise-ridge.com	No	Light Green
8	Hugh McCulley	TSNSF, PTRA	hmcculley@cjmlaw.com	No	Orange
9	Tyson Moeller	Union Pacific Railroad	tomoeller@up.com	No	Light Blue
10	Shain Eversley	Houston-Galveston Area Council	shain.eversley@h-gac.com	No	
11	Maureen Crocker	Houston Public Works	maureen.crocker@houstontx.gov	No	Orange
12	Bruce Mann	Port Houston	bmann@poha.com	No	Light Blue

Wednesday, January 24, 2018
1:30 p.m. – 3:30 p.m.
Houston-Galveston Area Council
3555 Timmons Ln.
Houston, TX 77027

Ports Area Mobility Study Workshop

#	Name	Organization	Email	Are you an elected official? If yes, position:	Group Color
13	Rusty Senac	Chambers County	arsenac@chamberstx.gov	Precinct 4 Commissioner	Orange
14	Alan Clark	Houston-Galveston Area Council		No	
15	Brenda Mainwaring	Union Pacific	brendamainwaring@up.com	No	Light Blue
16	Barbara Koslov	Harris County	barbara.koslov@cjo.hctx.net	Representative for Judge Ed Emmett	Orange
17	Paul Cristina	BNSF Railway	paul.cristina@bnsf.com	No	Light Green
18	Andrew Mao	Texas Department of Transportation			Light Green
19	Charles Airiohuodion	Texas Department of Transportation			Orange
20	Robert Sakowitz	Hazak Corporation	rsakowitz@hazak.com	No	Light Green
21	Anne Dunning	Port Houston	adunning@poha.com	No	Light Green
22	Shelley Whitworth	Houston-Galveston Area Council	shelly.whitworth@h-gac.com	No	

Houston-Galveston Area Council

Wednesday, January 24, 2018
1:30 p.m. – 3:30 p.m.
Houston-Galveston Area Council
3555 Timmons Ln.
Houston, TX 77027

Ports Area Mobility Study Workshop

#	Signature	Name	Organization	Email	Are you an elected official? If yes, position:
1	Cliff Edwards	CLIF EDWARDS	HC Pct 4	CEDWARDS@HCP4.NET	REP.
2	Mike Wilson	Mike Wilson	Port FREEPORT	wilson@portfreeport.com	No
3	DAVID MILNER	DAVID R. MILNER	GHP - DANNENBAUM	David.Milner@Dannenbaum.com	NO
4	~~CHARLES NUNU~~	CHARLES NUNU	CHORUS LOGISTICS	CANUNU@PROTONMAIL.CH	NO
5	Jennifer Almonte	Jennifer Almonte	Hc Pct 2	jennifer.almonte@pct2.hctx.net	no
6	[illegible]	Andrea DeCandis	H-GAC	andrea.decandis@h-gac.com	NO
7	[illegible]	NORMAN WHITTON	EIHSAI	president@sunrise-ridge.com	No
8	Hugh L McCulley	Hugh McCulley	TSNSF, PTRA	hmcculley@cjmlaw.com	No
9	Tyson Moeller	Tyson Moeller	UPRR	tomoeller@up.com	NO
10	Shain Eversley	Shain Eversley	H-GAC	Shain.Eversley@H-GAC.com	NO
11	~~MAUREEN CROCKER~~	Maureen Crocker	HPW	maureen.crocker@houstontx.gov	NO
12					

Houston-Galveston Area Council

Ports Area Mobility Study Workshop

Wednesday, January 24, 2018
1:30 p.m. – 3:30 p.m.
Houston-Galveston Area Council
3555 Timmons Ln.
Houston, TX 77027

#	Signature	Name	Organization	Email	Are you an elected official? If yes, position:
13	[signature]	Bruce Mann	Port Houston	bmann@poha.com	
14	[signature]	Rusty Senac	Chambers County	ARSENAC@CHAMBERSTX.GOV	Commish Pct 4
15	Alan Clark		H-GAC		
16	Brend Mainwaring	Brenda Mainwaring	UPRR	brendamainwaring@up.com	no
17	Barbara Koslov	Barbara Koslov	Harris Co	barbara.koslov@cjo.hctx.net	work for Judge Emmett Harris Co
18	Paul Crisman	Paul Crisman	BNSF	paul.crisman@BNSF.com	No
19	ANDREW MAO	Texas DOT			
20	Charles Airiohuodion	Tx DOT			
21	ROBERT T. SAKOWITZ	HAZAK CORP E-NDEAVOR CORP →		rSAKOWITZ@HAZAK.COM	No
22	[signature]	Anne Dunning	Port Houston	adunning@poha.com	No
23	Shelley Whitworth	H-GAC		shelley.whitworth@h-gac.com	No

Workshop Agenda

Ports Area Mobility Study Workshop

January 24, 2018, 1:30 – 3:30 PM

1. **Registration and Distribution of Meeting Materials**

2. **Welcome to the Workshop**

3. **Workshop Overview and Logistics Discussion**

4. **Ports Area Mobility Study Overview**
    a. **Purpose and Goals**
    b. **Study Progress to Date**
    c. **Purpose of Workshop Today**

5. **Individual Feedback Session: Identify Data Gaps and Project Maps** (utilizing large-scale maps)

6. **Open Discussion: Identification of Regional Infrastructure Issues and Concerns**

7. **Screening Criteria/Project Prioritization Process Overview - Presentation**

8. **Identification of Screening Criteria and Project Prioritization Criteria (Group Brainstorming Session)**

9. **Conclusion & Collection of Feedback Forms**

Workshop Ground Rules

Ports Area Mobility Study Workshop

January 24, 2018, 1:30 – 3:30 PM

- Respect that this is an invitation-only workshop.
- Please refrain from using your personal cell phone, laptop, or other electronic devices during the workshop. Your presence and attention are very valuable to us today.
- All participants are considered equal during the workshop.
- One person talks at a time.
- There will be no “side-bar” discussions among group members while another member is speaking. In other words, we will have one meeting.
- Every idea and comment is valid.
- Every effort will be made to reach consensus.
- Seek common ground and action – not problems and conflicts. Differing opinions are okay.
- Keep an open mind.
- Strive for results.
- The workshop will start and end on time. All sessions within this workshop will start on time.
- Make use of the designated break times, and refrain from taking excessive breaks to maximize participation.
- Everyone is encouraged to participate.
- Suspend predetermined positions to allow the collective intelligence of the group to emerge.
- All ideas are held up for consideration, reflection, and inquiry.
- Say what you mean and mean what you say.
- Seek to understand the process.
- Use the group memory when working in groups.
- The meeting facilitator structures time and tasks. For example, the facilitator may call for a 15-minute brain-storming session. This will be timed.
- When activities are timed, stop speaking shortly after the timer goes off.
- A meeting facilitator will handle the room temperature and other housekeeping needs for the group.
- Stay in the room during meeting times.
- It is okay to move around the room when you need to.
- No lectures.
- People need not agree.
- Monitor your participation. Some need to hold back to allow others to share. Others need to force themselves to share more.
- It is okay to have fun.

Individual Feedback Form

Ports Area Mobility Study Workshop
January 24, 2018, 1:30 – 3:30 PM

Houston-Galveston Area Council

Name: ______________________________
Email: ______________________________
Phone: ______________________________

Please utilize the maps available around the room to acquaint yourself with the projects that have been preliminarily identified for inclusion in the Ports Area Mobility Study. Given this information, please complete the following form to reflect your individual, professional knowledge, expertise, and experience.

1. If you have recommendations about additional, potential projects that could be included in the study, please place a sticker on the maps provided using the sticker dots available.

2. Please provide additional information about additional, potential projects for consideration. For each sticker dot placed on the map, please complete corresponding information below.

Sticker #	Project Description	Approx. Project Location	Potential Project Sponsor

3. May we contact you directly for additional information regarding the projects identified above? ____**Yes** ____**No**

4. Is there any additional information or feedback that you would like to provide the study team?

Group Feedback Form

Ports Area Mobility Study Workshop
January 24, 2018, 1:30 – 3:30 PM

Group Color: ______________________

Group Members: ______________________

____

____

Screening Criteria Feedback

Please refer to the Initial / Universe of Project Screening section of the presentation. Given the information provided during that presentation, please complete the following form to reflect your individual and professional knowledge, expertise, and experience.

1. Is there any additional screening criterion not considered in the outlined methodology that you believe would be important to include? If so, please describe it and provide ideas for indicators that could be used to quantify it.

____

____

____

____

____

____

____

____

____

____

____

____

2. From the list of criteria used in the Initial / Universe of Project Screening (see list in the table below), please rank each one of them based on their importance relative to the other criteria listed. Please circle the importance of each criterion in the matrix (1 represents highest, 3 represents lowest). Please identify and rank other potential criteria not provided in the matrix below. Please complete this for each criterion.

Screening Criterion	IMPORTANCE (1=Highest, 3=Lowest)		
Diverting Freight Flow away from Congested Urban Core	1	2	3
Project Supports Regional Commodity Flow	1	2	3
Project Supports Local Commodity Flow	1	2	3
Project Readiness (Existing Status of the Project - shovel ready, funded and programmed, other)	1	2	3
Timing of Need (When the project is needed to improve freight mobility – immediate, long-term)	1	2	3
New or Existing Project / Revision of New/or Existing Policy (Ease of implementation)	1	2	3
Other*: ______________________	1	2	3
Other*: ______________________	1	2	3

* = In case an additional criterion was identified in item 1 of this form.

Project Prioritization Feedback

Please refer to the Project Prioritization section of the presentation. Given the information provided during that presentation, please complete the following form to reflect your individual and professional knowledge, expertise, and experience.

3. Is there any additional prioritization criterion not considered in the outlined methodology that you believe would be important to include? If so, please describe it and provide ideas for indicators that could be used to quantify it.

4. From the list of criteria used in the prioritization process (see list in the table below), please rank each one of them based on their importance relative to the other criteria listed. Use an "X" to define the importance level of each criterion using the categories provided in the criterion column of the matrix. Please select no more than 3 criteria under each importance column.

	IMPORTANCE		
Goals	**High**	**Medium**	**Low**
Travel Time Reliability			
Connectivity			
Congestion Mitigation			
Travel Costs			
Safety			
Environmental			
Economic / Regional Growth			
Other*: ____________________			

* = In case an additional criterion was identified in item 3 of this form.

Please provide additional feedback here.

The table below lists projects by name and desciption, obtained from various regional plans and displayed at the public workshop. They are categorized by the estimated capital needed and the type of projects.

Low Capital: Intersection Improvements or Signal Timing Coordination	
Fairmont Parkway	Construct Geometric Improvements and ITS/Traffic Signal Improvements At 14 Intersections from BW 8 to 7th Street.
Pine Street (Freeport)	Elevated intersection at FM 1495/SH 36 intersection.
Port Road (Drive)	Signalize intersection of Port Drive and SH 146.
SH 275 Traffic Light Synchronization	SH 275 / Harborside Drive; Synchronize the traffic lights through the downtown area on Harborside Drive.
SH 288	Reconstruct Intersection Including Additional Through And Turn Lanes On FM 518 And Additional Turn Lanes On SH 288 Frtg Roads With Signal.
SH 288/CR 45 & CR 48	Construct U-Turns and Acceleration/Deceleration Lanes.
SH 288/CR 57 & CR 60 & CR 63	Construct U-Turns and Acceleration/Deceleration Lanes.
SH 288	Construct Truck Weigh Facility At CR 32.
SH 288	Add Through And Turn Lanes On FM 518 And Add Turn Lanes On SH 288 Frtg Roads With Signal.
Medium Capital: Grade Separation Projects	
Alameda-Genoa Road Grade Separation	BNSF Mykawa Subdivision, MP 14.06. Crosses three tracks at end of BNSF yard (DOT #023207W).
Federal Road Grade Separation	Federal Road Grade Separation over PTRA railroad.
Griggs Rd & Lond Rd Grade Separation	BNSF Mykawa Subdivision, MP 19.35. Grade separate crossings at Griggs and Long. (DOT #023214G, 023215N).
SH 288/CR48	Construct Grade Separation.
SH 288/CR57	Construct Grade Separation.
SH 288/CR60	Construct Grade Separation.
SH 288/CR63	Construct Grade Separation.
SH 288/CR64	Construct Grade Separation.
SH 288/Rodeo Palms Parkway	Construct Grade Separation.
SH 332/FM 523	Construct Grade Separation.
SH 36	Grade separation over new SH 35, overlay and restripe pavement from 2 to 4 lanes.
SH 36	Grade Separation Over New SH 35, Overlay And Restripe Pavement From 2 To 4 Lanes From 200' N Of CR 467/Hogg Ranch Rd To SH 35.
Spencer Highway	Construct Grade Separation Over Mainline Double-Rail Track.
West Belt Railroad Grade Separation	Construction of 5 grade separations and the closure of five additional crossings to create a 5.9-mile sealed corridor in Houston on the West Belt Subdivision between Tower 26 and TNO Junction.
Grade Separation Main Street	Grade Separation Main Street in Galena Park on the PTRA.
Grade Separation Independence Parkway	Grade Separation Independence Parkway in La Porte on the PTRA.
Dayton Wye Connection	New connection/wye between UP Baytown and Lafayette subdivisions west of Dayton, including new grade separation for US Hwy 90.
Federal Rd	Construct Railroad Grade Separation With Median.

Medium Capital: Direct Connectors between Highways	
IH 10 at SH 330	Construct East Bound Entrance Ramp.
Barbours Cut Blvd Direct Connectors	Direct-connector from Barbours Cut Terminal to SH 146 and SH 225.
Direct Connectors SH 225 @ BW 8	Construct Direct Connectors.
SH 330 to IH 10	Improve northbound connectivity from SH 330 to IH 10 - 2 lanes or direct connect.
Jacintoport Boulevard	Jacintoport Blvd.; Connect Jacintoport Road to Penn City Rd (Penn City Connector).
Jacintoport Direct Connectors	Construct Direct Connectors between BW 8 and Jacintoport Blvd.
SH 288	Construct 8 direct connectors at BW 8 interchange.
Southern Access Rd	Construct Direct Connector WB Southern Access Rd 146 To NB SH 146 From WB Southern Access Rd To NB SH 146.
Southern Access Rd	Construct Direct Connector From SB Lanes Of SH 146 To Southern Access Rd.
Texas City/La Marque IH 45	Construct Two Direct Connectors to LP 197 (SB to EB & WB to NB) to Port of Texas City at Shoal Point at Texas City Wye.
SH 225	SH 225 and IH 610 Interchange.
Medium to High Capital: Railroad Capacity Improvements	
Port of Freeport Rail Project 1	Parcel 14 Rail Development: 21,000 feet of track including 6,000 foot lead and 3 x 5,000 foot yard tracks.
Port of Freeport Rail Project 2	Add a unit train terminal.
Bayport Single Track Rail Connection	Construction of approximately 6,500 linear feet of new single track rail line from near the intersection of the existing UPRR ROW at Red Bluff Rd. to the proposed warehouse development. The project will include three at-grade crossings with signalization at SH 146 and Old SH 146, plus modification to switched and turnouts for tying into the existing mainline, and for future expansion.
West Belt Railroad Underpass 1	Construct Railroad Underpass At Navigation Blvd and Commerce St And Close At-Grade Crossings At Hutchins and Commerce St.
West Belt Railroad Underpass 2	Construct Railroad Underpass At York St And Close At-Grade Crossings At Sampson, Mckinney, York, And Milby Streets.
Port of Freeport Rail Project 3	Add a rail dock.
Bayport Double Track Rail Connection	Construct Double Track Rail Lines and Run-Around Track from Mainline to the Bayport Terminal Intermodal.
Bayport Intermodal Rail Yard 1	Construct Intermodal Rail Yard Incl 6 Storage Tracks, 3 Working Tracks, And 1 Container Track At Bayport.
Bayport Intermodal Rail Yard 2	Construct Intermodal Rail Yard Incl 6 Storage Tracks, 3 Working Tracks, And 2 CONTAINER TRACKS AND 1 RUNAROUND TRACK At Bayport.
Broadway Street Rail	Convert a 0.28-mile (1,478-foot) segment of single-track railway to double-track railway near the Houston Ship Channel.
Second Main Line Construction	Construction of a second main line in Houston from the GH&H Junction to Strang on the Port Terminal Railway Association track: supports port and chemical industry expansion.
Second Rail for PTRA to Bayport	Construct 2nd rail track allowing PTRA access from Strang Yard to Red Bluff Road.
Double Track BNSF Mykawa sub	Double Track BNSF Mykawa sub.
Freeport to Rosenberg	New rail line that could run parallel to SH 36 and SH 36A once a route is determined.
Double Track Sinco Junction to Harrisburg Junction	Double Track Sinco Junction to Harrisburg Junction.
Tower 76	Tower 76 Houston – SE Connector: Connecting track in southeast quadrant of Tower 76 in Houston.

Medium to High Capital: Roadway Extension/Widening Projects	
South Sheldon Road	Replace South Sheldon Road roadway with 5-lane typical section between IH 10 and the Jacintoport Cluster, Truck/Pipeline Terminal.
SH 288	Construct 2-Lane NB Frontage Road.
SH 146	Construct Median Improvements And Extend And Widen Turn Lanes From SH 146 SB At IH 10 To IH 10 WB Frtg Rd At SH 146 NB.
SH 146	Construct 4 Mainlanes And Grade Separation From SH 146E To Ferry Rd.
61st Street Extension Galveston	61st Street; Broadway/SH 87 to Harborside Drive/SH 275 - 4-lane extension.
Appelt Drive	Improvements from Jacintoport to Market – widen to 4 lanes.
Barbours Cut Blvd	Expansion to 6 lanes.
Battleground Road/Independence Parkway	Replace Roadway with 5-lane typical section between SH 225 and Lynchburg Ferry.
BU 90-U	Widen To 6 Lane Divided With Continuous Left Turn Lane.
BW 8	Widen From 4 To 8-Main Lanes In Sections From SH 225 To IH 45.
Clinton Drive	Replace Roadway with 5-lane typical section between Federal Road and IH-610.
Fairmont Parkway (widening)	Widening.
FM 517	Widen To 4-Lane Divided W/ Curb & Gutter from FM 3436 to SH 146.
FM 519	Widen To 4-Lane Divided From SH 6 To IH 45.
Haden Road	Haden Road extension to Penn City Rd connector.
IH 45 S	Widen To 10 Main Lanes And Two 3-Lane Frontage Roads From Harris C/L To S Of FM 518.
IH 45 S	Widen To 10 Main Lanes, Two 3-Lane Frontage Roads And Access Into Two Diamond Lanes From S Of NASA 1 Bypass To Galveston C/L.
Independence Parkway	Independence Parkway (improve Northbound connectivity to SH 225) – construct dedicated turning lane.
Industrial Boulevard (Road)	Replace Roadway with 5-lane typical section between Federal Road and the Houston Ship Channel port terminals and truck/rail facility.
Jacintoport Blvd/Penn City Rd Corridor	Widen Jacintoport "Road" to 4 lanes.
Jacintoport Boulevard	Replace Roadway with 5-lane typical section between Beltway 8 to Terminal Houston Ship Channel Port Terminal.
Penn City Road	Replace Penn City Road roadway with 5-lane typical section (IH 10 FR to 3100 Block).
Pine Street (Freeport)	Replace FM-1495 roadway with 5-lane typical section between SH 288 Northerly to the Terminal on Pine Street.
Port Road	Widen To 6-Lane Divided From SH 146 To Todville Rd.
Port Road (Drive) Expansion	Construct over 9,000 feet of new roadway drainage to expand from 4 to 6 lane at critical sections between SH 146 and Cruise Road.
Rosenberg to Arcola	Second Main Line ROW and Design (BNSF Galveston Subdivision).
SH 146	Widen to 8 Lanes, Grade Separation at Major Intersections and 2 2-Lane Frontage Roads from Red Bluff Rd to NASA Road 1.
SH 146	Widen to 6 Lanes, with 2 2-Lane Frontage Roads from Fairmont Parkway to Red Bluff Rd.
SH 146	Widen to 6 Lanes, with 4-Lane Express Lanes from NASA Road 1 to Harris/Galveston County Line.
SH 146	Widen to 6 Lanes from FM 518 to FM 517.

SH 146	Widen to 6 Lanes, with 4-Lane Express Lanes from Harris/Galveston County Line to FM 518.
SH 146	Widen to 6-Lane arterial from FM 1764 to FM 1765.
SH 288	Construct 4 Toll Lanes With Grade Separations From Harris C/L To CR 58.
SH 288	Construct 4 toll lanes from IH 610 to Brazoria C/L.
SH 288	Construct NB Exit And Entrance Ramps And Tie-In Road At Rodeo Palms Parkway.
SH 36	Widen to 4-Lane Divided Rural between Fort Bend County Line and 0.355 Miles North of SH 35.
SH 36	Widen to 4-Lane Divided Rural between FM 522 and 2.044 Miles North of SH 332.
SH 36	Reconstruct to 4-Lane Divided With Continuous Left Turn Lane Intersection Improvements.
SH 36	Widen to 4-Lane Divided Rural from 0.9 mi S of The Brazos River to FM 1495 (Seg 15).
SH 36	Widen to 4-Lane Divided Rural from 0.43 mi N of FM 2218 to 0.284 mi S of Needville-Fairchilds.
SH 36	Widen to 4-Lane Divided Rural from 0.284 mi S of Needville-Fairchilds to Brazoria county line.
SH 36	Widen To 4-Lane Divided Roadway (Continuous Left Turn Lane And Rural In Sections) With Intersection Improvements.
Sheldon Road	Sheldon Road expansion (Jacintoport Road to IH 10) - Widen to 4 lanes.
Southern Access Rd	Widen To 4-Lane Divided With Raised Median From Old SH 146 To Bayport Cruise Terminal.
Texas City/Galveston IH 45	Reconstruct IH 45 to 8 Main Lanes, 2 2-Lane Frontage Roads, from 0.1 mi N of Causeway to S of Texas City Wye.
Texas City/La Marque IH 45	Reconstruct IH 45 to 8 Main Lanes, 2 2-Lane Frontage Roads, from N of Texas City Wye to N of FM 519.
Texas City/La Marque IH 45	Reconstruct IH 45 to 8 Main Lanes, 2 2-Lane Frontage Roads, from N of FM 519 to N of FM 1764.
Texas City/La Marque IH 45	Reconstruct IH 45 to 8 Main Lanes, 2 2-Lane Frontage Roads, from N of FM 517 to S of FM 1764.
Texas City/La Marque IH 45	Widen to 8 lanes and reconstruct existing 2 lane frontage roads from S of FM 518 to N of FM 517.
Wallisville Road	Widen To 4-Lane Divided Road With Curbs, Lighting, Sidewalks And Necessary Underground Utilities from Lockwood Dr to IH 610 E.
SH-225	Expansion/Improvement (8-East).
SH-225	Expansion/Improvement (8-West).
Grand Parkway NE Segments	
FM 1942	Road Improvements Hatcherville Road to SH146.
Hatcherville Rd	From FM-1942 to Liberty-Chambers County Line - road widening.
FM 565	From SH 146 to SH 99 widening and addition of tunring lanes.

High Capital: Projects including Bridges and New Highways.	
Broadway Second Main Track	Construct 3,500 Feet Of Track And Reconstruct Railroad Bridge (Double Track) From GH&H To Manchester Junction.
BW 8	Widen From 4 To 8-Lanes Including Bridge Across Houston Ship Channel From IH 10 To SH 225.
Galveston IH 45	Reconstruct IH 45 including SH 275 and 61st Street Connections to 8 Main Lanes, 2 2-Lane Frontage Roads, from 61st Street to 0.1 mi S of Causeway.
IH 45 S	Reconstruct IH 45/SH 146/SH 6 Interchange Including Widen IH 45 Mainlanes From 6 To 8 From N Of Texas City Wye To S Of Texas City Wye.
Pelican Island Bridges	Pelican Island Vehicular and Railroad Bridges Preliminary Study.
Red Bluff Rd	Widen To 4-Lane Divided Roadway Including Bridge Agross Taylor Lake.
SH 146	Construct RR overpass from FM 519 to Loop 197.
Shoal Point Access Rd	Construct New 4-Lane Principal Arterial From LP 197 To Southern End Terminal Site.
Southern Access Rd	Construct 2-Lane W/ Raised Median From Old SH 146 To Todville Rd Connection.
IH 610	Bridge at Houston Ship Channel.
IH 69 Bypass	IH 69 routed around Houston that allows connectivity for all MPO port team members to the interstate network. The IH 69 connector from Freeport to Trinity Bay would turn north and connect to Cleveland, Texas. This would offer connectivity to all ports and route truck traffic around Houston reducing traffic through the heart of the city.

Houston-Galveston Area Council

Ports Area Mobility Study

Please contact the following project staff if you have more comments or questions:

HGAC - patrick.mandapaka@h-gac.com
HGAC - Shain.Eversley@h-gac.com
HDR – Reddy.Edulakanti@hdrinc.com

Houston-Galveston Area Council

Ports Area Mobility Study

Please contact the following project staff if you have more comments or questions:

HGAC - patrick.mandapaka@h-gac.com
HGAC - Shain.Eversley@h-gac.com
HDR – Reddy.Edulakanti@hdrinc.com

Houston-Galveston Area Council

Ports Area Mobility Study

Please contact the following project staff if you have more comments or questions:

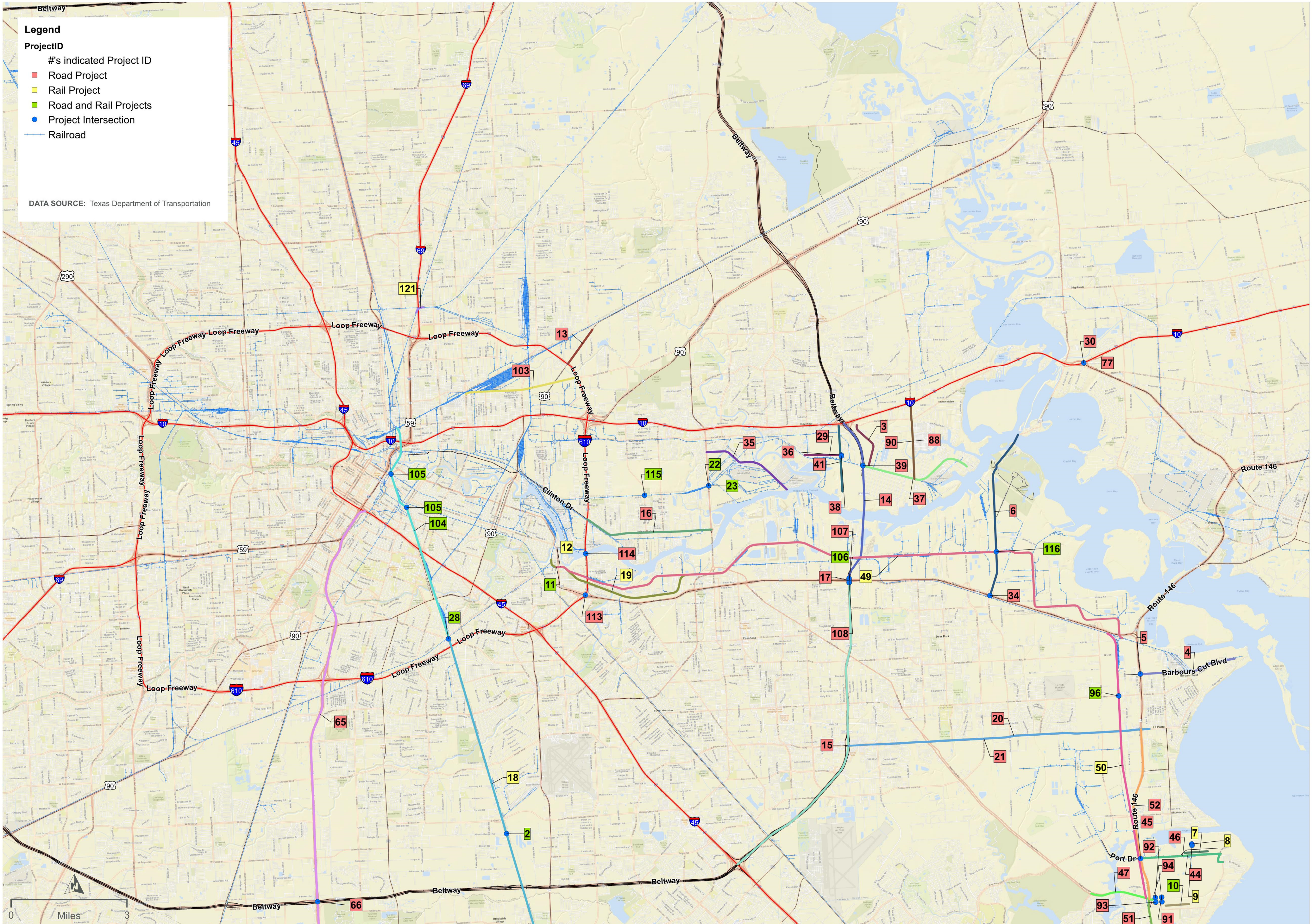
HGAC - patrick.mandapaka@h-gac.com
HGAC - Shain.Eversley@h-gac.com
HDR – Reddy.Edulakanti@hdrinc.com

Houston-Galveston Area Council

Ports Area Mobility Study

Please contact the following project staff if you have more comments or questions:

HGAC - patrick.mandapaka@h-gac.com
HGAC - Shain.Eversley@h-gac.com
HDR – Reddy.Edulakanti@hdrinc.com



HGAC PORT MOBILITY STUDY

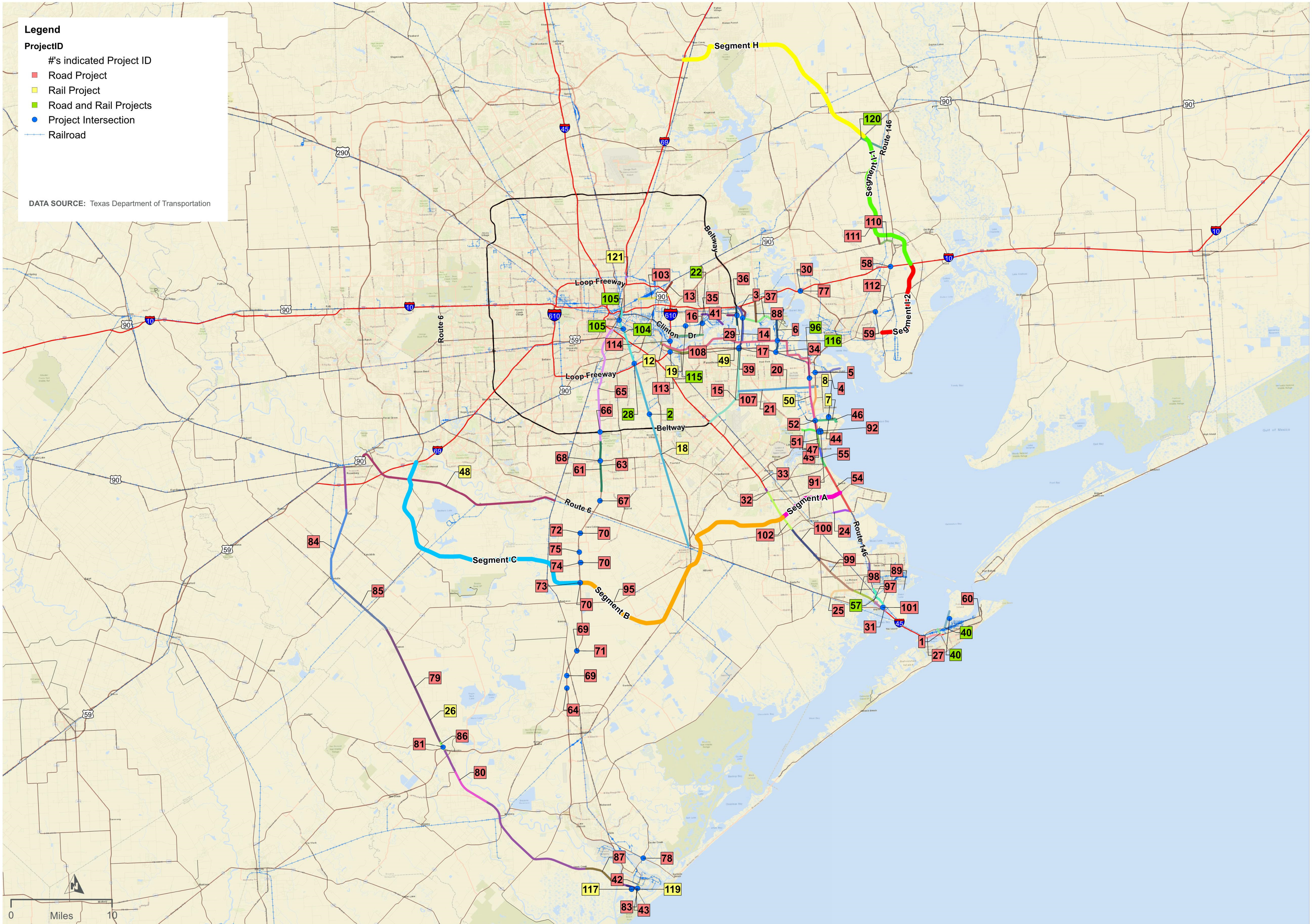
PROJECT LOCATION

FIGURE 1

(CLIENT LOGO)

(REPORT NAME)

PATH: \\MAHPI-FILE01\GIS_PROJECTS_HOUSTON_GALVESTON_AREA_COUNCIL\GIS\MAP_DOCS\DRAFT\HGAC_STUDY_MAP.MXD - USER: KLEE - DATE: 1/16/2018



(CLIENT LOGO)

HGAC PORT MOBILITY STUDY

PROJECT LOCATION

FIGURE 1

PATH: \\MAHPI-FILE01\GIS_PROJECTS_HOUSTON_GALVESTON_AREA_COUNCIL\GIS\MAP_DOCS\DRAFT\HGAC_STUDY_MAP.MXD - USER: KLEE - DATE: 1/15/2018

(REPORT NAME)

Ports Area Mobility Study

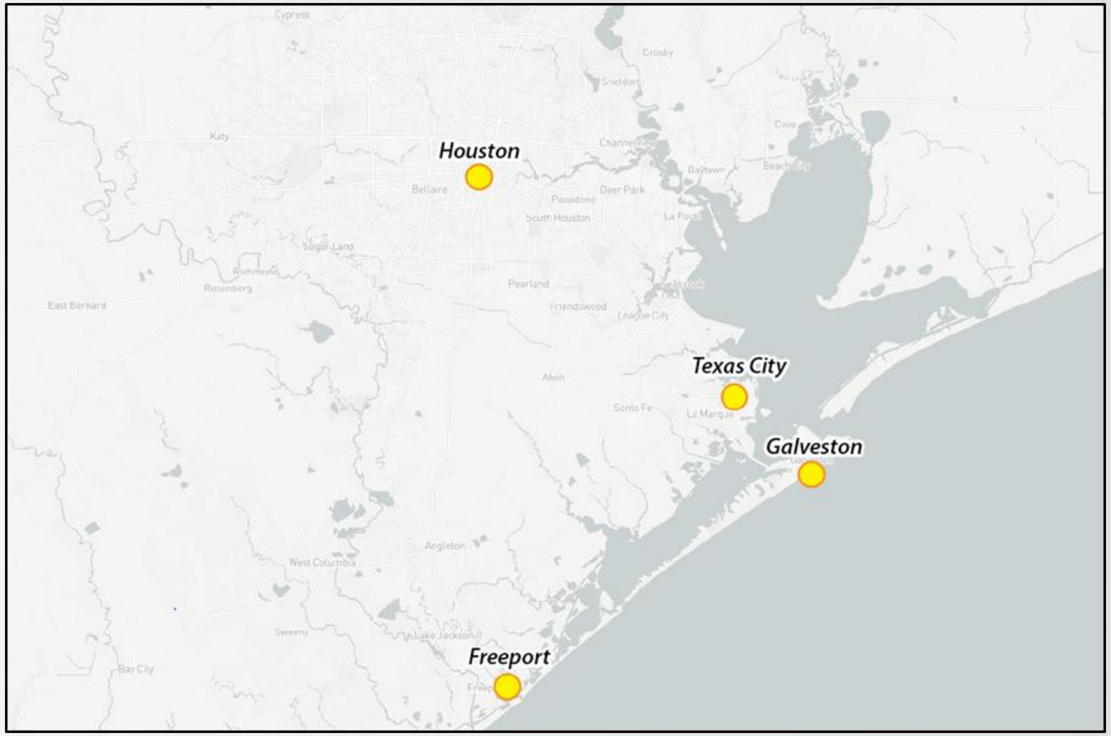
Workshop January 24th 2018

Regional Collaboration • Transportation Planning • Multimodal Mobility

H-GAC METROPOLITAN PLANNING ORGANIZATION

Study Background

- Recommendation from 2012 HGAC Regional Goods Movement Study to directly connect the region's ports with emerging markets in the region and all points beyond.
- Consideration of other issues:
  - Diverting freight flow away from congested urban core
  - Changes in commodity flows (e.g. foreign crude oil imports versus domestic production)
  - Panama canal expansion
  - Growth in chemical manufacturing



Study Objectives

- Identify freight and goods supply chains that are dependent upon on the region's port facilities
- Identify improvements to better facilitate port related freight mobility:
  - Infrastructure and facilities
  - Multimodal improvements
  - Operational strategies
  - Policy-level changes

Study Activities

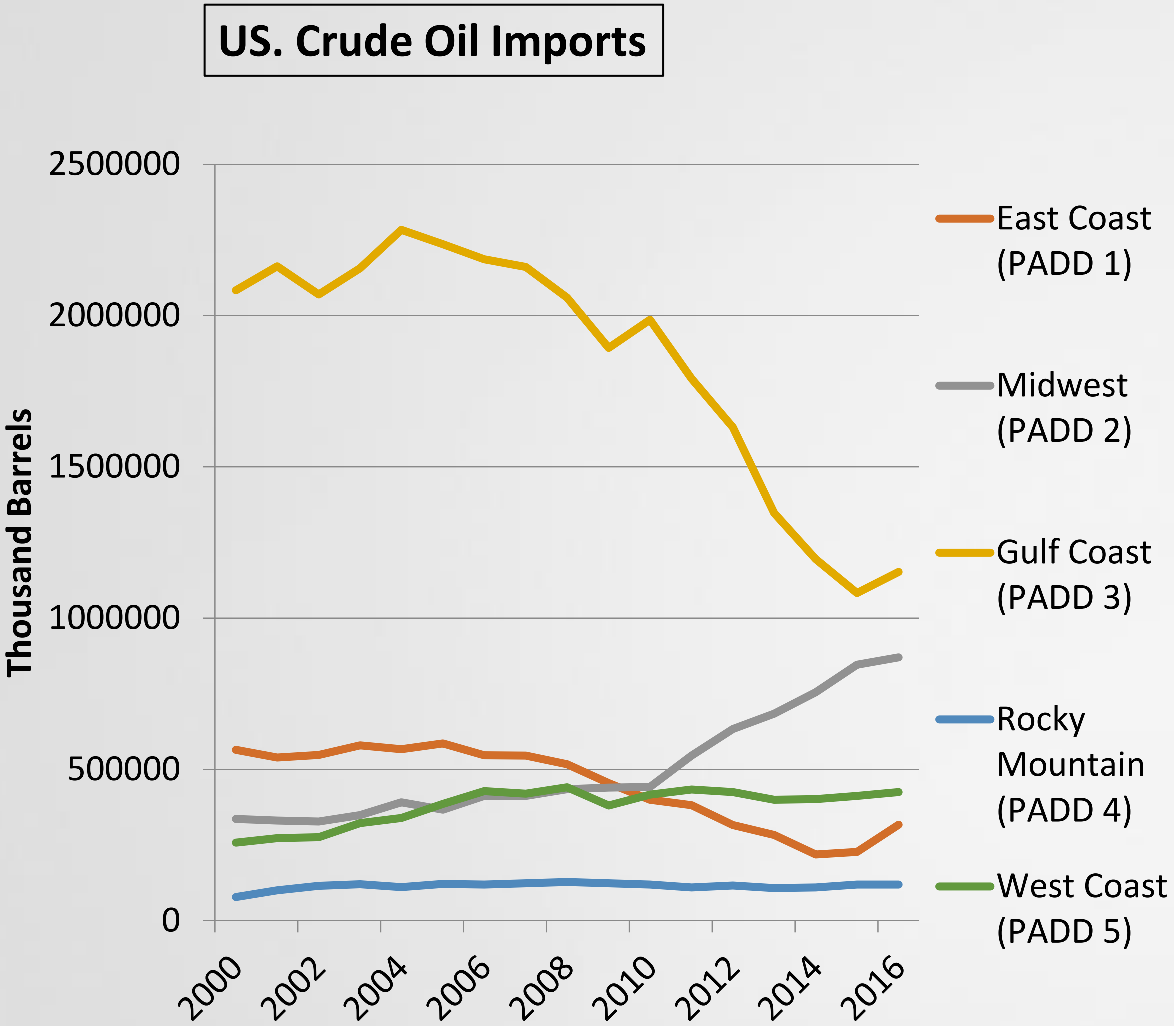
- Port profiles
- Data gathering and analysis
  - Trade and Cargo flow
  - Truck Counts
  - ATRI Truck GPS
  - Truck driver surveys
- Supply Chain Analysis
- Improvements/project identification, assessment, prioritization

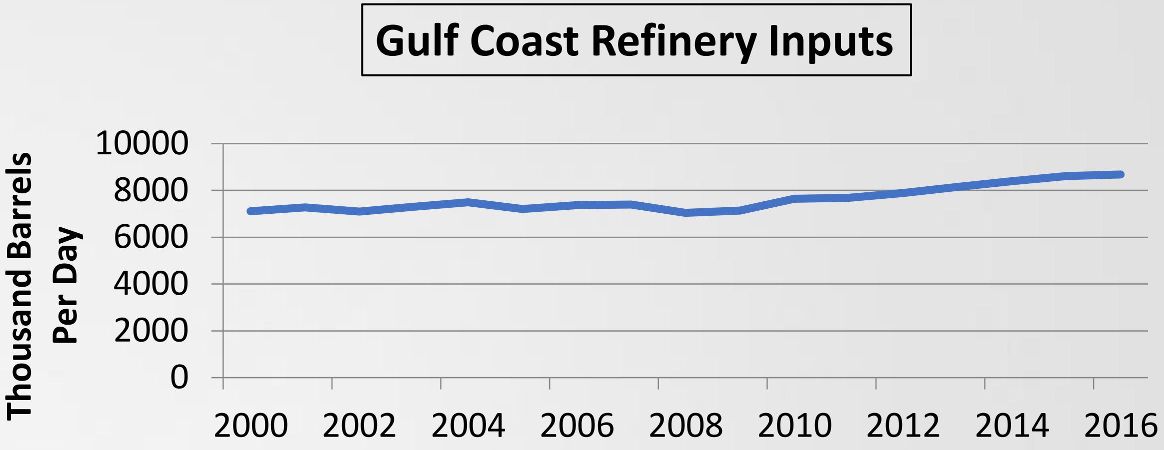
Some findings……

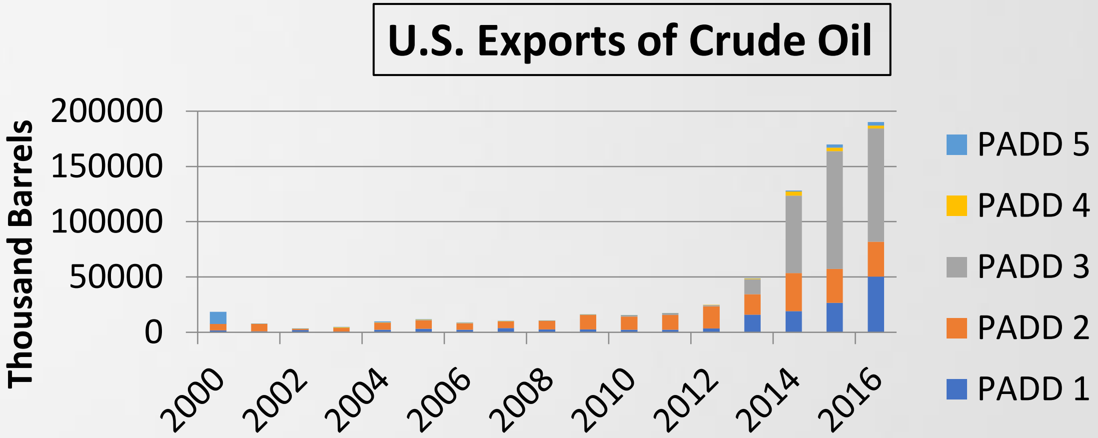
Growth in Houston Export Containerized Tonnage

	2011	2012	2013	2014	2015	2016	'11-'16 CAGR %
Los Angeles/Long Beach	29,973,261	27,059,059	27,886,875	28,071,297	23,672,299	28,929,355	-0.7%
Houston, TX	10,926,561	12,047,628	13,799,281	16,801,238	17,787,418	14,221,518	5.4%
Savannah, GA	14,351,476	12,518,824	11,939,780	12,463,801	11,769,924	12,062,782	-3.4%
New York/New Jersey	11,402,486	10,309,642	9,639,822	9,224,426	9,439,392	10,449,107	-1.7%
Oakland, CA	7,793,629	7,278,709	7,260,225	7,075,258	6,540,280	7,834,400	0.1%
Norfolk-Newport News, VA	6,127,265	6,721,925	7,600,061	8,011,856	7,953,921	8,499,078	6.8%
Charleston, SC	5,348,421	5,150,078	5,124,394	5,581,703	6,013,841	6,346,060	3.5%
Seattle, WA	6,538,265	5,386,412	4,913,356	4,273,950	3,950,148	4,267,256	-8.2%
Tacoma, WA	4,226,873	4,749,114	5,430,166	5,639,318	5,424,161	7,081,149	10.9%

Commodity Flow Change







METROPOLITAN PLANNING ORGANIZATION

Supply Chain Changes

- Heineken mode shifts from truck to sea based distribution (2015)

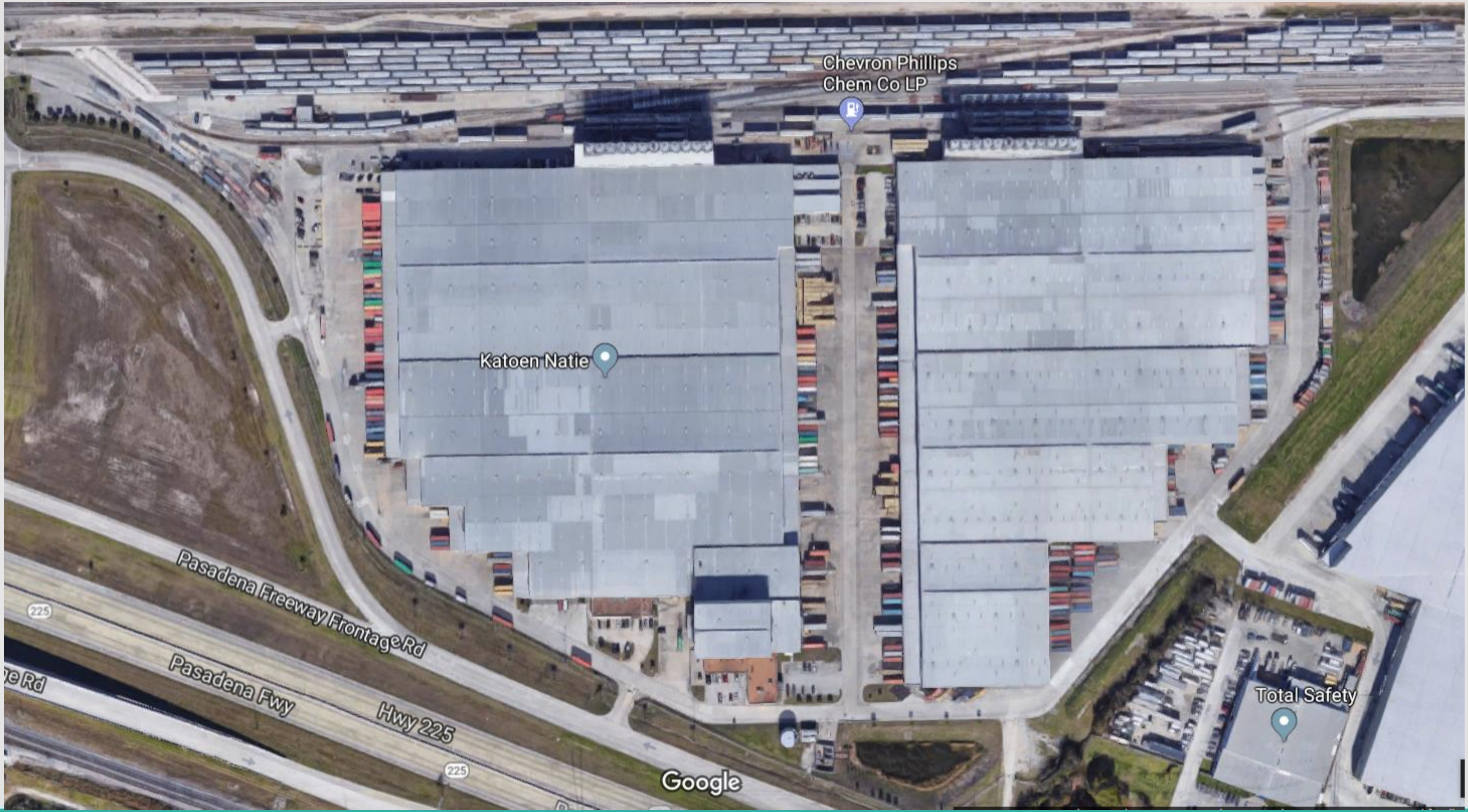
Supply Chain Structure – Plastic Resin

- Understanding how supply chains relate to Port Mobility
- Producers utilize rail based "Storage in Transit"
- Growth in Bagging facilities

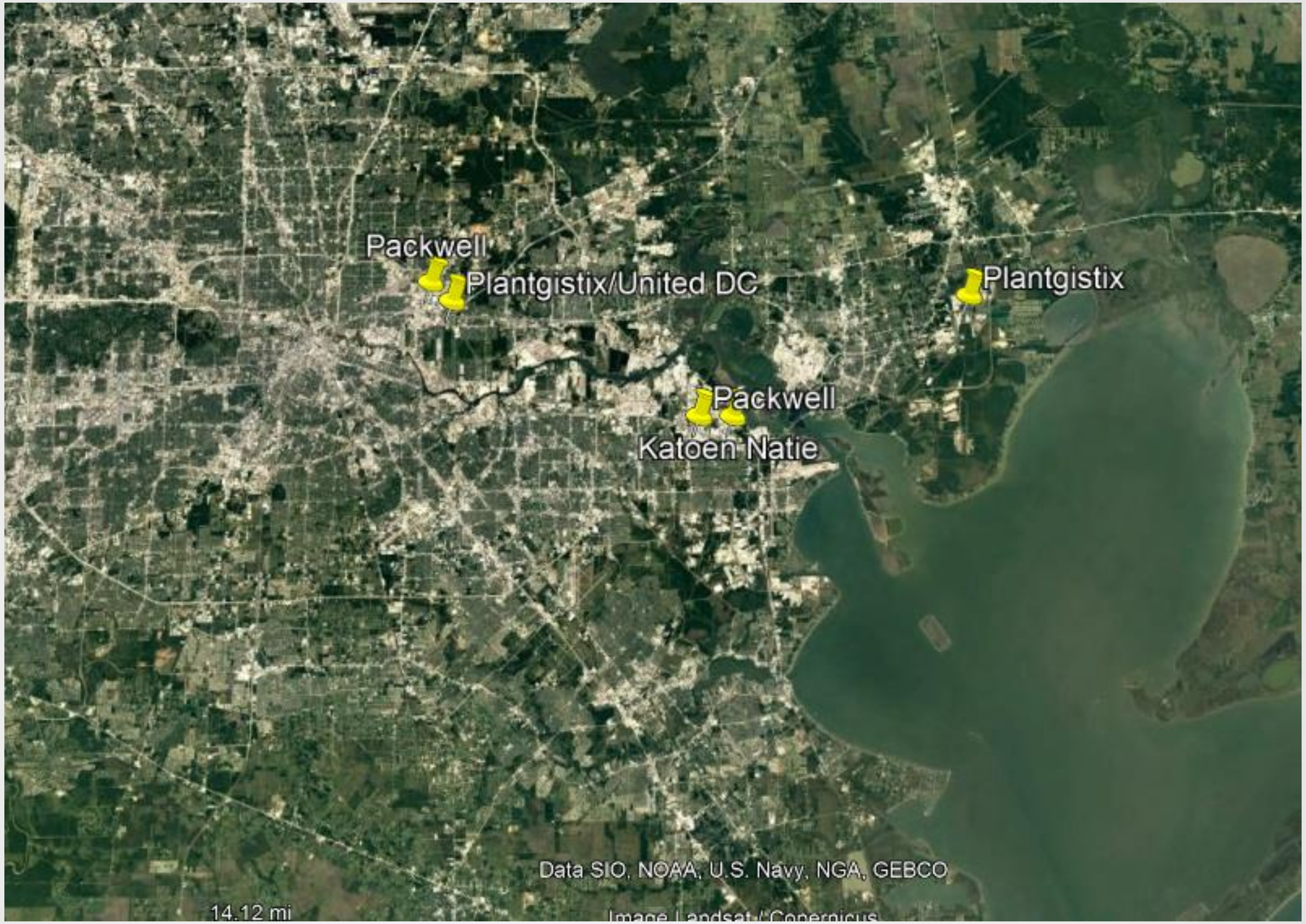
Figure 2. Supply Chain for Texas Plastic Resin.

Source: Texas Transportation Institute

Katoen Natie Bagging Facility

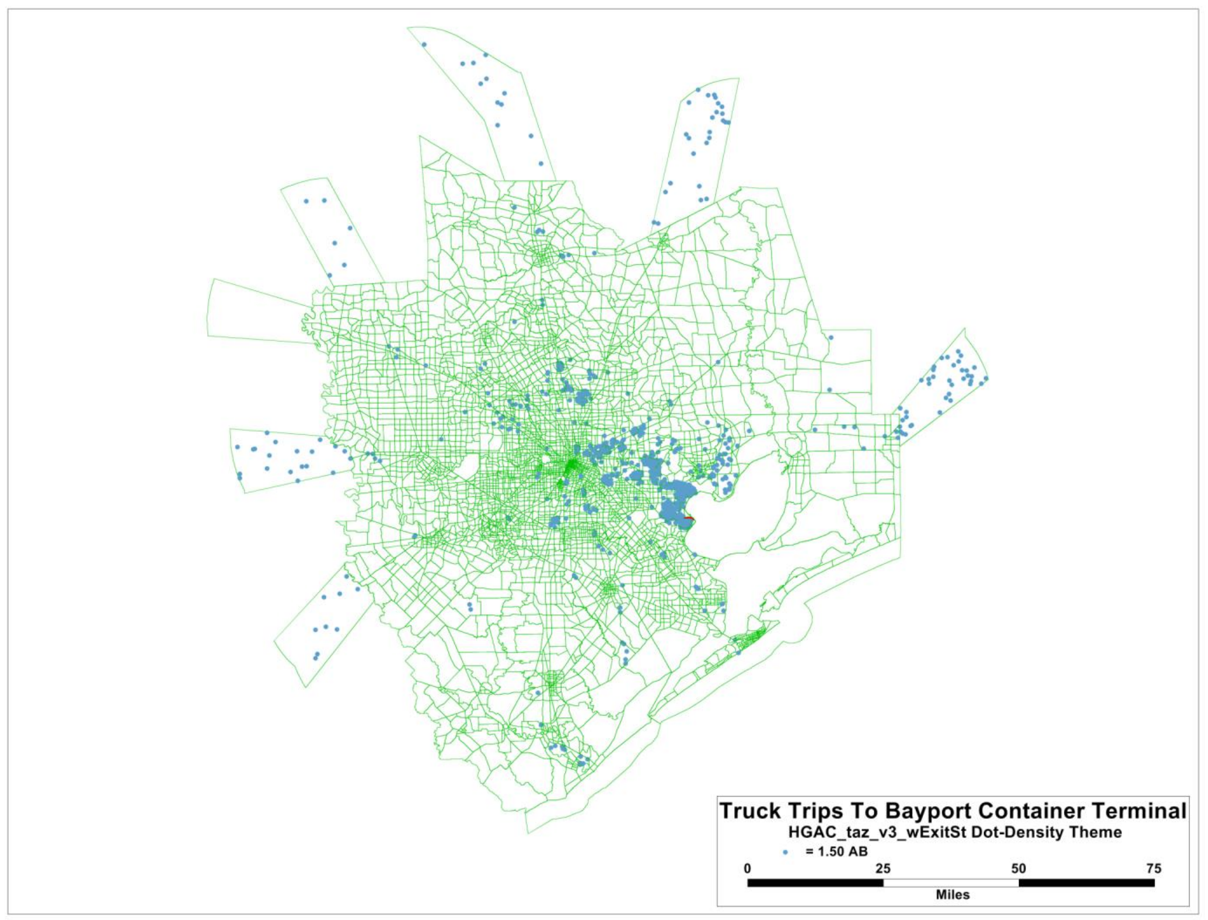


Location of Bagging Facilities

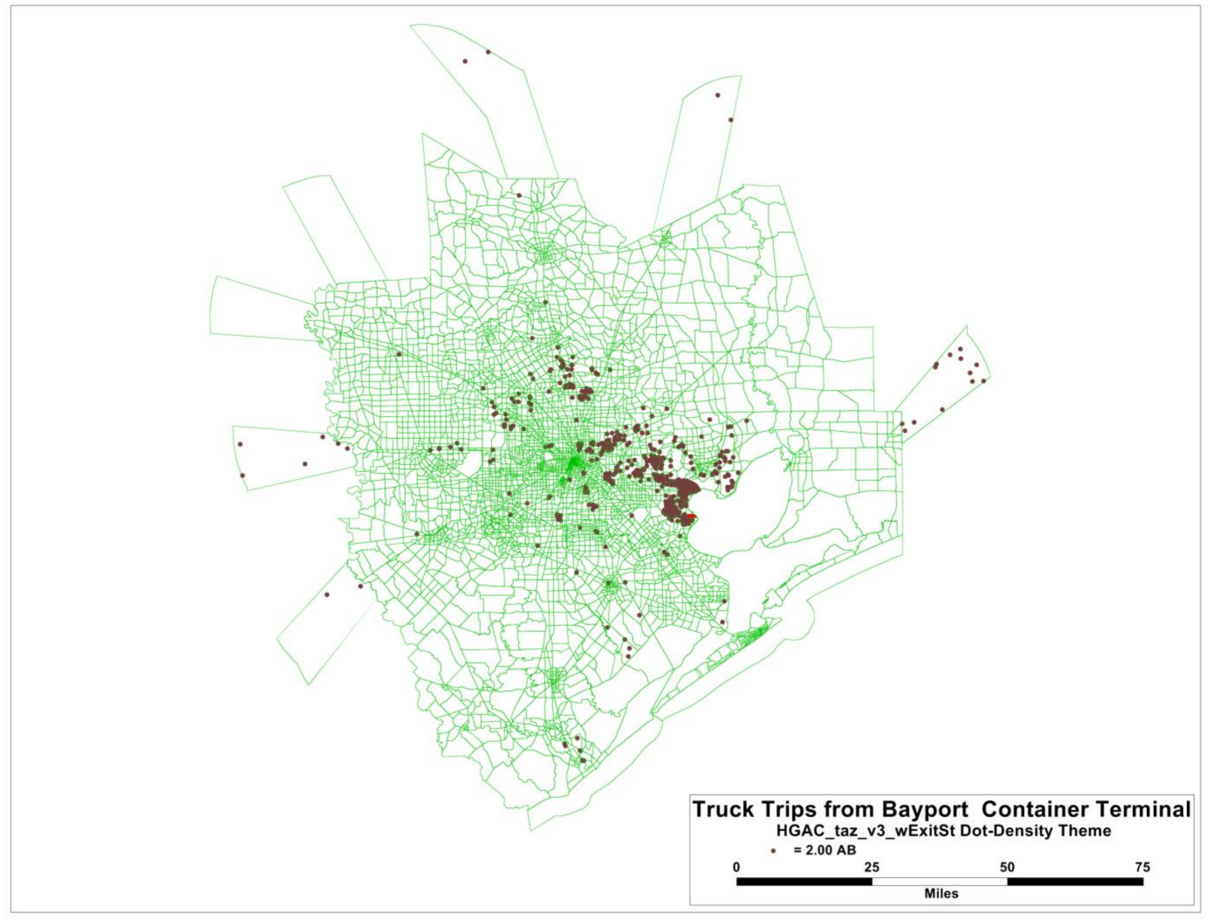


ATRI Data – Houston Container Terminals

To Bayport Container Terminal

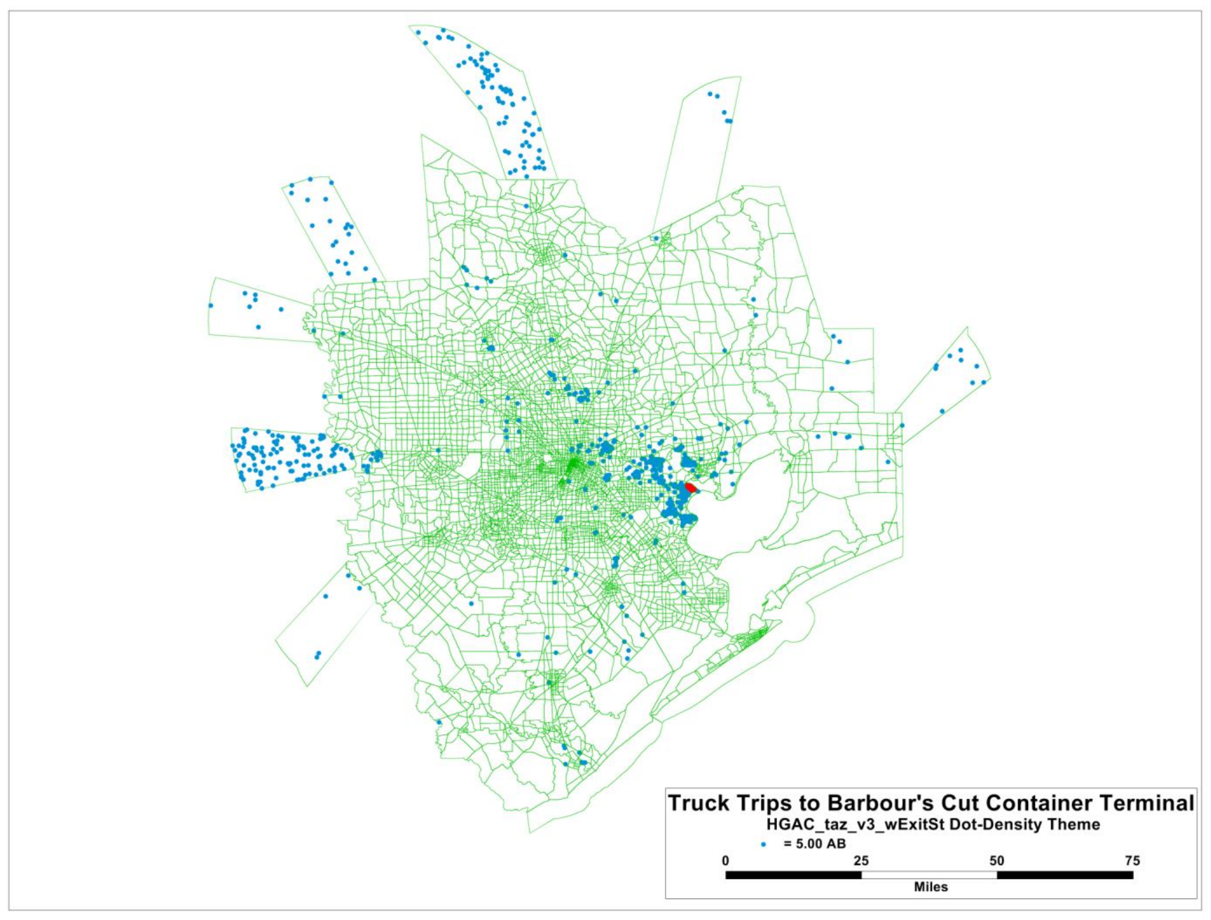


From Bayport Container Terminal

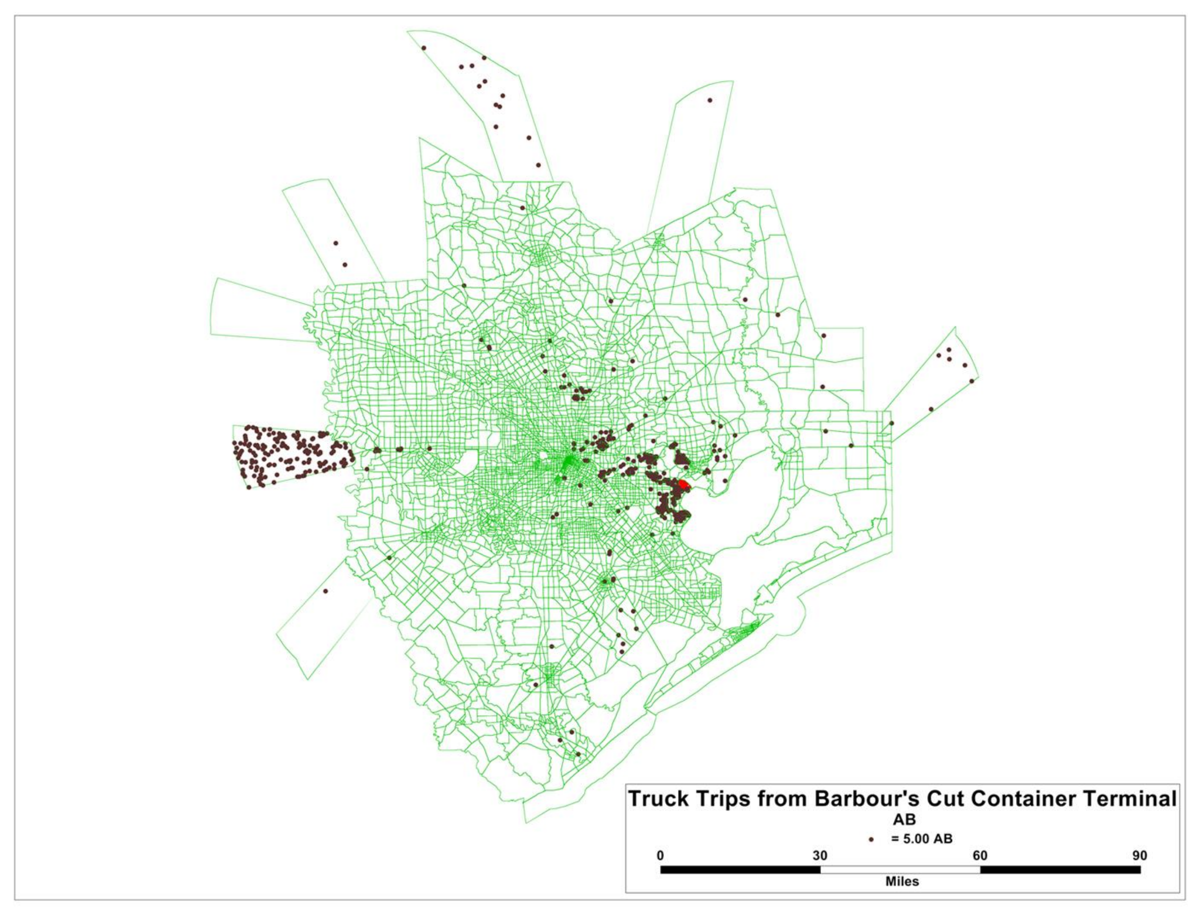


ATRI Data – Houston Container Terminals

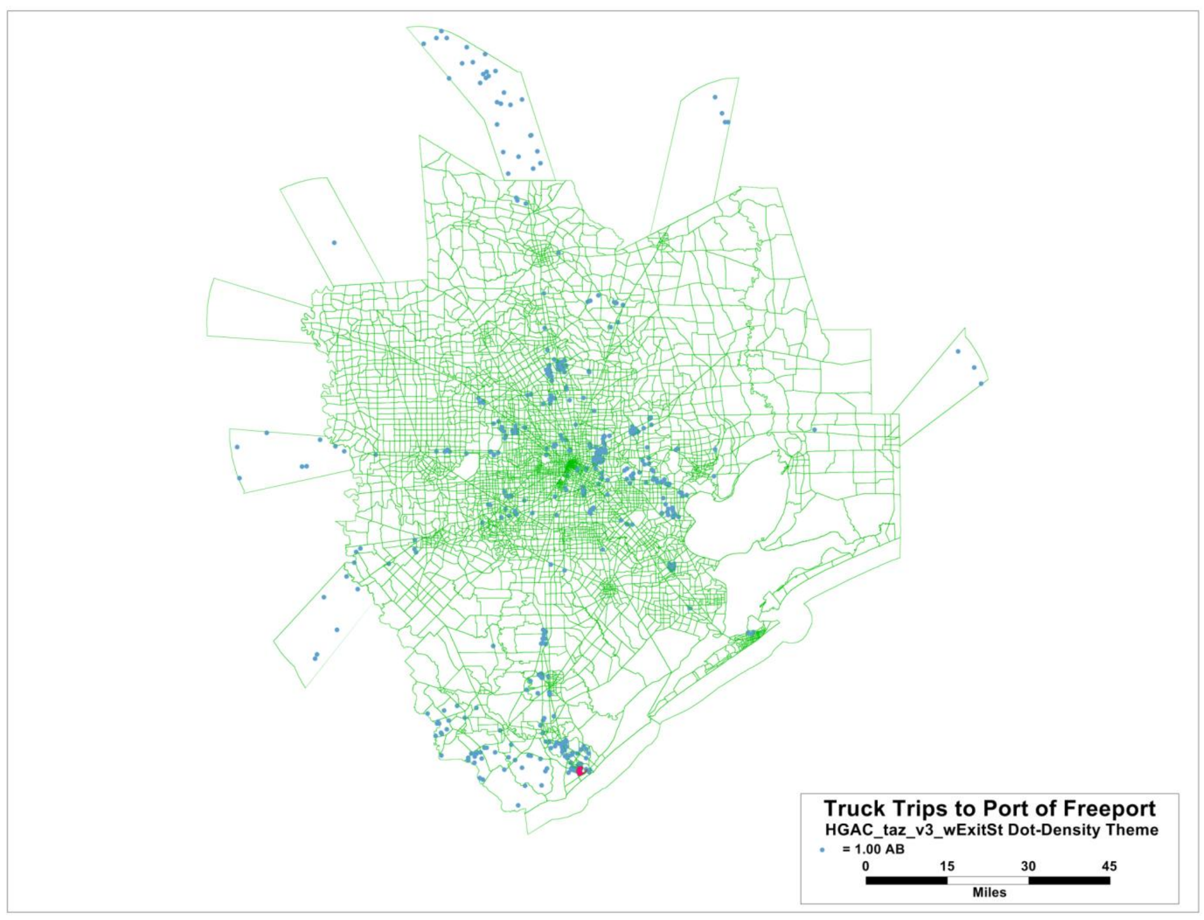
To Barbour's Cut Container Terminal

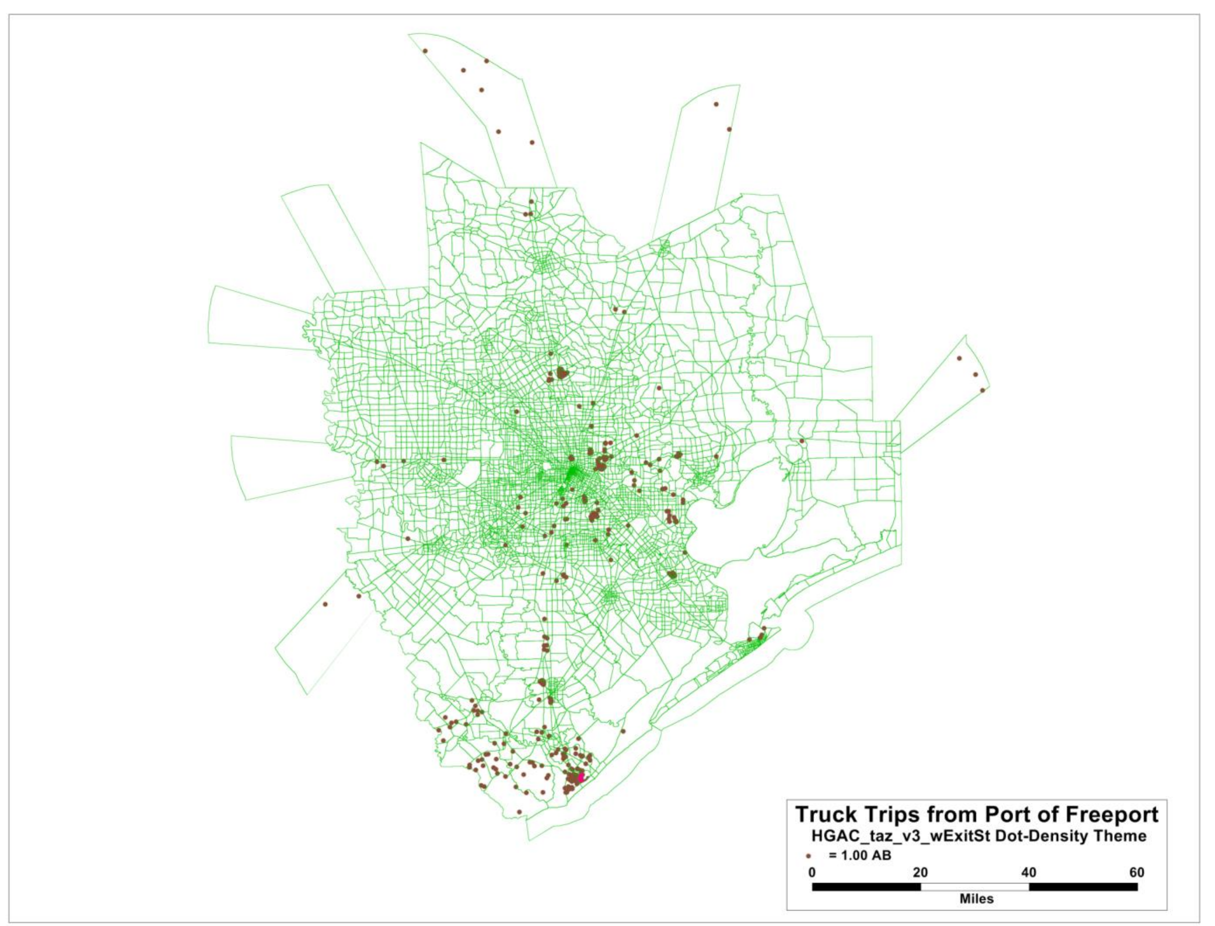


From Barbour's Cut Container Terminal

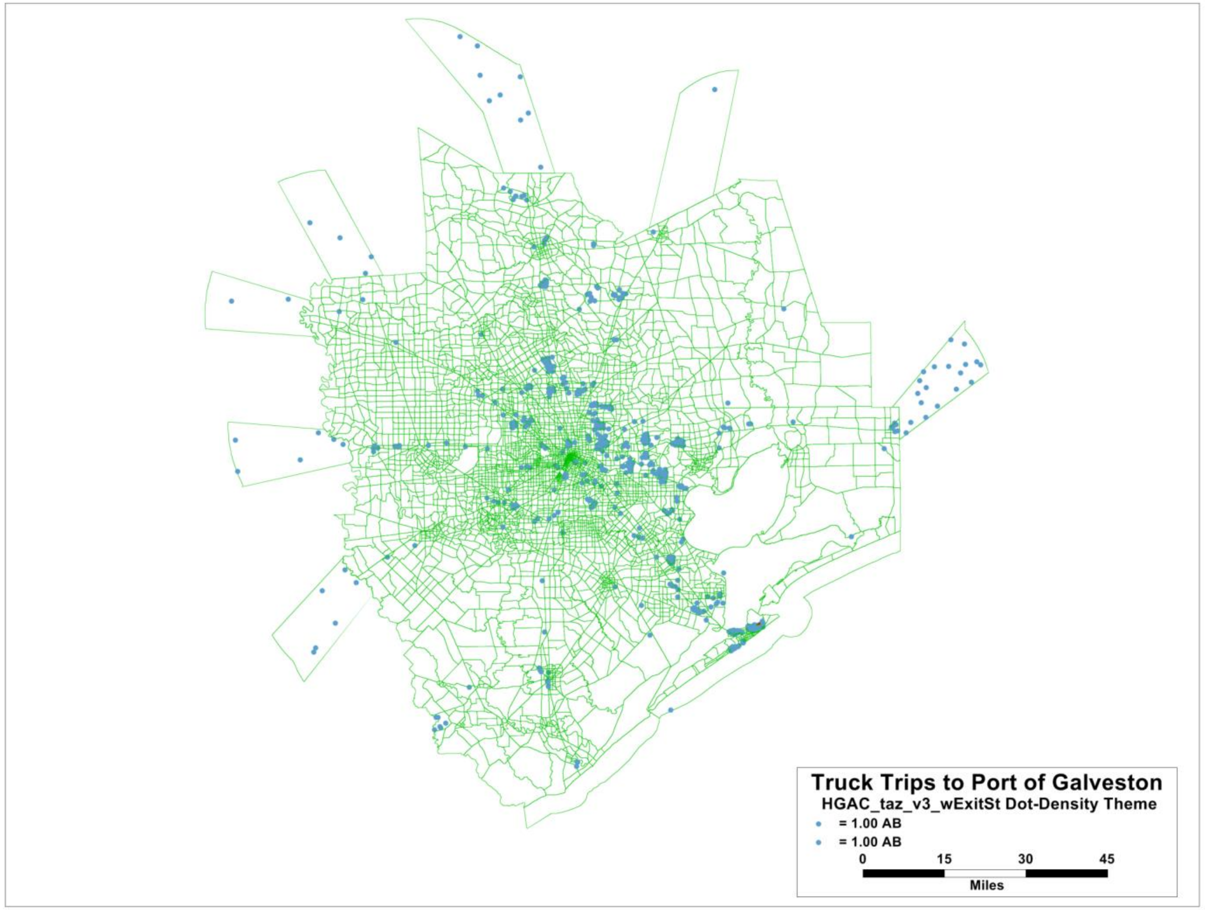


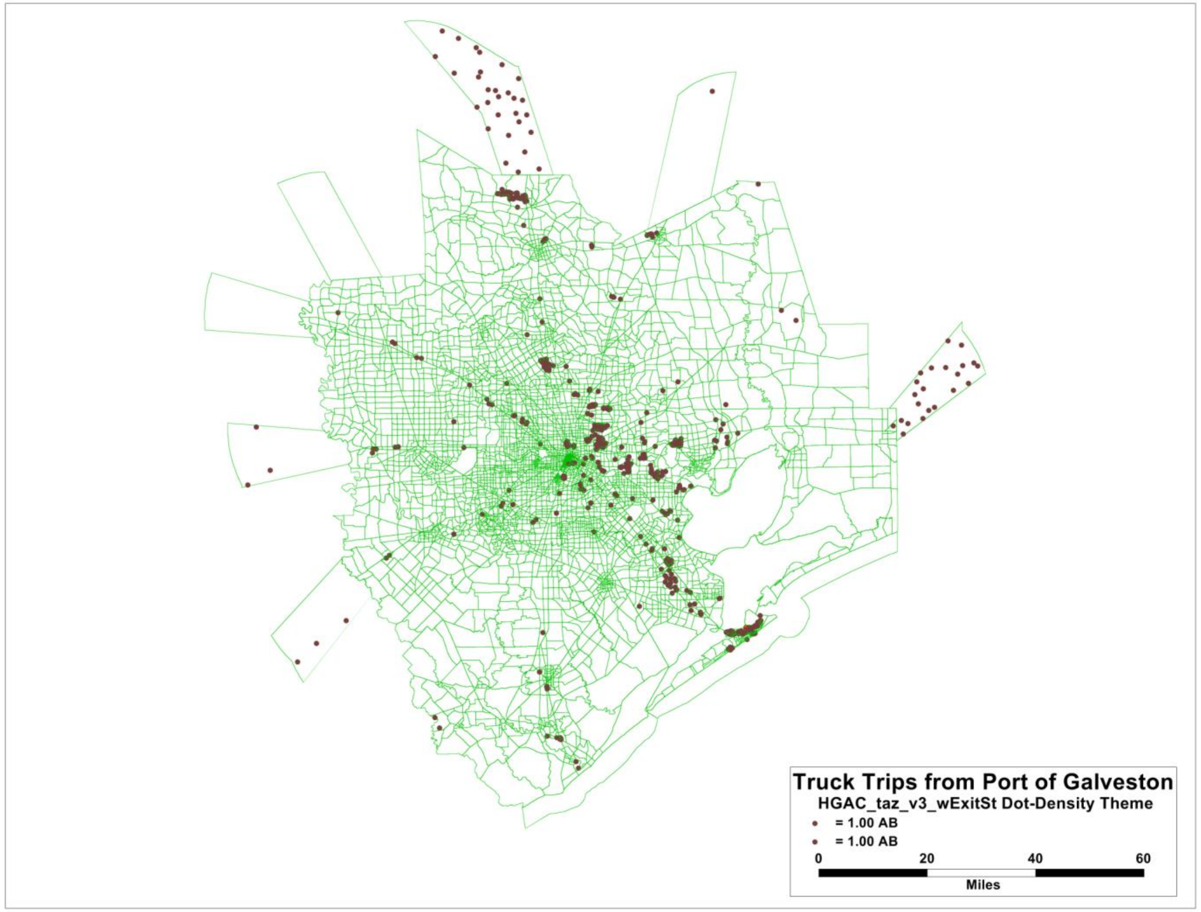
ATRI Data – Port of Freeport



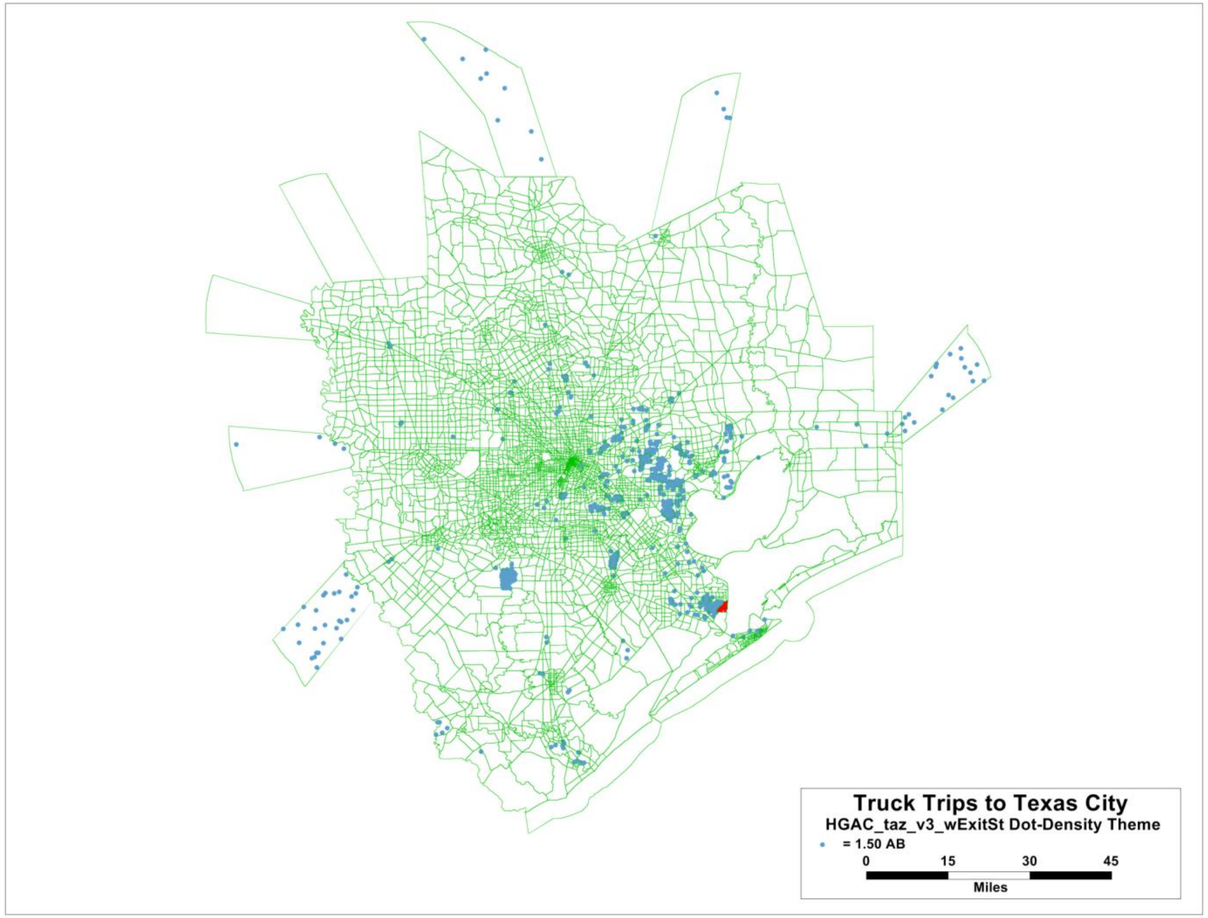


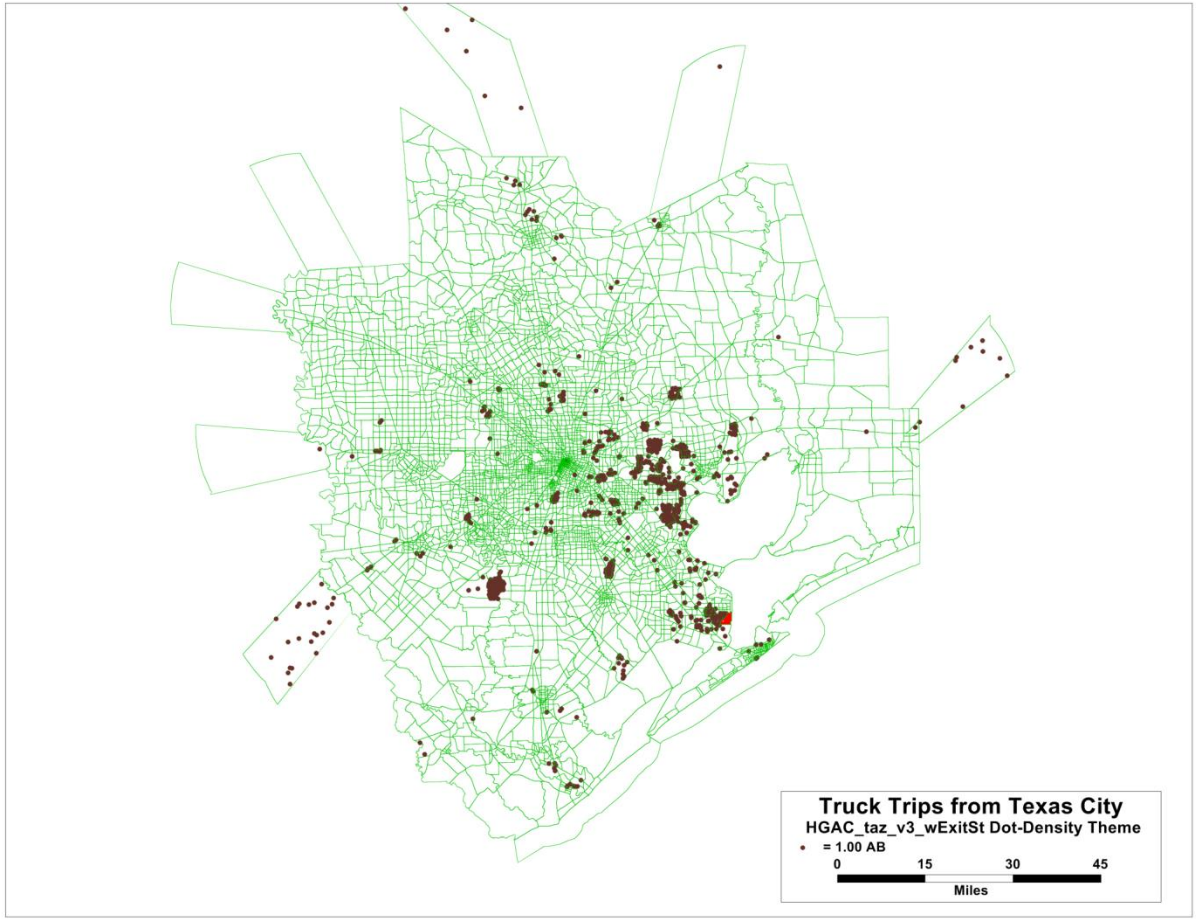
ATRI Data – Port of Galveston



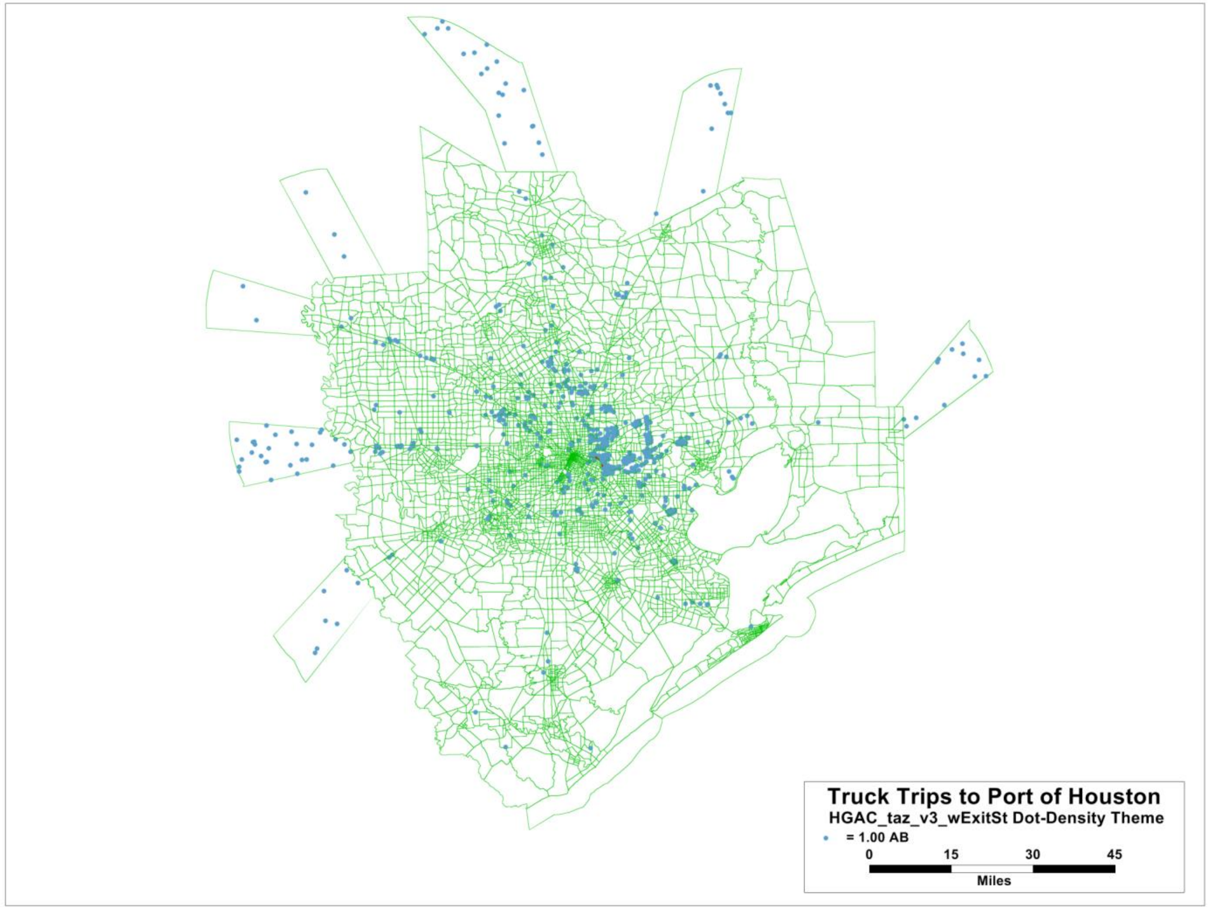


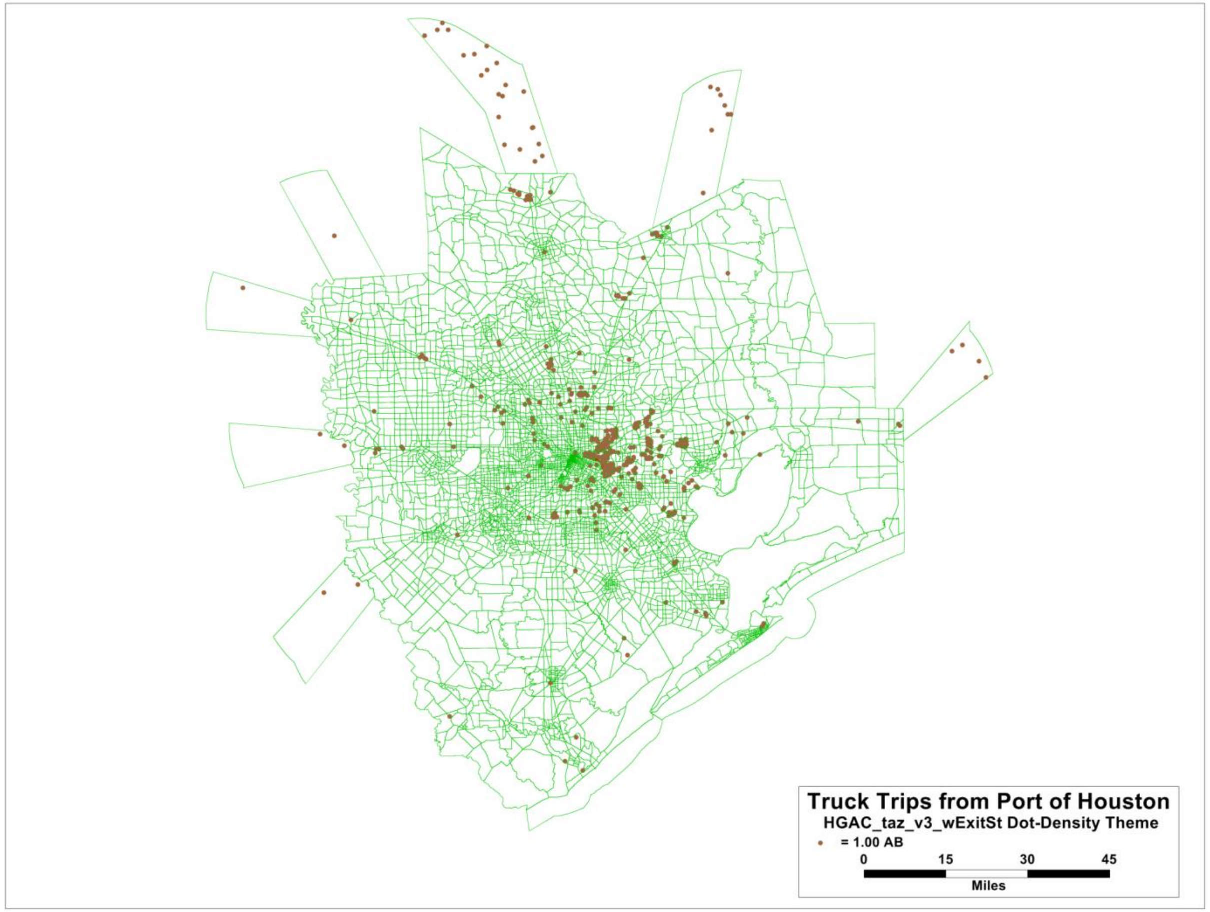
ATRI Data – Port of Texas City



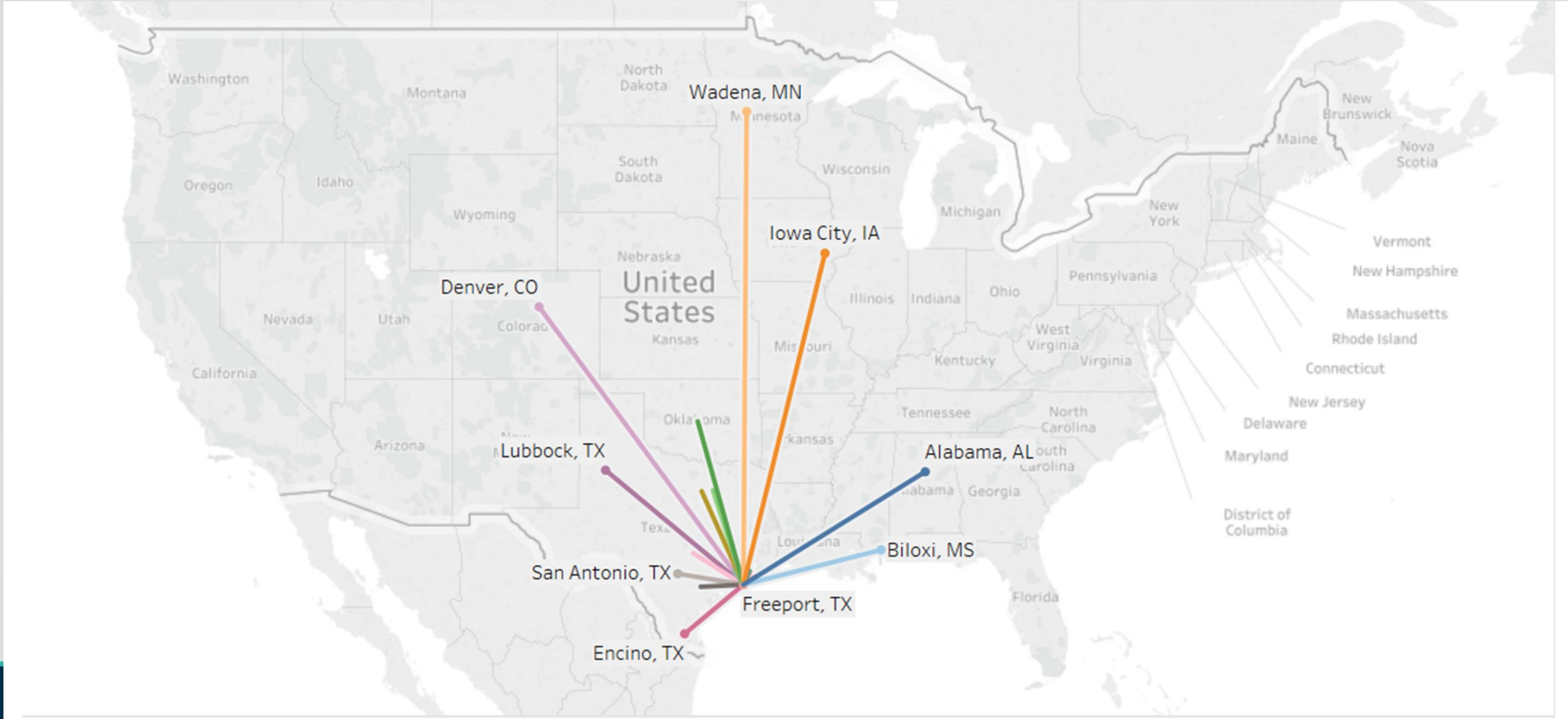


ATRI Data – Port of Houston (Turning Basin)

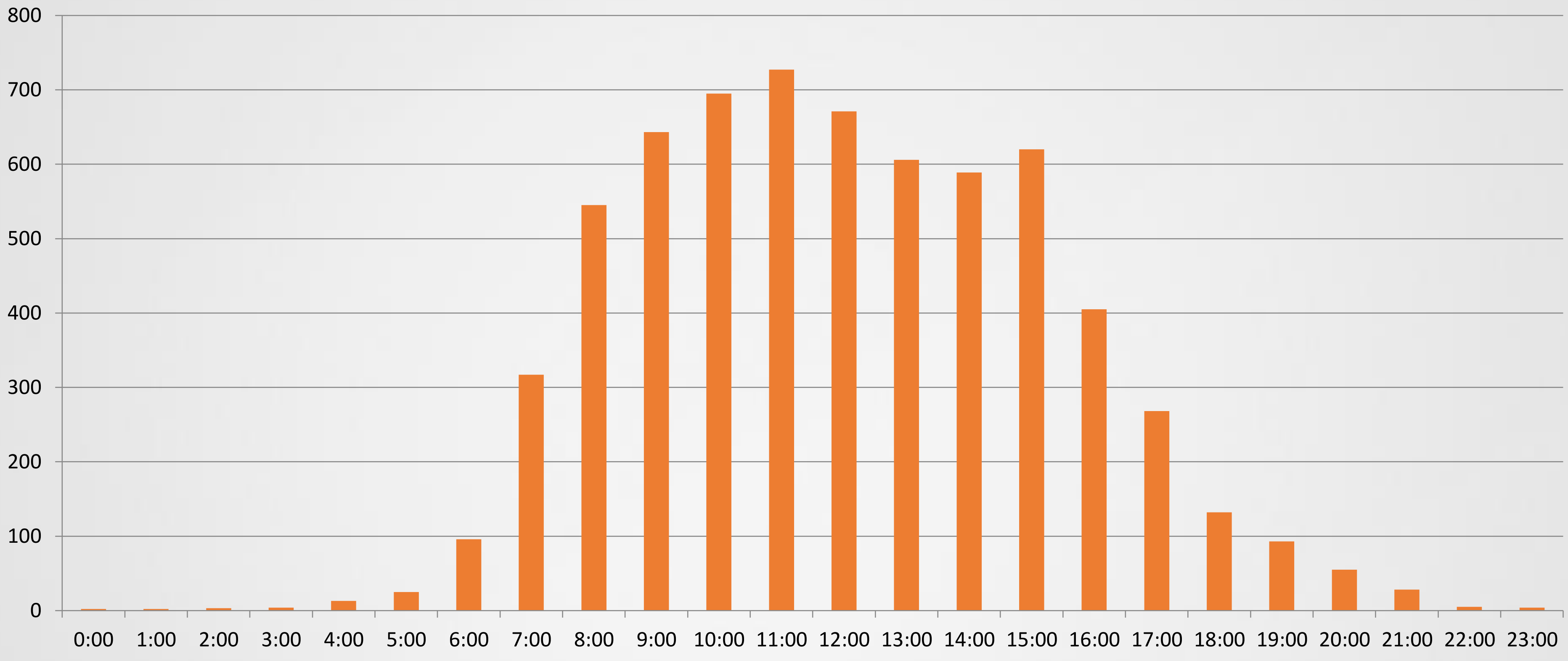




Truck Driver Survey
Destination of Trucks from Freeport



24 Hour Truck Profile – Port Road Approach to Bayport Terminal



Both directions November 14th (Post Bayport Gate Time Extension)

What is this telling us?

- Significant number of local trip generators
- Wide catchment region for certain commodities, but more local for others
- Some supply chain structures make mode shift challenging

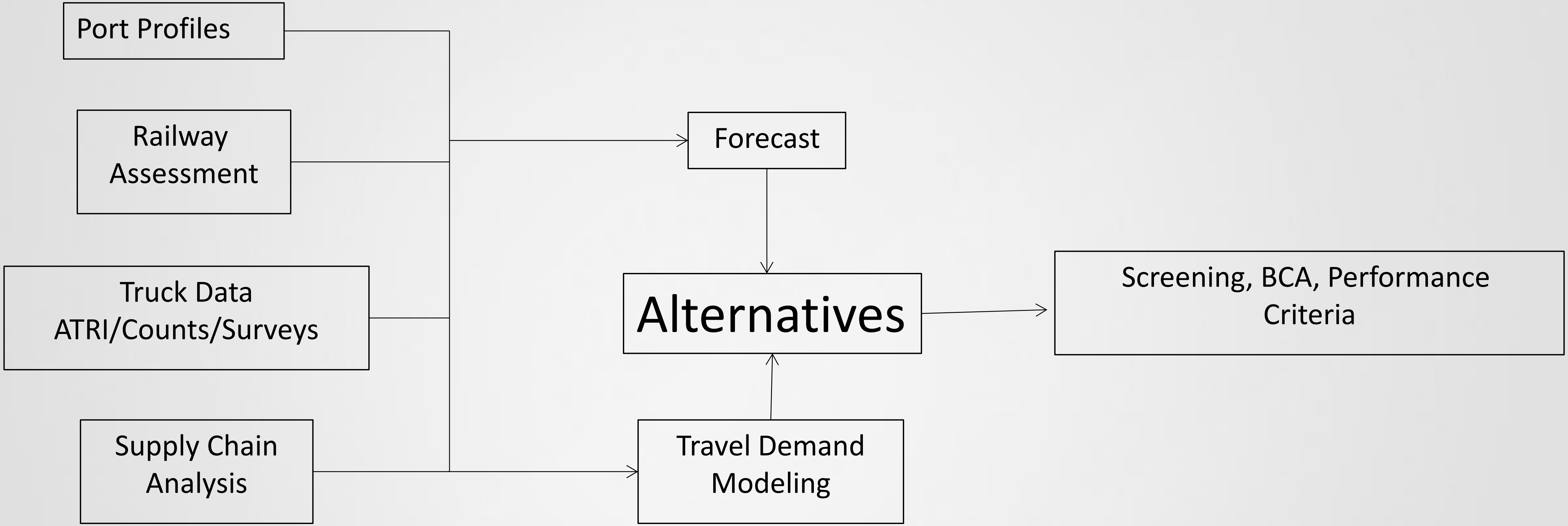
Purpose of this workshop

- Your knowledge and experience to assist with:
  - Have we identified the right projects?
    - Your suggestions on multimodal, operational and policy options?
    - Are we missing any infrastructure projects?
    - Future projects – e.g. I-69 Bypass, Freight Shuttle
  - Identifying screening criteria and project prioritization
  - Making sure we have the right information to identify solutions that support port mobility across the region

- Questions?

- Feedback exercise to follow

Alternative Evaluation Process

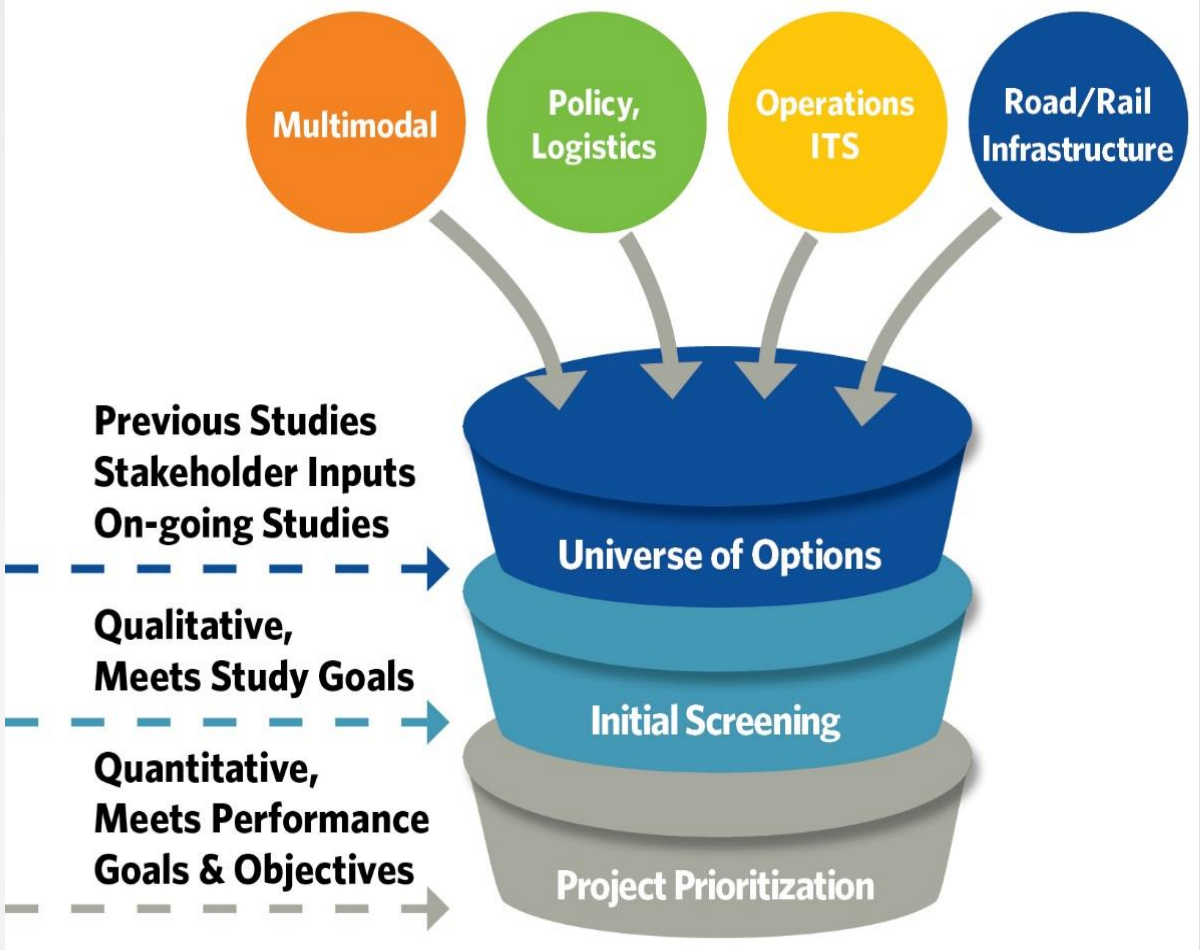


Alternative Evaluation Process Steps

- Inputs
  - Universe of projects
  - Study goals & objectives
- Steps

  1 - Screened Projects best meeting Goals

  2 - Prioritized projects best meeting performance goals & objectives
- Outputs
  - Best performing individual projects used to define and evaluate system scenarios



Screening Criteria Process/Methodology Overview

- Purpose
  - Identify & screen universe of all known & emerging projects/policies that best meet the goals of the Ports Area Mobility Study
- Process/Method
  - Define all projects & policies
  - Define goal & scoring criteria for screening
  - Use a screening matrix for the evaluations
  - Develop thresholds for moving screened projects/policies to Step 2 - Prioritization

Screening Criteria Process/Methodology Overview (con't)

- Goals defined using
  - 2013 Goods Movement Plan
  - Fast Act National Performance Goals
  - Houston Congestion Management Plan & Regional Transportation Plan
- Draft goals, improvements to:
  - System reliability, connectivity, congestion mitigation, travel cost, safety, environmental/air quality, & economic/regional growth

Screening Criteria Process/Methodology Overview (con't)

- Other screening criteria in addition to goals:
    - Project Readiness – Status
    - Timing of Need – Short, medium, long term
    - New or Existing - Ease of integration
    - Regional Significance – Anticipated benefit impact
    - Residential Neighborhood Impact – Potential to create unwanted impact
    - Others TBD

Screening Criteria Process/Methodology Overview (con't)

- Screening matrix will be structured to assess each project/policy's
  - Criteria for each goal
  - Rational
  - Definition for potential benefit (low, med, high)
  - Score & rank by tier
  - Threshold for advancing projects/policies to Step 2
- See example matrix

Screening Criteria Process/Methodology Overview (con't)

- Example screening matrix

		Potential Benefit		
Criteria	Rational	Low	Moderate	High
Project Readiness **(Project only)**	Existing status of project	○ (No work started)	◒ (some work completed)	● (substantial work completed)
Timing of need (project needs to be completed in this time frame)	When project is needed to improve the freight mobility system	○ (Long-term Need (16+ years))	◒ (Medium Need (11-15 years))	● (Immediate Need (within 0-10 years))
New or Existing Project/Revision of Existing or new Policy	Ease of integration	○ (New idea/concept)	◒ (In existing plans or revision of existing policy)	● (Implementation of project or policy actively being worked on)
Regional Significance	Geographic area impacted	○ (localized improvement)	◒ (Houston region)	● (Overall Houston region and Port region)
Residential Neighborhood Impact	Potential to create unwanted neighborhood impact (noise, traffic, visual, etc.)	○ (Adversely impacts neighborhood(s))	◒ (Includes some adverse impacts to neighborhood(s))	● (No / Or reduces adverse impacts to neighborhood(s))
Goals (assessed individually)	Does project/policy meet the goal?	○ (No)	◒ (Somewhat)	● (Yes)

Project Prioritization Process

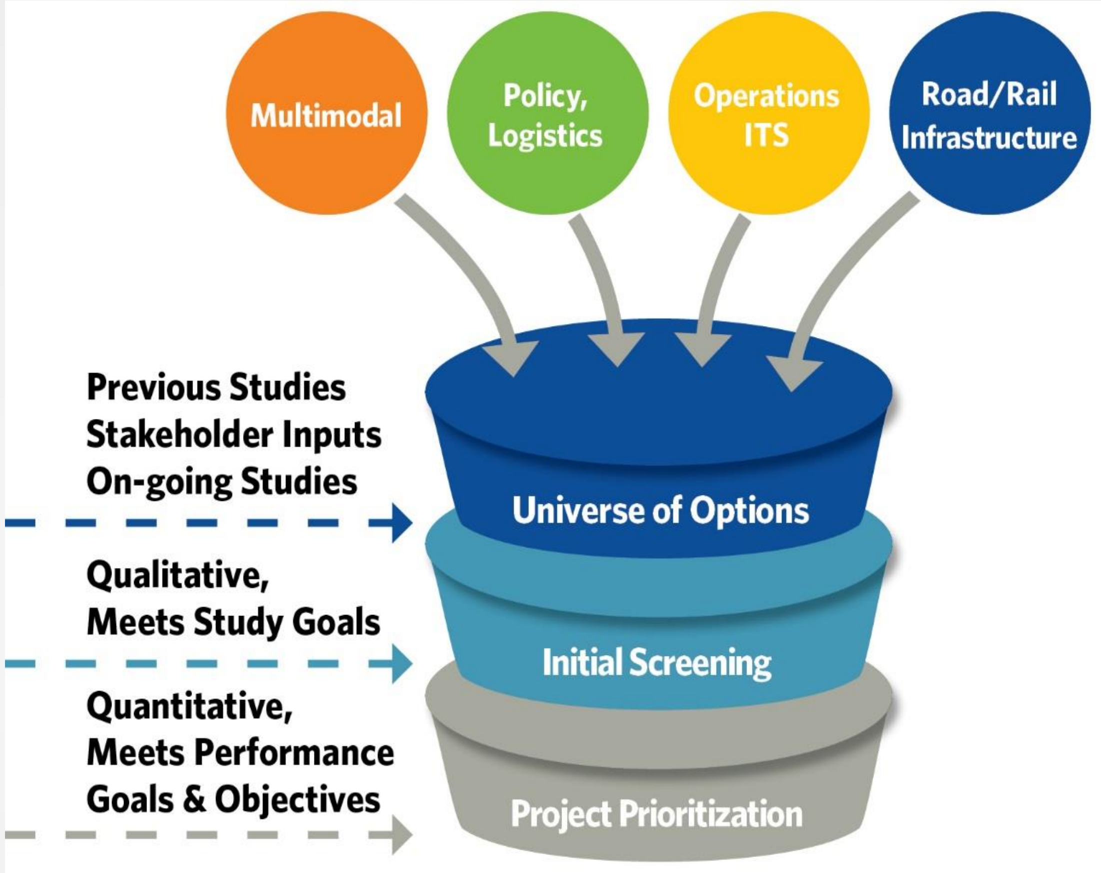
- Inputs
  - Projects selected during Initial Screening
  - Relative importance of each goal & objective
  - Quantifiable indicators capturing goals & objectives
- Steps

  1 – Identification of weights for multi-criteria analysis, by modal categories

  2 – Quantification indicators for each project

  3 – Apply multi-criteria analysis

  4 – Identify costs for each project and budget constraints
- Outputs
  - Classification of projects into short-, medium- and long-term implementation



Project Prioritization Methodology Overview

- Purpose
  - Prioritize previously screened projects using quantitative measures
  - Projects align with regional goals and financial constraints
- Process/Method
  - Define relative importance of goals/objectives
  - Identify measures that quantify goals/objectives
  - Apply multi-criteria analysis process
  - Identify costs of implementation for each project

Goals & Objectives

Goals	Objectives
Travel time reliability	Reduction of travel in number of congested miles
	Number of interchanges along travel path
	NHS bridge condition
	NHS pavement condition
Connectivity	Regional and port
	Intermodal options
Congestion Mitigation	Vehicle hours traveled (VHT)
	Travel time reduction for non-truck traffic
	LOS Improvements
Travel costs	Loss of productivity due to congestion + Tolls + Fuel
	Vehicle miles traveled (VMT)
Safety	Reduction in crashes
	Hazmat incidents
Environmental	Air Quality
	Noise Reduction
Economic/Regional Growth	Meeting future demand
	Preparing for supply-chain forecasts

Examples of Quantifiable Indicators

2013 GMP/Nat'l Goals	2013 GMP Example Measures	Port Mobility Study Initial/Draft Measures	Source
System Reliability	Interstate highway buffer index	Truck travel time index on FSN	Other
	Truck travel time on major corridors	Truck travel times on FSN corridors	2013 GMP
Connectivity		Distance traveled in 8 hours by truck / rail on starting at the Port of Houston	Other
Congestion Mitigation	LOS	Truck Travel Time Index on FSN	Other
	Duration of congestion of Freight-Significant Network	% delayed daily conditions by FSN facility	2013 GMP
		Truck congestion annual costs in $billions	2040 RTP
Travel Costs	Logistics Costs/GNP	Per-mile cost of driving	Other
Safety	Truck injury & fatal crash rates	Vehicle (truck) crash rates per million annual VMT	2040 RTP, CMP
	Highway-rail at-grade incidents	Railroad crossing (rail-vehicle) accidents per year	2040 RTP, CMP

Example of Prioritization Matrix

Ref	Project	Key Issue Addressed	Ind. 1 (TTR)	Ind. 2 (Conn.)	Ind. 3 (Cong.)	Ind. 4 (Travel Cost)	Ind. 5 (Safety)	Ind. 6 (Envir.)	Ind. 7 (Econ.)	Ind. ...	Cumulative Weighted Score	Prioritization Rank
2	XXXX	Re-occurring urban congestion	8	4	9	6	5	9	4		6.43	1
3	XXXX	Truck travel time reliability	7	4	8	5	6	6	3		5.57	4
16	XXXX	Connectivity	6	8	5	7	7	5	6		6.29	2
77	XXXX	Re-occurring urban congestion	8	4	8	4	6	8	5		6.14	3

Example of Prioritization Outcome

Ref	Project	Key Issue Addressed	Cumulative Weighted Score	Prioritization Rank
2	XXXX	Re-occurring urban congestion	6.43	1
16	XXXX	Connectivity	6.29	2
77	XXXX	Re-occurring urban congestion	6.14	3
3	XXXX	Truck travel time reliability	5.57	4

+

Ref	Project Cost
2	$
16	$$$
77	$$
3	$$$

=

Ref	Timeframe
2	Short-Term
16	Long-Term
77	Medium-Term
3	Long-Term

- Please contact the following project staff if you have more comments or questions:
  - HGAC – Patrick.mandapaka@h-gac.com
  - HGAC – Shain.Eversley@h-gac.com
  - HDR – Reddy.Edulakanti@hdrinc.com

Upon arrival, workshop attendees were welcomed to sign in on the sign-in sheets provided and were assigned to color-coded groups according to their individual expertise and study interests.

Workshop attendees were provided with a Workshop Agenda, Workshop Ground Rules, a Project Overview Form, Individual and Group Feedback Forms, and a study Contact Card.

The workshop began with an introduction of the study team and a brief explanation of the workshop structure and ground rules.

Following the introduction, the study team led a study overview PowerPoint presentation that provided the purpose and goals of the study, the purpose of the workshop, and study progress to date.

Large-scale maps displaying projects already identified by the study were arranged around the room for attendees to provide individual feedback, in correspondence with the Individual Feedback Form.

During the individual feedback session, study team representatives were available to engage in one-on-one discussion with attendees.

Attendees discuss projects included in the Project Overview Form during the individual feedback session.

Following an open discussion to identify regional infrastructure issues and concerns, the study team provided an overview PowerPoint presentation about the study's screening criteria and project prioritization process.

Workshop attendees were then tasked to join their assigned group, select a group scribe, and brainstorm to complete a single Group Feedback Form.

The workshop concluded with closing remarks by the study team and the collection of the completed Individual and Group Feedback Forms.

Ports Area Mobility Study Workshop
Individual Feedback Database

First Name	Last Name	Email	Phone	Project/ Sticker #	Project Description	Approx. Project Location	Potential Project Sponsor	May we contact you for information re: projects identified?	Is there any additional information or feedback that you would like to provide the study team?
Jennifer	Almonte	jennifer.almonte@ptc2.hctx.net	713-274-2322	Project #16	Status: Scheduled to let in July 2018	Clinton Dr. Limits: West of Port of Houston to 610 Loop	TxDOT, Harris County Pct. 2		I might have missed it, but there is a need to raise several bridges over I-10. Three to four low crossings cause multiple strikes monthly.
				Project #20	14 Intersection improvements Status: In construction Expected complete date: March 2018	Fairmont Pkwy.	Harris County Pct. 2		
				Project #22/23	Harris County Pct. 2 has a reconstruction project for Federal Rd. to meet the southern limit of grade separation to washburn traffic circle. Status: Scheduled to let in July 2018	Federal Rd.	TxDOT, Harris County Pct. 2		
				Project #47	Red Bluff Rd. Status: In design Bidding: 2018		TxDOT, Harris County Pct. 2		
				Project #88/37	Sheldon Rd. expansion and Jacintoport Blvd./Sheldon Rd. to Beltway 8 expansion are Pct. 2 priorities. Both require a grant or other organizations participation. Pursuing reconstruction intersection improvements at Federal and Market will be in design summer/fall 2018	Sheldon Rd. and Jacintoport Blvd. to Beltway 8	Harris County Pct. 2		
Clif	Edwards	cedwards@hcp4.net	281-787-8822					Yes	The projects assure a sustainable simple expansion. Minimal costs - Maximum Improvements Shift freight movements to off-hours/nights - Similar to Europe / New York ID routes - by improving freight movement on a route/corridor thereby allowing increased mobility of passenger vehicles. Value ROI/ CBA of improving a route that allows increased economic creativity of a project on an increased funding stream. Could the results of the Texas Freight Mobility Plan be incorporated into project priority? Alternative new technology for moving freight?
Charles	Nunu	clnunu@protonmail.ch	713-553-8479					Yes	Infrastructure is our issue. There is <u>no vision</u> to address technological and economic drivers and trends. 1. Segregated roads/lanes for trucks 2. Increase revenue for drivers (we need more drivers). 3. Chorus Logistics already has (at the app level) to manage inventory, DOT, IFTA, insurance, location, cargo. This would increase truck owner revenue. We need more trucks! 4. We need to rethink specialized lanes. Identify preserved trucks (who-vehicle safety/history). 5. Extended drayage (out of Port of Houston) 6. We need to charge fees to top-off diminishing gasoline tax revenue. 7. Can we electrify a route for powered transport to move (Amazon goods/retail) about 9% of current cargo? More simply, what is cheap that has a payback of a year that will add speed/revenue for transporters/trucks? Reroute or use toll roads for partnerships. Sorry this is muddled, perhaps too random. Happy to show you a truck transport/ freight wet or dry cargo system.

Ports Area Mobility Study Workshop
Individual Feedback Database

First Name	Last Name	Email	Phone	Project/ Sticker #	Project Description	Approx. Project Location	Potential Project Sponsor	May we contact you for information re: projects identified?	Is there any additional information or feedback that you would like to provide the study team?
A. Rusty	Senac	arsenac@chamberstx.org	281-383-2011	Sticker #1	Rail grade separation - FM 565/FM 1405	City of Baytown, Chambers County	Union Pacific, BNSF, TxDOT, City of Baytown, Chambers County	Yes	Project #47: Pedestrian and bike trails should be removed Reduce tolls for night operations on the Grand Parkway. Talk to drivers to find out their issues from their perspective. Maybe people here know. Going directly to drivers may give us some low-hanging fruit to use.
				Sticker #2	Allow greater than 80,000lbs GVW loads on SH99 with appropriate tractor trailer configuration.	Grand Parkway City of Mount Belvieu	TxDOT, H-GAC		
				Sticker #3	Connector on Spur 330 to east bound on I-10	Baytown I-10 East	City of Baytown TxDOT		
									Attended the H-GAC Ports Mobility Study Workshop yesterday. They had some maps with companies listed… They had Plantgistix on FM 565, KTN on Hwy 225. I asked the lead if they had information on what is being developed especially in west Chambers County; KTN, Ravago, Vinmar, Ameriport, etc... He said he did not but that information would be helpful, especially in terms of expected truck volumes. I suggested they contact you at the Baytown West Chambers County Economic Development Foundation. Reddy Edulakanti, Project Manager, HDR - reddy.edulakanti@hdrinc.com, cell: 347.703.2463. I copied Reddy on this email and told him that you worked closely with the Greater Houston Partnership and Port Houston and that you could tell him who he should contact at GHP, if he needed that information.
Mike	Wilson	wilson@portfreeport.com	979-233-2665	Project #47	Pedestrian and Bike Trails	Red Bluff Rd.		Yes	Why are projects pedestrian and bike projects included? Where is I-69 shown? It needs to be highlighted. Where are port connector routes?
				Project #68	Pedestrian and Bike Trails	SH 288			
Norman	Whitton	president@sunrise-ridge.com							Please see the images provided by Mr. Whitton in the scanned feedback documents file.
									Thank you for inviting me to participate in yesterday's workshop regarding the prioritization of construction projects to support enhanced mobility for the ports area. I believe that the input from the workshop will greatly assist H-GAC to develop a stronger plan and one that will achieve higher results at lesser cost. Because the short time allowed only limited response (and my handwritten comments might be difficult to read, sorry!), I am taking the opportunity to provide a set of comments that might be useful as your team continues to develop the plans. The planning process can be challenging and requires sustained effort over a long period of time. I know that I am entering comments part-way through the process, and that I may not be fully aware of all the activity that was done, is underway or planned for the future. As such, I am offering these comments as suggestions for your consideration. Please see additional comments provided by Mr. Whitton in the scanned feedback documents file.
				Project #11	Broadway St. - Double track	Broadway St.	This project is already funded and should go into construction soon.		
				Project #95	I-69 connection should be listed at the top of the list.	East bypass of I-69 to serve ports	TxDOT		

Ports Area Mobility Study Workshop
Group Feedback Database

Group Color	Group Members	Additional Screening/Prioritization Criteria	Diverting Freight Flow away from Congested Urban Core	Project Supports Regional Commodity Flow	Project Supports Local Commodity Flow	Project Readiness	Timing of Need	New or Existing Project / Revision of New/or Existing Policy	Other	Additional Feedback
Light Green	1) Anne Dunning 2) Andrew Mao 3) Norman Whitton 4) Robert Sakowitz 5) Paul Cristina	Interdependency We are bean-counting with this process rather than looking at the big picture. Focus on volume. We should be selecting projects based on effectiveness demonstrated in a simulation model. All of the projects are capacity focused. We need to look at the demand side. This level of selection needs to happen only after we answer how each action will serve what volume where and when. These 3 criteria are interdependent and must be taken together, considering interdependence among projects as well.	Safety, pollution - all traffic impacts Depends on market	Depends on market	Depends on market	1			Cost	
Light Blue	1) Bruce Mann 2) Clif Edwards 3) David Milner 4) Jennifer Almonte 5) Tyson Moeller 6) Brenda Mainwaring	For prioritization process use Texas Freight Mobility Plan, exhibit 10-11 of TFMP Except sustainable funding (if goal is created, we'll find funding) How calls for projects are executed Small projects like pedestrian path should not be listed Should look at larger, more impactful projects "Uberizing" freight - ships and trucks Volume of truck/cargo by route		1 - Linchpin	1	3 - Take out		3 - Take out		
Orange	1) Mike Wilson 2) Commissioner Rusty Senac 3) Maureen Crocker 4) Charles Nunu 5) Charles Airiohuodion 6) Barbara Koslov 7) Hugh McCulley	1. Regional significance 2. Connectivity 3. Viability 4. Safety 5. Economics (all have to make a living) 6. Coordinated policy 7. Technology								
	Norman Whitton - completed additional feedback form individually	These criteria are too limiting and small-focused. 1. Strategic fit with corridors and growth segments 2. Cost reduction in logistics chain 3. Reduction of negative impacts on City (pollution, congestion)				No, Irrelevant		No		What is the role of the ports? Three scenarios may be: Local - support Houston and smaller volume elsewhere? State Leader - provide Texas with primary container port? (for Dallas and San Antonio vs. Corpus Christi) Mid-continent Leader - compiles with LA/BC for mid-continent Cost is critical - find ways to drive down costs In transport, two cost reduction technologies are coming - 1) autonomous driving, 2) electrification Combined, these technologies can drive down trucking costs 20-30 percent. 24-hour operations is another way to get capacity at low cost. Expand to 24-hour operation and push trucking to nighttime roadway use. Dedicate truck lanes on high-traffic routes to support autonomy and electrifications - all the way to Dallas and San Antonio. Set up tractor leasing program for electric trucks and battery charging to reduce pollution and costs. Automated/electronic customs and bill of lading at ports Missing information/analysis: Port/freight-logic competitive costs Analysis of cost blocks - how to reduce those costs Need freight/truck routing and understanding of vehicle counts Autonomous truck adoption Electric truck adoption Policies/projects that obtain more data and information Pilot projects to test/begin implementing electrification and autonomous driving projects

Individual Feedback Form

Ports Area Mobility Study Workshop
January 24, 2018, 1:30 – 3:30 PM

Houston-Galveston Area Council

Name: Jennifer Almonte
Email: jennifer.almonte@pct2.hctx.net
Phone: 713 274 2322

Please utilize the maps available around the room to acquaint yourself with the projects that have been preliminarily identified for inclusion in the Ports Area Mobility Study. Given this information, please complete the following form to reflect your individual, professional knowledge, expertise, and experience.

1. If you have recommendations about additional, potential projects that could be included in the study, please place a sticker on the maps provided using the sticker dots available.

2. Please provide additional information about additional, potential projects for consideration. For each sticker dot placed on the map, please complete corresponding information below.

~~Sticker~~ Project #	Project Description	Approx. Project Location	Potential Project Sponsor
16	Clinton Dr Limits: W of Port of Houston to 610 Loop status: Scheduled to let July 18		Txdot, HC Pct2
20	Fairmont Pkwy 14 intersection improvements Status: in construction ECD: March 18		HC, Pct 2
22/23	Federal Rd Grade Separation Status: bidding (let) July 18	Pct 2 has a reconstruction project for Federal to meet the S limit of grade sep to Washburn traffic circle Bid May 18	TxDot, HC Pct2
47	Red Bluff Rd in design bidding 2018		Txdot HC Pct2
88/37	Sheldon Rd expansion and Jacintoport Sheldon to Beltway 8 expansion are Pct 2 priorities both require grant / other org participation	→ pursuing reconstruction, intersection improvement at Federal and Market in design summer/fall 18	

I might have missed it, but raising several bridges over I-10 at low crossings could strike multiple monthly

3. May we contact you directly for additional information regarding the projects identified above? ____**Yes** ____**No**

4. Is there any additional information or feedback that you would like to provide the study team?

Individual Feedback Form

Ports Area Mobility Study Workshop
January 24, 2018, 1:30 – 3:30 PM

Houston-Galveston Area Council

Name: CLIF EDWARDS
Email: CEDWARDS@HCP4.NET
Phone: 281 787 8822

Please utilize the maps available around the room to acquaint yourself with the projects that have been preliminarily identified for inclusion in the Ports Area Mobility Study. Given this information, please complete the following form to reflect your individual, professional knowledge, expertise, and experience.

1. If you have recommendations about additional, potential projects that could be included in the study, please place a sticker on the maps provided using the sticker dots available.

2. Please provide additional information about additional, potential projects for consideration. For each sticker dot placed on the map, please complete corresponding information below.

Sticker #	Project Description	Approx. Project Location	Potential Project Sponsor

3. May we contact you directly for additional information regarding the projects identified above? X Yes ___ No

4. Is there any additional information or feedback that you would like to provide the study team?

Email is best

The Projects assumes a [illegible] simple expansion.

Minimal Cost - Maximum Improvement -
- shift freight movement to off hours or night hours. - similar to Europe/NYC

Ip. Routes. - by improving freight movement on a route/corridor, thereby allowing increased mobility of pass. Veh. Vehicles.

Value ROI/CBA of improving a routes and that allows increased economic creating an increased funding stream

~~Some of~~ Could the Results of the Texas Freight Mobility Plan be incorporated into Project Priority?

Alternative New Technology for moving freight ? Autonomous ? ? Electrification ?

Freight Moves @ Night like Europe

Houston-Galveston Area Council

Individual Feedback Form

Ports Area Mobility Study Workshop
January 24, 2018, 1:30 – 3:30 PM

Name: CHARLES L NUNU
Email: CLNUNU@PROTONMAIL.CH
Phone: 713 553 8479

Please utilize the maps available around the room to acquaint yourself with the projects that have been preliminarily identified for inclusion in the Ports Area Mobility Study. Given this information, please complete the following form to reflect your individual, professional knowledge, expertise, and experience.

1. If you have recommendations about additional, potential projects that could be included in the study, please place a sticker on the maps provided using the sticker dots available.

2. Please provide additional information about additional, potential projects for consideration. For each sticker dot placed on the map, please complete corresponding information below.

Sticker #	Project Description	Approx. Project Location	Potential Project Sponsor
	NOT ENOUGH	TIME PLEASE TURN	OVER.

3. May we contact you directly for additional information regarding the projects identified above? ✓ Yes ___ No

4. Is there any additional information or feedback that you would like to provide the study team?

INFRASTRUCTURE IS ONE ISSUE.
THERE IS NO VISION TO ADDRESS TECHNOLOGICAL & ECONOMIC DRIVERS & TRENDS.

1) SEGREGATED ROADS LANES for TRUCK WHICH
2) INCREASE REVENUE for DRIVERS. (WE Need MORE DRIVERS)
3) CHORUS LOGISTICS ALREADY HAS AT THE APP LEVEL TO MANAGE INVENTORY, DOT, IFTA, INSURANCE, LOCATION - CARGO, INVENT. (THIS) WOULD INCREASE TRUCK OWNER REVENUE - WE NEED MORE TRUCKS.

4) WE NEED TO RETHINK SPECIALIZED LANES. IDENTITY PRESERVED TRUCKS (WHO - VEHICLE SAFETY/HISTORY)
5) EXTENDED DRAYAGE (out of Port of Houston)
6) WE NEED TO CHARGE FEES TO TOP off dimenishing GASOLINE TAX REVENUES
7) CAN WE ELECTRIFY A Route for POWERED TRANSPORT. TO MOVE SAY (AMAZON Goods/Retail) ~ 9% of Current CARGO.

MORE SIMPLY. 1) WHAT IS CHEAP - THAT HAS A PAYBACK of A YEAR. THAT WILL ADD Speed/Revenue for TRANSPorter/TRUCK - ReRoute or ~~[illegible]~~ USE TOLL ROADS for PARTNERSHIPS.

SORRY THIS IS MUDDLED - PERHAPS TOO RANDOM - HAPPY TO SHOW YOU A TRUCK TRANSPort/Freight Wet or DRY CARGO. System

Individual Feedback Form

Houston-Galveston Area Council

Ports Area Mobility Study Workshop
January 24, 2018, 1:30 – 3:30 PM

Name: A. Rusty Senac
Email: ARSENAC@CHAMBERSTX.ORG
Phone: 281 383 2011

Please utilize the maps available around the room to acquaint yourself with the projects that have been preliminarily identified for inclusion in the Ports Area Mobility Study. Given this information, please complete the following form to reflect your individual, professional knowledge, expertise, and experience.

1. If you have recommendations about additional, potential projects that could be included in the study, please place a sticker on the maps provided using the sticker dots available.

2. Please provide additional information about additional, potential projects for consideration. For each sticker dot placed on the map, please complete corresponding information below. Figure 1

Sticker #	Project Description	Approx. Project Location	Potential Project Sponsor
New 1	FM 565 FM1405 Figure 1	Baytown Chambers County Rail Grade Separation	UP BNSF TxDOT Baytown Chambers County
New 2	Allow > 80,000 lb GVW Loads on SH99 with appropriate Tractor Trailer Configurations	Grand Parkway City of Mont Belvieu	TxDOT HGAC
New 3	Connector on Spur 330 to EB I-10	Baytown I 10 East	City of Baytown TxDOT

3. May we contact you directly for additional information regarding the projects identified above? __✓__ Yes ____ No

4. Is there any additional information or feedback that you would like to provide the study team?

47. Bike Ped S/B Removed [illegible]

* Night Operations reduced toll or no toll for GP

* Talk to Drivers to find out their issues from their perspective — maybe people here know — going directly to Drivers may give us some low hanging fruit to use.

From: BJ Simon [mailto:bjsimon@baytownedf.org]
Sent: Thursday, January 25, 2018 9:29 AM
To: A. Rusty Senac <arsenac@chamberstx.gov>
Cc: Edulakanti, Reddy <Reddy.Edulakanti@hdrinc.com>
Subject: RE: Port Area Mobility Study

Thank you, Rusty. Reddy, please call at your convenience.

BJS

B. J. Simon

Associate Executive Director

Baytown-West Chambers County

Economic Development Foundation

1300 Rollingbrook Drive, Suite 505

Baytown, TX 77521

(281) 420-2961

(832) 339-3889

bjsimon@baytownedf.org

www.baytownedf.org

From: A. Rusty Senac [mailto:arsenac@chamberstx.gov]
Sent: Thursday, January 25, 2018 9:13 AM
To: BJ Simon <bjsimon@baytownedf.org>
Cc: reddy.edulakanti@hdrinc.com

Subject: Port Area Mobility Study

BJ:

Attended the HGAC Port Mobility Study yesterday. They had some maps with companies listed....They had Plantgistix on FM 565, KTN on Hwy 225. I asked the lead if they had information on what is being developed especially in West Chambers; KTN, Ravago, Vinmar, AmeriPort, etc... He said he did not but that info would be helpful, especially in terms of expected truck volumes. I suggested they contact you at Baytown West Chambers Count Economic Dev. Foundation. Reddy Edulakanti, Proj Mgr, HDR- reddy.edulakanti@hdrinc.com, cell: 347.703.2463.

I copied Reddy on this e mail and told him that you worked closely with Greater Houston Partnership and Port Houston and that you could tell him who he should contact at GHP if he needed that information.

A.R. Rusty Senac
Chambers County
Commissioner, Pct. 4
7711 Highway 146
Baytown, Texas 77523-7579
Office: (281) 383-2011
Fax: (281) 573-1823

Houston-Galveston Area Council

Individual Feedback Form

Ports Area Mobility Study Workshop

January 24, 2018, 1:30 – 3:30 PM

Name: Mike Wilson
Email: wilson@portfreeport.com
Phone: 979-233-2663

Please utilize the maps available around the room to acquaint yourself with the projects that have been preliminarily identified for inclusion in the Ports Area Mobility Study. Given this information, please complete the following form to reflect your individual, professional knowledge, expertise, and experience.

1. If you have recommendations about additional, potential projects that could be included in the study, please place a sticker on the maps provided using the sticker dots available.

2. Please provide additional information about additional, potential projects for consideration. For each sticker dot placed on the map, please complete corresponding information below.

Sticker #	Project Description	Approx. Project Location	Potential Project Sponsor
43 67	Ped/Bike	Red Bluff #47 288 #	Figure 2 Why are these included?
I-69 – where is this shown? Needs to be highlighted.			
Where are Port connector routes?			

Mike Wilson

3. May we contact you directly for additional information regarding the projects identified above? ✓ Yes ____No

4. Is there any additional information or feedback that you would like to provide the study team?

From: Norman Whitton [mailto:president@sunrise-ridge.com]
Sent: Thursday, January 25, 2018 2:09 PM
To: patrick.mandapaka@h-gac.com; shain.eversley@h-gac.com; Edulakanti, Reddy <Reddy.Edulakanti@hdrinc.com>; Decker, Stephen <Stephen.Decker@hdrinc.com>; adunning@poha.com
Cc: Charles Nunu <clnunu@protonmail.ch>; rsakowitz@hazak.com; bmann@poha.com; andrew.mao@txdot.gov; barbara.koslov@cjo.hctx.net
Subject: Port Area Mobility Study

Folks:

Thank you for inviting me to participate in yesterday's workshop regarding the prioritization of construction projects to support enhanced mobility for the ports area. I believe that the input from the workshop will greatly assist HGAC to develop a stronger plan and one that will achieve higher results at lesser cost. Because the short time allowed only limited response (and my handwritten comments might be difficult to read, sorry!), I am taking the opportunity to provide a set of comments that might be useful as your team continues to develop the plans.

The planning process can be challenging and requires sustained effort over a long period of time. I know that I am entering comments part-way through the process, and that I may not be fully aware of all the activity that was done, is underway or planned for the future. As such, I am offering these comments as suggestions for your consideration.

Thank you, and best regards

Norm Whitton

Managing Director, Electric Interstate Highway Standards Association

832-782-0362 www.interstate2.org

FIRST, there is a strong need for scenario planning that is fully integrated with the aspirations and plans of the Ports and their shippers. Some of this work may be underway by the Ports, but it needs to be more fully integrated into the mobility study so that mobility issues can be better identified.

- at a minimum, the scenarios should consider 2-3 cases of substantially different port throughput. Those cases might roughly correspond to a) Houston/Galveston becomes a major United States port for supplying the mid-Continent region and, say, 20+ MM TEUs/yr of volume, or b) Houston/Galveston grows as Texas and local Houston economy grows, with say, 12 MM TEUs of volume. I am not sure what the correct volume should be; this needs to be fully integrated with the Port planning effort.

- the port volume data needs to be carefully characterized into key market segments, first by type (bulk liquid, bulk solid, containers, large machinery (wind), oilfield machinery, other machinery, cars). I saw no analysis of traffic using these data. Each of these market segments should be forecast separately, and the forecasts should consider key drivers for that particular segment (such as renewable energy construction, oil exports, etc) based on shipper industry. Types that then have significant impact on truck and rail traffic need further breakdown. For example, Containers should be analyzed as "Food/Beverage" "Retail Dry Goods" "Resins" "Oilfield Machinery" "Other"; non-containerized imports need to be analyzed as "Wind Machinery" "Oil Field Goods" etc. This breakdown is needed so that future volume/destinations combinations can be estimated. There should also be categories for dry bulk export products that are shipped inbound on rail or truck, such as grains or cement.

- additional sub-scenarios should consider changes in US trade policy, rise / fall of major industries such as oil, chemicals and cement as carbon emission fees arise, and introduction of new technology, such as autonomous driving, vehicle electrification and roadway / port integrated optimization.

- the volume forecasts should have an evolution over time that is based on the sub-scenarios plus input from major shippers such as Walmart, Amazon (now 9% of US retail), petroleum service industry, resin baggers, import car dealer groups and wind developers. The input from Heineken was excellent and similar input is needed in other major shipper groups.

- shipments that go over land by truck and rail need to be further defined for origin / destination. HDR has started that work, but has not shown enough granularity nor have they considered routing to get to those destinations. It is vital to understand this to make any kind of strategy on which corridors should be expanded.

- the overall scenarios should be fully informed by a cost simulation of freight logic vs. competitor options (LA+rail vs. Panama+Houston+rail to Dallas or Chicago for example) so that we fully understand where shipments are going and what impact changing transportation costs will have on volume. This needs to be supplemented by a competitive analysis of the alternates that shippers may face. In particular, the likely competitive response from railroads to protect their lucrative long-haul from LA to the mid-Continent deserves much more detailed analysis.

SECOND, there is a need to analyze the impacts of the growth scenarios on traffic and transportation infrastructure in the region and in/outbound from the region. So far, this has been done by colloquial input from various interested parties. While this is very useful to ensure that real-life experience is baked in, it is possible, unfortunately, with that kind of input, we may receive biased results that may not fully optimize the overall system. Again, simulation of freight logic for a limited number of transportation corridors (major highways, major rail routes), will help provide more-objective data to base decisions on. This kind of simulation will also prove very helpful in evaluating the benefits of various solutions that might be proposed. If a full simulation is too expensive, then it is critical to forecast vehicle counts on various corridors and consider the incremental capacity loads. I believe that HDR was considering to do that in future. This analysis needs to be fully completed before any solutions are considered or ranked, so at a minimum, this work needs to be accelerated ahead of the activity that was done at the workshop yesterday.

THIRD, there is a need for a much broader range of potential solutions to be considered, in addition to the myriad of "pour more concrete" projects that were displayed so well at the meeting.

- solutions that change operating policy / procedures, such as moving to 24 hour port operations, and restricting truck traffic to nighttime off-peak hours. To smooth operation at the ports, maybe rail loading/movements can be completed with a focus during daylight hours.

- solutions that eliminate truck traffic, such as providing land/buildings and rail facilities for resin baggers to relocate immediately adjacent to the container terminals, thus eliminating hundreds of truck movements per day. And, a rail line that serves the Bayport terminal, even if the railroads are not willing to fund it (see comment above about competitor options and a need to fully understand railroad behavior in protecting their existing LA long hauls). Traffic at Bayport may need to be "forced" onto rail and this is an area where important consideration is needed to identify how it can be done in the face of potentially uncooperative railroads.

- solutions that use information technology and pricing policy to eliminate congestion (such as fees to pay for automated customs clearing) and to optimize traffic (such as differentiated fees for time of day loading, or congestion pricing on roads)

- solutions that pilot test newly emerging transportation technologies, such as electrification and autonomous driving. For example, these may require dedicated truck lanes, but promise much lower operating costs. A pilot test can help identify implementation problems and then allow more-rapid deployment in future.

- solutions that explicitly consider funding. Projects that must be funded by a dwindling volume of fuel taxes are much more difficult to implement; alternate funding methods (such as fees / tolling) need to be considered, and the economic attractiveness of fees revenue vs. cost of the project needs to be evaluated for viability and user uptake.

FOURTH, there is a need to group these solutions into 6-10 coherent strategies, with at most 3 overarching strategies. It is important to make a plan that can be communicated easily; a hierarchy of strategies and solutions is far easier to comprehend and explain, than one with hundreds of smaller components.

- "no-regrets" actions that provide value under all scenarios (including "status quo") such as automated customs clearing, or a very limited number of projects fixing broken pavement in constricted/congested locations

- data support for future planning and operational optimization efforts. This could include mandating data gathering (such as BOL source/destination pairs to fully analyze port traffic). It could also include funding sources (say, small fee per container) to fund full simulation studies and more-detailed planning in future. It could also include real-time vehicle tracking and route optimization (such as Google Wayze with data fed back to central databases for planning units). It would be useful to require railroads to share data, even if they don't want to. Some type of approach may be needed to protect competitive data, but if their data reluctance is based on their interest in maintaining the long-haul LA/mid-Continent route, then this is antithetical to HGAC interests.

- road traffic reduction as a major strategy (this would include moving truck traffic to rail or pipeline, eliminating traffic by relocating shippers to the port, or using underutilized capacity at night)

- major corridor upgrades (maybe 3-7 of these?). This could include projects to expand the Hiway 36 corridor to West Houston, the I-69 bypass from the Bay area to northeast Houston, or dedicated truck lanes on I-45, TX 288 or other routes to end destinations in the city, such as Amazon warehouses, or a concentration of resin baggers. These corridors should also consider the new technology pilots, for dedicated truck lanes and integration of electrification and autonomous vehicles. In some cases, it might be useful for the project owner to also provide the new-tech tractors on a lease program, to encourage trucking companies to join the pilot test.

FIFTH, there is a need for a decision process that is mindful while still objective. In my 12 years of experience as a management consultant specializing in strategy, numerical ranking processes were time consuming yet frequently resulted in decisions that few participants could support, since the rote process was unable to consider the real issues behind the strategy. I strongly believe that the proposed process of numerical ranking about a hundred individual "pour more concrete" projects is unlikely to result in a coherent decision or one that HGAC will be able to support.

- the individual smaller projects should be grouped by corridor for 3-7 major corridors to be considered (for example, there are 8-10 SH 36 upgrades; these should be considered as a single unit). Any "pour more concrete" projects that don't align with a corridor strategy, need to be carefully considered and most likely killed.

- the strategies (as discussed above) need to be ranked based on economic impact vs. cost (return on investment and size of investment), and contribution toward the overall capacity (as evaluated by the simulations discussed above) needed to achieve the volumes for the different scenarios. It is likely that this will result in one to three corridor strategies taking clear precedence over others in the initial periods of the plan. (my guess is that I-69 bypass might rank highest of the different corridors, but there is no analysis yet that supports that gut feel). Later in the plan, other corridors will be ranked in order of development timing.

- There should be a risk analysis for each strategy, this would include implementation issues, funding, local/stakeholder opposition, dependency on scenario (what happens if expected volumes don't arise?), etc. Risk mitigation steps, and key indicators that will provide warning of an unacceptable risk, should also be identified.

- There should be zero consideration given to "shovel readiness" or similar short-term considerations. This approach is likely to divert resources from more-valuable activity.

Google Maps

Baypart Terminal

Norman Whitton
Electric Interstate Hwy

Imagery ©2018 Google, Map data ©2018 Google 100 ft

Google Maps

Baypot Teminal

Imagery ©2018 Google, Map data ©2018 Google 200 ft

Google Maps ~~944 W Sandy Lake Rd~~ Barbours Cut. Terminal

Imagery ©2018 Google, Map data ©2018 Google 100 ft

Individual Feedback Form
Ports Area Mobility Study Workshop
January 24, 2018, 1:30 – 3:30 PM

Houston-Galveston Area Council

Name: ____________________

Email: ____________________

Phone: ____________________

Please utilize the maps available around the room to acquaint yourself with the projects that have been preliminarily identified for inclusion in the Ports Area Mobility Study. Given this information, please complete the following form to reflect your individual, professional knowledge, expertise, and experience.

1. If you have recommendations about additional, potential projects that could be included in the study, please place a sticker on the maps provided using the sticker dots available.

2. Please provide additional information about additional, potential projects for consideration. For each sticker dot placed on the map, please complete corresponding information below.

Sticker #	Project Description	Approx. Project Location	Potential Project Sponsor
11	Broadway Double Track	This project is already funded and should go into construction soon.	
95	IH 69 Connection Should be listed at top of list	East Bypass of I-69 to serve ports	TxDOT

3. May we contact you directly for additional information regarding the projects identified above? ____**Yes** ____**No**

4. Is there any additional information or feedback that you would like to provide the study team?

Group Feedback Form

Houston-Galveston Area Council

Ports Area Mobility Study Workshop
January 24, 2018, 1:30 – 3:30 PM

Group Color: light Green table

Group Members: Anne Dunning
Andrew Mao
Norman Whitton

Screening Criteria Feedback

Please refer to the Initial / Universe of Project Screening section of the presentation. Given the information provided during that presentation, please complete the following form to reflect your individual and professional knowledge, expertise, and experience.

1. Is there any additional screening criterion not considered in the outlined methodology that you believe would be important to include? If so, please describe it and provide ideas for indicators that could be used to quantify it.

Interpendency
We are bean-counting with this process rather than looking at the big picture.
Focus on volume.

We should be selecting projects based on effectiveness demonstrated in a simulation model.

All of the projects are capacity focused. We need to look at the demand side.
This level of selection needs to happen only after we answer how each action will serve what volume where and when. These 3 criteria are interdepent and must be taken together, considering interdependence among projects as well.

2. From the list of criteria used in the Initial / Universe of Project Screening (see list in the table below), please rank each one of them based on their importance relative to the other criteria listed. Please circle the importance of each criterion in the matrix (1 represents highest, 3 represents lowest). Please identify and rank other potential criteria not provided in the matrix below. Please complete this for each criterion.

safety, pollution – all traffic impacts

Screening Criterion	IMPORTANCE (1=Highest, 3=Lowest)		
Diverting Freight Flow away from Congested Urban Core Depends on market	1	2	3
Project Supports Regional Commodity Flow	1	2	3
Project Supports Local Commodity Flow We care about both depending on market.	1	2	3
Project Readiness (Existing Status of the Project - shovel ready, funded and programmed, other)	1	2	3
Timing of Need (When the project is needed to improve freight mobility – immediate, long-term)	1	2	3
New or Existing Project / Revision of New/or Existing Policy (Ease of implementation)	1	2	3
Other*: Cost	1	2	3
Other*:	1	2	3

* = In case an additional criterion was identified in item 1 of this form.

Project Prioritization Feedback

Please refer to the Project Prioritization section of the presentation. Given the information provided during that presentation, please complete the following form to reflect your individual and professional knowledge, expertise, and experience.

3. Is there any additional prioritization criterion not considered in the outlined methodology that you believe would be important to include? If so, please describe it and provide ideas for indicators that could be used to quantify it.

4. From the list of criteria used in the prioritization process (see list in the table below), please rank each one of them based on their importance relative to the other criteria listed. Use an "X" to define the importance level of each criterion using the categories provided in the criterion column of the matrix. Please select <u>no more than 3 criteria</u> under each importance column.

	IMPORTANCE		
Goals	**High**	**Medium**	**Low**
Travel Time Reliability			
Connectivity			
Congestion Mitigation			
Travel Costs			
Safety			
Environmental			
Economic / Regional Growth			
Other*: ____________________ ____________________			

* = In case an additional criterion was identified in item 3 of this form.

Please provide additional feedback here.

Norm Whitton

Group Feedback Form

Ports Area Mobility Study Workshop
January 24, 2018, 1:30 – 3:30 PM

Houston-Galveston Area Council

Group Color: Green

Group Members: ______

Screening Criteria Feedback

Please refer to the Initial / Universe of Project Screening section of the presentation. Given the information provided during that presentation, please complete the following form to reflect your individual and professional knowledge, expertise, and experience.

1. Is there any additional screening criterion not considered in the outlined methodology that you believe would be important to include? If so, please describe it and provide ideas for indicators that could be used to quantify it.

These criteria are too limiting & small-focused.

(1) Strategic fit w/ corridors & growth segments
(2) Cost reduction in logistics chain
(3) Reduction of negative impacts on City (pollution, congestion)

2. From the list of criteria used in the Initial / Universe of Project Screening (see list in the table below), please rank each one of them based on their importance relative to the other criteria listed. Please circle the importance of each criterion in the matrix (1 represents highest, 3 represents lowest). Please identify and rank other potential criteria not provided in the matrix below. Please complete this for each criterion.

Screening Criterion	IMPORTANCE (1=Highest, 3=Lowest)		
Diverting Freight Flow away from Congested Urban Core	1	2	3
Project Supports Regional Commodity Flow	1	2	3
Project Supports Local Commodity Flow	1	2	3
NO Project Readiness (Existing Status of the Project - shovel ready, funded and programmed, other) irrelevant	1	2	3
OK ~~Timing of Need (When the project is needed to improve freight mobility – immediate, long-term)~~	1	2	3
New or Existing Project / Revision of New/or Existing Policy (Ease of implementation) no	1	2	3
Other*:	1	2	3
Other*:	1	2	3

* = In case an additional criterion was identified in item 1 of this form.

Project Prioritization Feedback

Please refer to the Project Prioritization section of the presentation. Given the information provided during that presentation, please complete the following form to reflect your individual and professional knowledge, expertise, and experience.

3. Is there any additional prioritization criterion not considered in the outlined methodology that you believe would be important to include? If so, please describe it and provide ideas for indicators that could be used to quantify it.

4. From the list of criteria used in the prioritization process (see list in the table below), please rank each one of them based on their importance relative to the other criteria listed. Use an "X" to define the importance level of each criterion using the categories provided in the criterion column of the matrix. Please select no more than 3 criteria under each importance column.

	IMPORTANCE		
Goals	High	Medium	Low
Travel Time Reliability			
Connectivity			
Congestion Mitigation			
Travel Costs			
Safety			
Environmental			
Economic / Regional Growth			
Other*: ____________			

* = In case an additional criterion was identified in item 3 of this form.

Please provide additional feedback here.

- What is the role of the port? Three scenarios, maybe:
  - Local – support Houston & smaller volume elsewhere?
  - State Leader – provide TX with primary container port? (for Dallas & San Antonio vs. Corpus Christi)
  - Midcontinent Leader – compete w/ LA/BC for midcontinent?
- Cost is critical – find ways to drive down costs
  - in transport, two cost reduction technologies are coming
    1) autonomous driving
    2) electrification
  - combined these technologies can drive down trucking costs 20-30%
  - 24 hr operations is another way to get capacity at low cost.
- Expand to 24 hr operation & push trucking to night-time roadway use
- Dedicate truck lanes on high-traffic routes to support autonomy & electrifications – all the way to Dallas & San Antonio
- Set up tractor leasing program for electric trucks & battery charging to reduce pollution and costs.
- ~~Automate/electronic customs & bill of lading @ ports~~
- Missing information / analysis:
  - port / freight-logic competitive costs
  - analysis of cost blocks – how to reduce those costs
  - need freight/truck routing & understanding of vehicle counts
  - autonomous truck adoption
  - electric truck adoption
  - policies/ projects that obtain more data & information
  - pilot projects to test / begin implementing electrification & autonomous driving projects

Group Color: light blue

Group Members: Bruce Mann, Cliff Edwards, Gen Almonte, David Milner,

Group Feedback Form

Ports Area Mobility Study Workshop
January 24, 2018, 1:30 – 3:30 PM

Houston-Galveston Area Council

Screening Criteria Feedback

Please refer to the Initial / Universe of Project Screening section of the presentation. Given the information provided during that presentation, please complete the following form to reflect your individual and professional knowledge, expertise, and experience.

1. Is there any additional screening criterion not considered in the outlined methodology that you believe would be important to include? If so, please describe it and provide ideas for indicators that could be used to quantify it.

for prioritization process

(Use Texas Freight Mobility Plan and criteria exhibit 10-11 of TFMP
- exception Sustainable funding (if goal is created, we'll find funding)

- how calls for projects are executed
- small projects like pedestrian path should not be listed, should look at larger more impactful projects

- "uberizing" freight - ships and trucks

- volume of truck / cargo by route

2. From the list of criteria used in the Initial / Universe of Project Screening (see list in the table below), please rank each one of them based on their importance relative to the other criteria listed. Please circle the importance of each criterion in the matrix (1 represents highest, 3 represents lowest). Please identify and rank other potential criteria not provided in the matrix below. Please complete this for each criterion.

Screening Criterion	IMPORTANCE (1=Highest, 3=Lowest)		
Diverting Freight Flow away from Congested Urban Core	1	2	3
Project Supports Regional Commodity Flow - lynchpin	1	2	3
Project Supports Local Commodity Flow	1	2	3
take out ~~Project Readiness (Existing Status of the Project - shovel ready, funded and programmed, other)~~	1	2	3
Timing of Need (When the project is needed to improve freight mobility – immediate, long-term)	1	2	3
take out ~~New or Existing Project / Revision of New/or Existing Policy (Ease of implementation)~~	1	2	3
Other*:	1	2	3
Other*:	1	2	3

* = In case an additional criterion was identified in item 1 of this form.

Project Prioritization Feedback

Please refer to the Project Prioritization section of the presentation. Given the information provided during that presentation, please complete the following form to reflect your individual and professional knowledge, expertise, and experience.

3. Is there any additional prioritization criterion not considered in the outlined methodology that you believe would be important to include? If so, please describe it and provide ideas for indicators that could be used to quantify it.

4. From the list of criteria used in the prioritization process (see list in the table below), please rank each one of them based on their importance relative to the other criteria listed. Use an "X" to define the importance level of each criterion using the categories provided in the criterion column of the matrix. Please select no more than 3 criteria under each importance column.

	IMPORTANCE		
Goals	**High**	**Medium**	**Low**
Travel Time Reliability			
Connectivity			
Congestion Mitigation			
Travel Costs			
Safety			
Environmental			
Economic / Regional Growth			
Other*: ____________			

* = In case an additional criterion was identified in item 3 of this form.

Please provide additional feedback here.

Group Feedback Form

Houston-Galveston Area Council

Ports Area Mobility Study Workshop
January 24, 2018, 1:30 – 3:30 PM

Group Color: Orang

Group Members: Charle Nunn, M. Wilson, Rusty Senac, M. Cloelker, Charles, Airishandi

Screening Criteria Feedback

Please refer to the Initial / Universe of Project Screening section of the presentation. Given the information provided during that presentation, please complete the following form to reflect your individual and professional knowledge, expertise, and experience.

1. Is there any additional screening criterion not considered in the outlined methodology that you believe would be important to include? If so, please describe it and provide ideas for indicators that could be used to quantify it.

① Regional Significance
② Throught, connectivity
③ Viability
④ Safety
⑤ Economics (all have to make a living)
⑥ Coordinated Policy
⑦ Technology

2. From the list of criteria used in the Initial / Universe of Project Screening (see list in the table below), please rank each one of them based on their importance relative to the other criteria listed. Please circle the importance of each criterion in the matrix (1 represents highest, 3 represents lowest). Please identify and rank other potential criteria not provided in the matrix below. Please complete this for each criterion.

Screening Criterion	IMPORTANCE (1=Highest, 3=Lowest)		
Diverting Freight Flow away from Congested Urban Core	1	2	3
Project Supports Regional Commodity Flow	1	2	3
Project Supports Local Commodity Flow	1	2	3
Project Readiness (Existing Status of the Project - shovel ready, funded and programmed, other)	1	2	3
Timing of Need (When the project is needed to improve freight mobility – immediate, long-term)	1	2	3
New or Existing Project / Revision of New/or Existing Policy (Ease of implementation)	1	2	3
Other*:	1	2	3
Other*:	1	2	3

* = In case an additional criterion was identified in item 1 of this form.

Project Prioritization Feedback

Please refer to the Project Prioritization section of the presentation. Given the information provided during that presentation, please complete the following form to reflect your individual and professional knowledge, expertise, and experience.

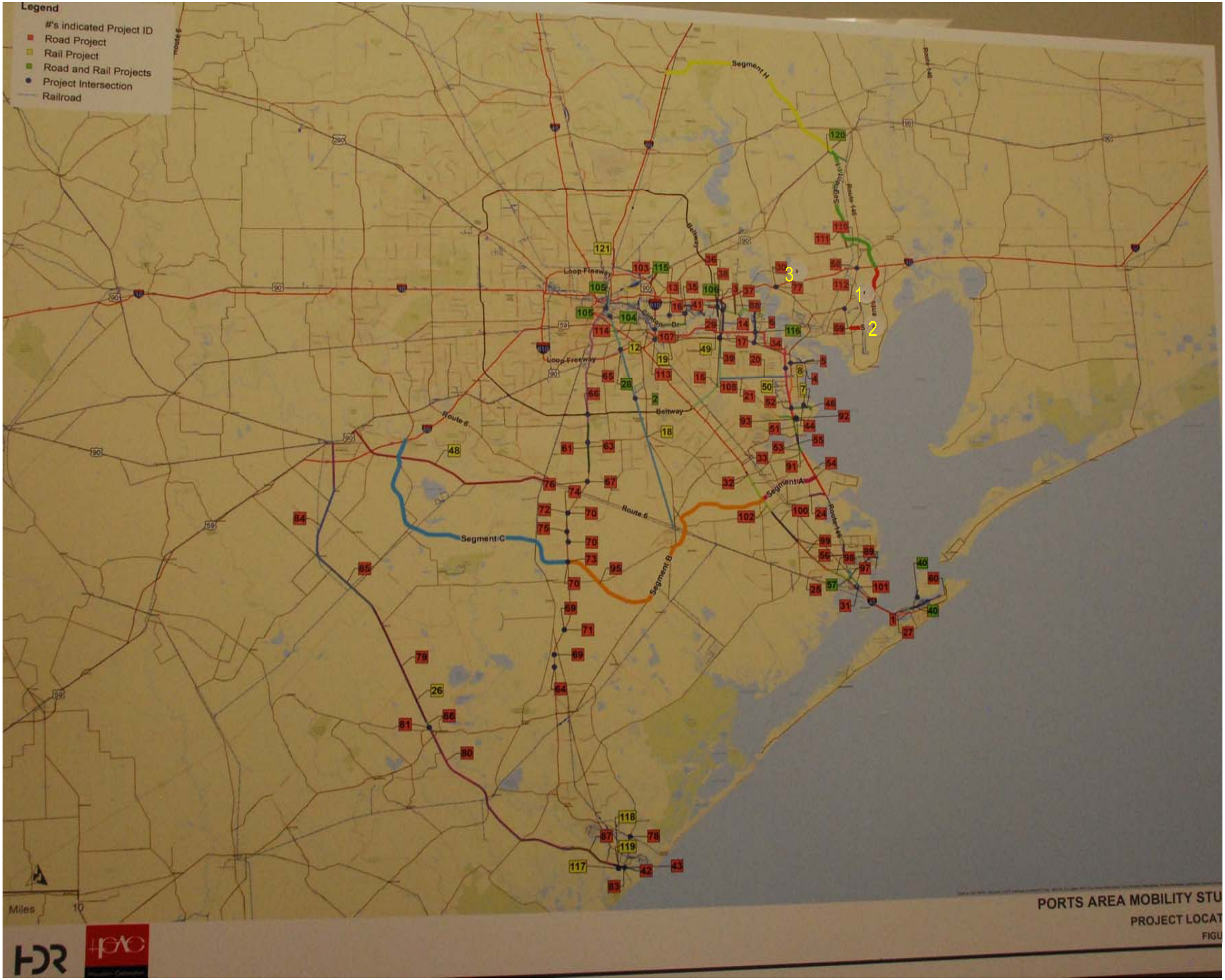
3. Is there any additional prioritization criterion not considered in the outlined methodology that you believe would be important to include? If so, please describe it and provide ideas for indicators that could be used to quantify it.

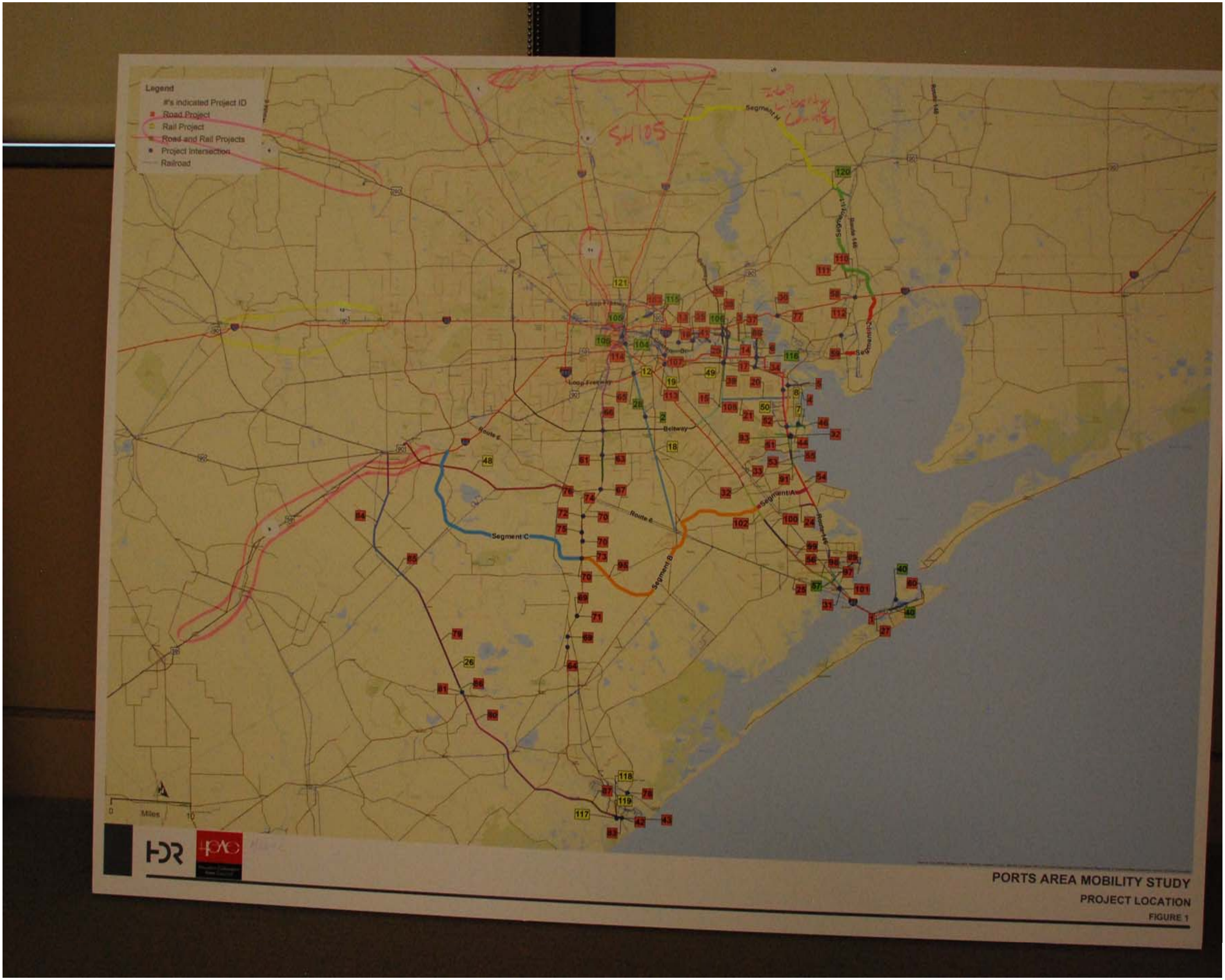
4. From the list of criteria used in the prioritization process (see list in the table below), please rank each one of them based on their importance relative to the other criteria listed. Use an "X" to define the importance level of each criterion using the categories provided in the criterion column of the matrix. Please select no more than 3 criteria under each importance column.

	IMPORTANCE		
Goals	**High**	**Medium**	**Low**
Travel Time Reliability			
Connectivity			
Congestion Mitigation			
Travel Costs			
Safety			
Environmental			
Economic / Regional Growth			
Other*: ______________________ ______________________			

* = In case an additional criterion was identified in item 3 of this form.

Please provide additional feedback here.


Legend
#'s indicated Project ID
Road Project
Rail Project
Road and Rail Projects
Project Intersection
Railroad
Segment H
Route 146
Loop Freeway
Beltway
Clinton Dr
Route 6
Segment A
Segment B
Segment C
Miles
10
PORTS AREA MOBILITY STU
PROJECT LOCAT
FIGU


Legend
#'s indicated Project ID
Road Project
Rail Project
Road and Rail Projects
Project Intersection
Railroad
SH105
Segment H
Segment C
Segment B
Segment A
Route 6
Beltway
Loop Freeway
Miles
HDR
PORTS AREA MOBILITY STUDY
PROJECT LOCATION
FIGURE 1