

REGIONAL GOODS MOVEMENT

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Submitted to

Houston-Galveston Area Council

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1. Introduction

This report presents a long-range plan for the goods movement system in the Houston-Galveston region.¹ The plan is designed to ensure that the region can continue to play a critical role in national and international supply chains while meeting regional economic goals, addressing critical mobility challenges, mitigating impacts on the environment and contributing to community livability and quality of life. The plan is the final product of the Houston-Galveston Area Council (H-GAC) Regional Goods Movement Study, a multi-year effort to collect data, conduct analysis, and engage with regional stakeholders covering multiple aspects of the region's goods movement system.

This chapter provides an introduction to what goods movement in the H-GAC region is about and why it is so important to the region. The chapter also lays out a vision for what the regional goods movement system can become as it continues to evolve to meet the needs of residents, shippers, carriers and a wide range of public and private sector stakeholders.

1.1 What Is Goods Movement in the H-GAC Region?

Goods movement and freight transportation are essential to support the H-GAC region's economy and quality of life. Goods movement is the wide array of activities that are involved in moving products from producers to consumers. Whether carrying imported goods from the Port of Houston or Port Freeport to regional distribution centers, supplying materials for local manufacturers, or providing connections from the region's refineries to statewide, national, and international markets, the movement of freight provides the goods needed to sustain regional industries and consumers on a daily basis. This system provides a number of important functions, including:

- **Supports Refining and Manufacturing Activities** – The region's oil refineries process more than 2 million barrels of crude oil per day, which account for more than 12 percent of the total U.S. refining capacity.² These refineries have access to local Texas production, foreign imports and oil produced offshore in the Gulf of Mexico, as well as the U.S. Government's Strategic Petroleum Reserve, which operates a large storage facility in Bryan Mound, near Freeport. In addi-

¹ Unless otherwise noted, the study area described in this plan includes the 8 counties (Brazoria, Chambers, Fort Bend, Galveston, Harris, Liberty, Montgomery, Waller) in the Houston-Galveston Area Council's (H-GAC) Transportation Planning Area.

² U.S. Congressional Research Service Report 41478, *The U.S. Oil Refining Industry: Background in Changing Markets and Fuel Policies*, 2010.



tion, regional manufacturers reach a mix of international, domestic, and local customers and suppliers by accessing the region's goods movement system. Manufacturing employment in the region is increasing at a rate nearly twice the national average (2.8 percent compared to 1.5 percent nationally) and the H-GAC region's 235,600 manufacturing jobs account for approximately 2 percent of manufacturing jobs in the U.S.³ As such, the goods movement system is a critical link between the region's export base and its markets.

- **Provides Access to International Gateways** – The H-GAC region is an important international gateway supporting international trade through its seaports, highways, and international airports. These facilities are a critical link between the U.S. economy and international markets, particularly the growing economies in Central and South America. The Port of Houston alone is the nation's second largest export gateway (with respect to weight) and the nation's leading breakbulk port, handling approximately 65 percent of all major U.S. project cargo.⁴
- **Serves the Needs of Local Business and Consumers** – Like any metropolitan region of its size, a substantial amount of goods movement in the H-GAC region involves providing goods and services to residents and local businesses. Activities that generate significant amounts of truck traffic in the region include services and deliveries to households, parcel pickup and delivery at local businesses, and deliveries from warehouse and distribution centers to retail establishments. Even if there were no international trade system or refining capacity in the region, goods movement would continue to serve a critical role in the region's economy and quality of life.

Identifying and implementing improvements on this system to accommodate increasing demand for goods movement is critical to the region's economic vitality and quality of life. The H-GAC region's economy relies, in large part, on its transportation assets, such as the region's highway, rail and pipeline systems, its deep water ports and airports, and the Gulf Intracoastal Waterway. This is reflected in the fact that a significant portion of the region's employment is in industries that depend upon goods movement. Tied to port activity specifically, the Port of Houston's public and private marine terminals generate more than 1 million jobs (54,000 direct jobs, 71,000 induced jobs, 50,000 indirect jobs and 852,000 jobs from related users).⁵ Similarly, Port Freeport generates nearly 66,700 jobs, 41,000 of which are direct or induced.⁶ Providing an efficient and reliable freight system helps to support these existing industries, as well as help to attract new businesses, industries, and residents to the

Freight in the H-GAC region

1st in U.S. pipeline volumes

2nd in U.S. port volumes

4th in U.S. truck volumes

³ Bureau of Labor Statistics, Southwest Information Office, *Houston Area Employment – September 2012*, http://www.bls.gov/ro6/fax/houston_ces.htm

⁴ Port of Houston, <http://www.portofhouston.com/general-terminals/>

⁵ Martin Associates, Port of Houston Authority, *The Local and Regional Economic Impacts of The Port of Houston*, May 2012.

⁶ Martin Associates, Port Freeport, *The Local and Regional Economic Impacts of Port Freeport*, October 2012

region. In addition, identifying and addressing freight-related issues and concerns is critical to:

- **Regional Mobility** – Significant portions of the region’s freeways and major arterials operate near or above capacity, leading to significant travel delay for passengers and goods. Freight is a contributing factor to regional congestion and it is projected that for every 100 trucks on the region’s roads today, there will be 177 trucks in 2035.⁷
- **Air Quality** – Emissions from the movement of freight negatively affect the health of people living in the region, as well as the region’s environment and economy. Annual truck-related emissions in the region account for more than half of the region’s transportation-related nitrous oxides (NO_x), fine particulate matter (PM_{2.5}), and carbon dioxide (CO₂).⁸
- **Safety** – Safety concerns arise from several sources, including trucks and passenger vehicles sharing the same congested roadways, at-grade rail crossings, and the transport of hazardous materials. Nearly one-third of all highway crashes in the metropolitan area involves a truck.⁹
- **Community Livability** – Freight transportation activities and facilities give rise to other negative community impacts if not properly planned, including noise and light pollution, excessive vibration, and wear and tear on roadways. Many of the region’s significant environmental justice communities are located in close proximity to freight intensive facilities and industries, particularly those within the urban core.

A Vision for Goods Movement in the H-GAC Region

The vision for the goods movement system in the H-GAC region is to be a connected, multimodal, world-class system that enhances the region’s economic vitality while supporting the mobility and livability needs of its citizens. This Goods Movement Plan will help the region to realize this vision by identifying improvements and strategies that accommodate and enhance mobility of both people and goods while mitigating the associated negative community impacts related to congestion, safety, the environment, and quality of life. The remaining sections of this report describe:

- The existing regional freight transportation system, the industries that depend on it and current and future freight demand (Section 2.0).

⁷ H-GAC Regional Goods Movement Study, *Regional Goods Movement Profile*, February 2011.

⁸ H-GAC Regional Goods Movement Study, *Regional Goods Movement Needs Assessment*, August 2011.

⁹ H-GAC Regional Goods Movement Study, *Regional Goods Movement Profile*, February 2011.

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- Existing and emerging freight, industry, and logistics trends impacting regional freight demand both now and in the future (Section 3.0).
 - Issues and challenges that might prevent the regional system from effectively absorbing this increased demand (Section 4.0).
 - Strategies to enhance mobility, reliability, and safety on the region's freight transportation system and to more effectively integrate freight issues into the region's transportation planning and programming activities (Section 5.0).

2. Goods Movement in the Region Today

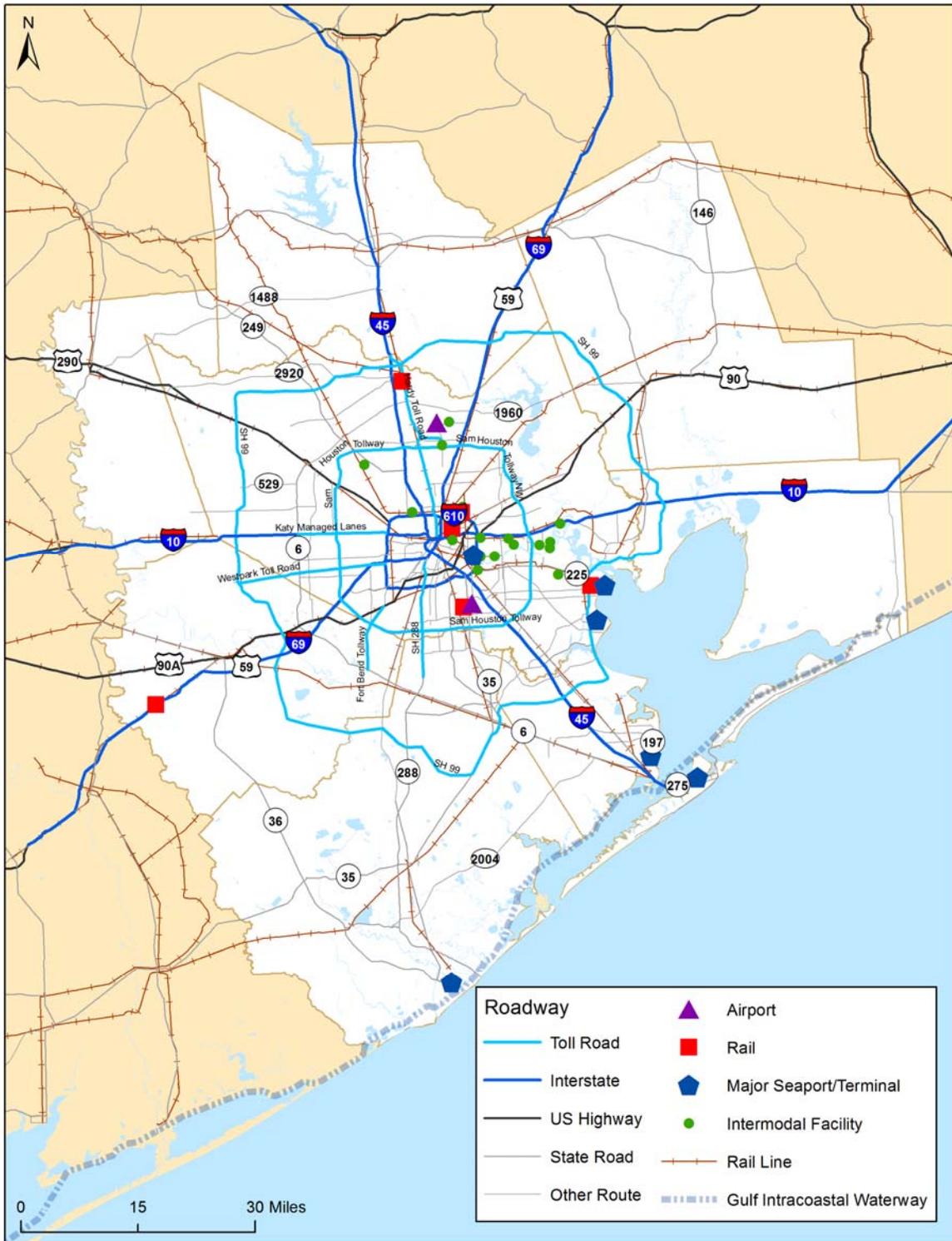
Understanding the individual elements of the H-GAC regional freight transportation system, as well as the commodity flow patterns associated with it, is critical in helping H-GAC better assess the ways in which freight vehicles are using the system and how freight movements contribute to system capacity and congestion, bridge stress, pavement consumption, economic development, and overall quality of life. This section describes the elements that make up the region's freight system; the weight and value of the commodities moving into, out of, through, and within the region; the top commodities in the region by both weight and value; and the industries that depend on the system.

2.1 H-GAC Freight System Overview

The region's freight transportation system, shown in Figure 2.1, is fully multimodal and consists of:

- More than 24,000 lane-miles of roadways carrying more than 465 million tons of goods annually. This includes 21 federally-designated intermodal connectors and 38 designated hazardous material routes that carry more than 150 million tons of hazardous materials each year.
- Three Class I railroads – Union Pacific (UP), BNSF Railway (BNSF), and Kansas City Southern (KCS) – operating nearly 1,000 miles of track in the region, with 829 miles of main track, 123 miles of siding track, and 47 miles of yard track, and carrying more than 150 million tons of local freight annually.
- Four deepwater ports, including the Port of Houston, Port Freeport, the Port of Galveston, and the Port of Texas City, the Gulf Intracoastal Waterway system (GIWW), and the Houston Ship Channel. Taken together, these facilities handle more than 312 million tons of freight each year.
- Two major air cargo facilities at George Bush Intercontinental Airport (IAH) that handle more than 400,000 tons of air freight annually.
- Approximately 21,500 miles of pipelines that carry more than 445 million tons of freight per year.
- Intermodal connectors that connect important freight facilities with mainline transportation networks. These not only include roadway connectors, like Jacintoport Boulevard, but also the Port Terminal Railway Association (PTRA), which connects rail industries along the Houston Ship Channel with the national freight rail system.

Figure 2.1 H-GAC Regional Multimodal Freight Transportation System



Source: Cambridge Systematics, Inc.

The following sections describe the individual elements that make up the region's freight transportation system. A detailed assessment of each mode is included in the Regional Goods Movement Profile.¹⁰

The region's highway system serves significant volumes of freight and passenger traffic – congestion, delays, and safety concerns impact ALL users.

Highways

Highways and the trucks that use them play an important role in the provision of door-to-door service for the region's businesses and consumers. This means that although millions of tons of commodities are handled in the region by the other modes, they often depend on trucks and highways for final pick-up and delivery operations.

In 2009, there were more than 24,000 roadway lane-miles in the region, with plans to expand to nearly 28,000 by 2035.¹¹ As shown in Figure 2.2, the highway network in the H-GAC region roughly resembles a wheel with Houston as its hub, surrounded by the two concentric beltways of I-610 and Beltway 8 (with a third beltway, the Grand Parkway, under development). The wheel's spokes are the major radial highways, including I-10, I-45, U.S. 59, SH 288 and others. This network carries the majority of the trucks circulating within the region as well as those hauling goods into and out of the region.

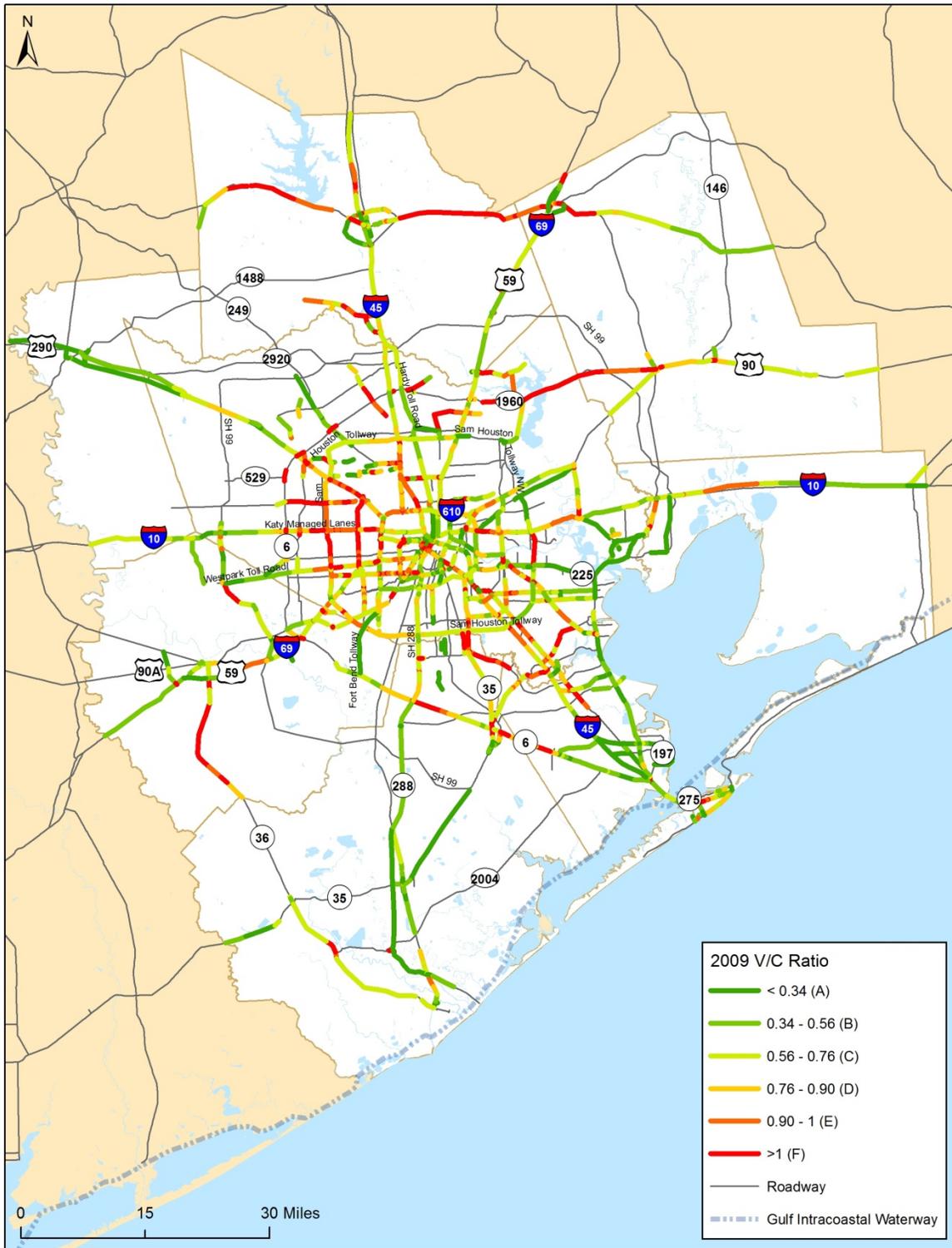
As shown in Figure 2.3, much of the H-GAC region's highway system operated at a Level of Service (LOS) D, E, or F in 2009.¹² This indicates a generally high level of congestion throughout the region. Many links within the highway system to the west and northwest of central Houston are operating at LOS E or F. While areas adjacent to the marine terminals along the Houston Ship Channel, in Galveston, and in Freeport have relatively good LOS, trucks routed anywhere to the west or north of Houston must pass through portions of the highway network that experience frequent and heavy congestion.

¹⁰ *Regional Goods Movement Profile, H-GAC Regional Goods Movement Study*, February 2011.

¹¹ H-GAC 2035 RTP Update.

¹² LOS is a commonly used service rating that compares total traffic volumes and percentage of trucks to the overall capacity of a given highway. LOS ratings are letter grades, with A representing free-flow conditions and F corresponding to gridlock and service breakdown.

Figure 2.3 Average Daily Level of Service 2009



Source: H-GAC Traffic Model.



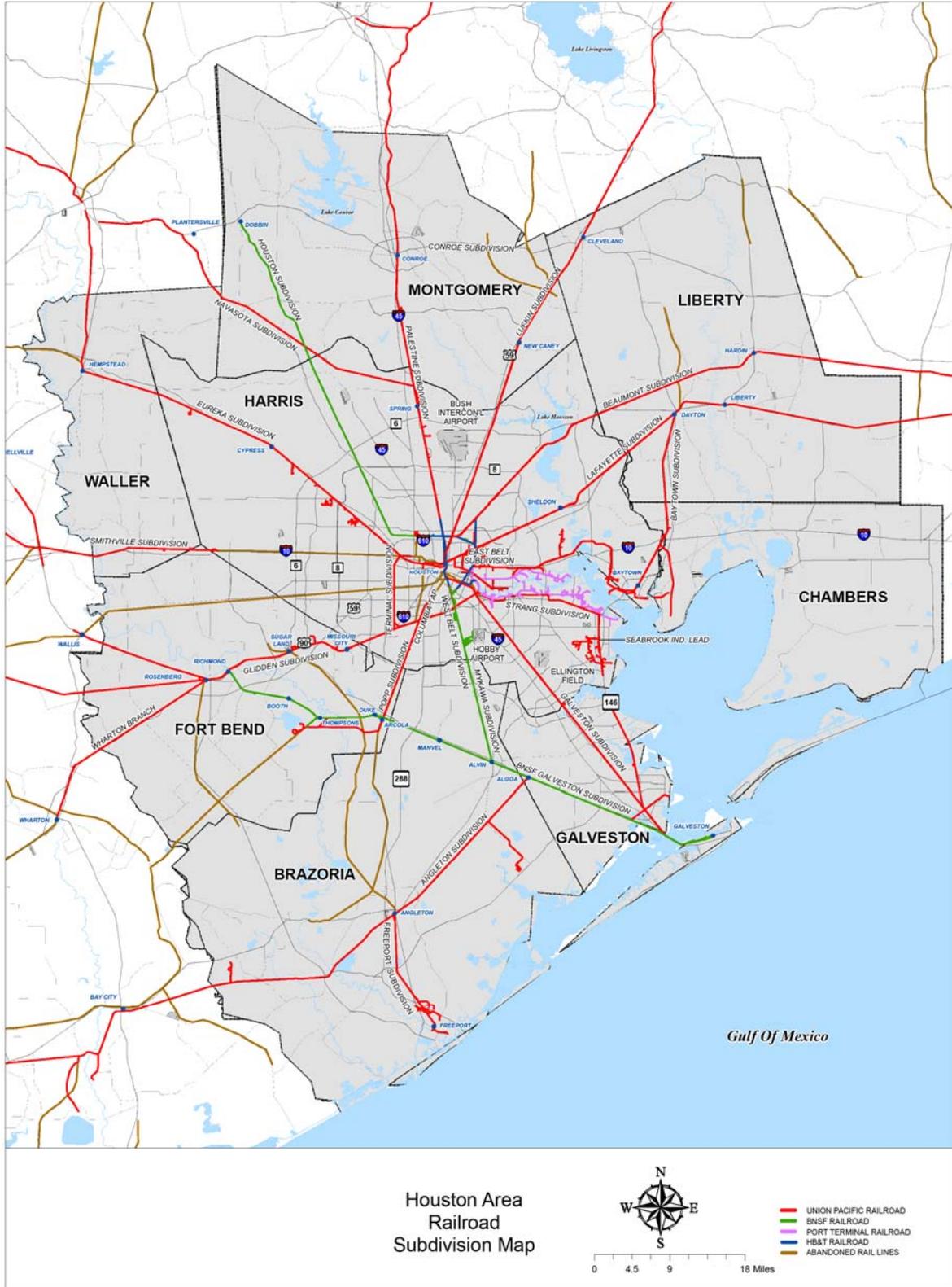
Railroads

The H-GAC region is a major origination and termination point within the national rail network rather than a hub or transit point. It is a major production market for the bulk industry as well as a receiving market for industrial supplies and consumer goods because it is home to a large proportion of the U.S. petrochemical business and one of America's largest urban populations. The regional rail network is shown in Figure 2.4.

UP is the predominant service provider with the most extensive regional network. BNSF accesses the Houston region from the north, and these two railroads jointly share about equally in the operations of the PTRA, which provides access to industries along the Ship Channel. KCS is a smaller factor in regional train activity and handles only goods originating from or destined for Mexico. Railroads handle 22 percent of the freight tonnage generated or received in the metropolitan area of Houston, apart from its pipeline activity. The 152 million tons moved by rail in 2007 represented 28 percent of Houston's inbound receipts, 18 percent of its outbound shipping and 8 percent of its purely local activity.¹³

¹³ Additional commodity flow information is provided in the *H-GAC Regional Goods Movement Study Commodity Flow Analysis* technical memorandum, February 2011.

Figure 2.4 Houston Rail Network



Source: TxDOT Houston Region Freight Study.



Ports and Waterways

The ports, ship channels, and waterways of the H-GAC area are of vital regional and national significance, linking key Texas industries, particularly its chemical, oil and agriculture industries, with markets and suppliers located throughout the world. The H-GAC region's waterborne transportation system, shown in Figure 2.5, consists of a network of federally maintained coastal and inland waterway ports and private terminals. These facilities handle high volumes of oil, chemicals, stone, cement, machinery, steel, automobile and containers – critical inputs and outputs for Texas' industrial, commercial and consumer markets.

An important component of this network is the GIWW, a 1,300-mile manmade navigable inland canal that runs along the Gulf of Mexico coastline from the southernmost tip of Texas at Brownsville to St. Marks, Florida. Texas' portion of the GIWW begins 270 miles west of the Harvey Locks in Louisiana at the Sabine River border with Louisiana and extends approximately 406 miles¹⁴ south-southwest to the Brownsville Channel, just north of the Rio Grande River, Texas' border with Mexico. The waterway provides a channel with a controlling depth of up to 12 feet, and is designated primarily as a protected channel for barges carrying freight, commercial fishing boats, and recreational watercraft. The Texas portion of the GIWW provides access to the state's deep and shallow-draft seaports, which contain more than 1,000 individual port and terminal facilities. Important facilities in the H-GAC region include:

- **Port of Houston**, which is located in the City of Houston and accesses the Gulf of Mexico and the GIWW via the Houston Ship Channel. In 2009, it ranked second in the U.S. in terms of total cargo handled and sixth in container traffic. Imports accounted for about 57 percent of foreign trade while exports accounted for about 43 percent.¹⁵ In addition, the Port of Houston handled nearly 1.8 million twenty-foot equivalent units (TEUs) in 2008.¹⁶ The Port of Houston has 142 maritime facilities with 182 deep draft vessel berths and 48 barge docks and is served by the UP, BNSF and KCS railroads¹⁷ as well as numerous major highways, including Interstates 10 and 45.
- **Port Freeport**, which is located in Brazoria County and has access to the GIWW and the Gulf of Mexico via the three-mile-long ship channel, has a depth of 45 feet and a width of 400 feet.¹⁸ The Port has 14 operating berths (both public and private docks).

¹⁴ United States Army Corps of Engineers Navigation Data Center.

¹⁵ Port of Houston Authority and AAPA.

¹⁶ AAPA North American Port Container Traffic 2008.

¹⁷ Ibid.

¹⁸ Port Freeport.

Figure 2.5 H-GAC Ports and Waterways



Source: Guide to the Economic Value of Texas Ports, TxDOT Report 0-5538-P1, Center for Transportation Research, University of Texas-Austin, February 2008 (revised December 2008).

- **Port of Galveston**, located alongside the GIWW on the north side of Galveston Island, at the entrance to Galveston Bay, with additional property and facilities located on adjacent Pelican Island. The Port has approximately 12 berthing spaces. Maximum berth length is 1,509 feet and maximum depth at berth is 40 feet. The Port is served by both BNSF and UP via the Terminal Railway, operated by Galveston Railway L.P.
- **Port of Texas City**, located in Galveston County with access to the GIWW, the Gulf of Mexico, and the Houston Ship Channel. The Port has a depth of 45 feet and a maximum berth length of approximately 1,000 feet. The Terminal Railway Company provides daily connections from the Port to the UP and BNSF mainlines. The Port is one of the largest petroleum import locations in the country and key commodities include crude petroleum and refined petroleum products.¹⁹

¹⁹ Center for Transportation Research, University of Texas-Austin, *Guide to the Economic Value of Texas Ports*, 2008.



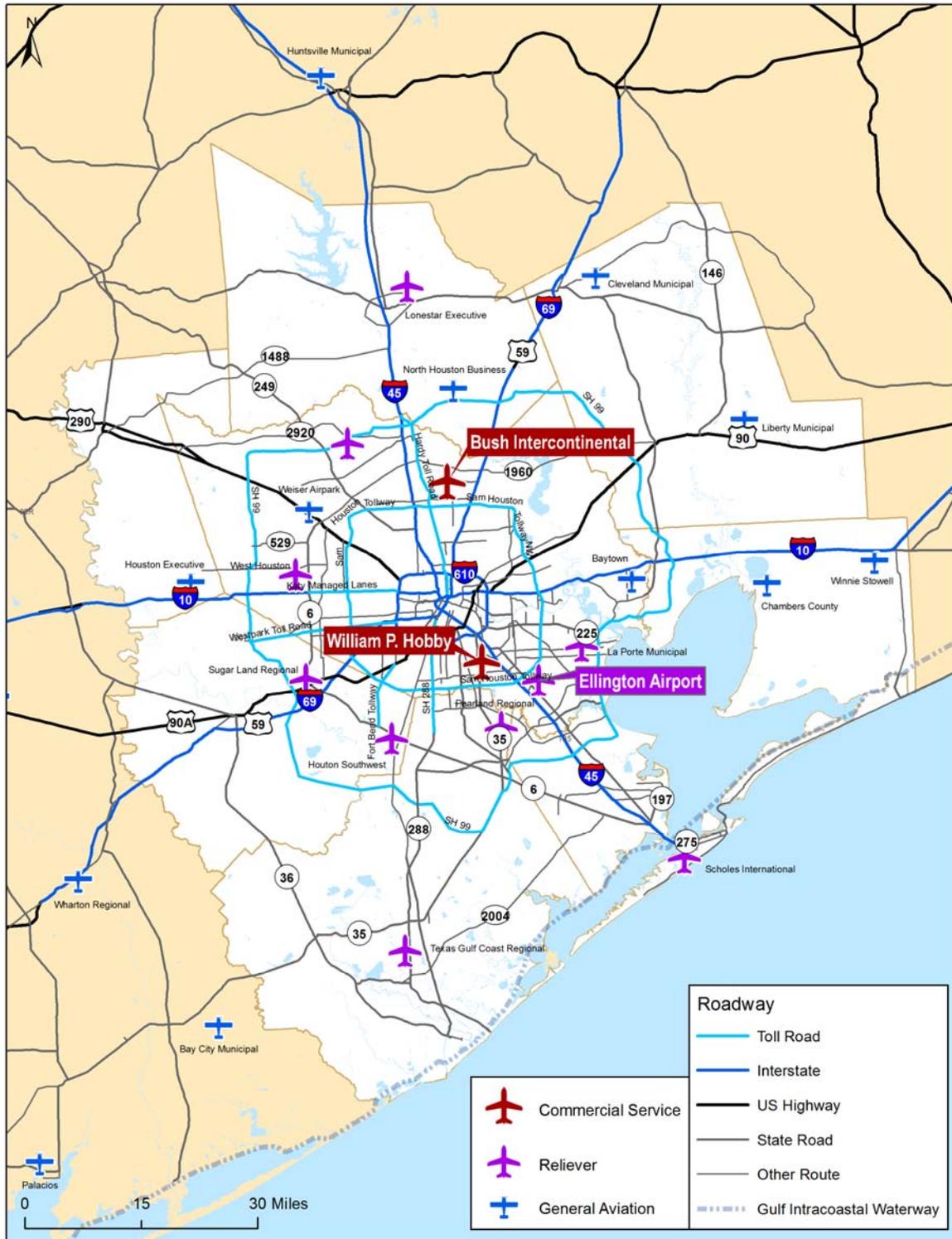
Air

Air freight is a small yet critical component of the H-GAC region's freight transportation network. As shown in Figure 2.6, the region is served by three commercial airports, Houston Hobby (HOU) and George Bush Intercontinental Airport (IAH). The region is also home to a number of general aviation facilities, only one of which (Ellington Airport) is capable of handling air cargo. Taken together, the region's commercial airports are a major link in the nation's air cargo network and were ranked 16th in the nation for air cargo tonnage in 2009, 98 percent of which was handled at IAH. Air cargo at IAH is handled at two facilities:

- **IAH Cargo Center**, which was opened in 2003 in response to growing air cargo demand. Current cargo operations take place on approximately 146 acres, with significant room for expansion. Approximately 20 aircraft parking spaces are available for use and more than 1.3 million square feet of warehouse space (including the buildings and parking/truck dock area and a cold storage facility) is available.
- **IAH Central Cargo Area**, which handles less volume than the IAH Cargo Center to the east, but is used by Federal Express and Continental Cargo, two of the largest freight shippers in the region. The area is made up of 70 acres of intensely developed apron, parking lots, warehouses, and roads. The aprons have room for 11 aircraft (four for Continental Cargo, four for Federal Express, and the remaining three for Aeroterm).

Air freight is small but growing – and since all air freight ends up on trucks, growth in air cargo volumes has a direct impact on the regional highway system.

Figure 2.6 H-GAC Regional Airports



Source: Cambridge Systematics, Inc.



Pipelines

Pipelines carry more than two-thirds of all the crude oil and refined products in the United States. They are generally the most economical way to transport large quantities of oil, refined oil products, or natural gas over land. The H-GAC region, where the heart of the U.S. oil industry is located, has a vast pipeline network. The numerous transportation activities in this region related to oil and natural gas collection and processing, demand an intricate pipeline system. Pipelines are important to the regional transportation system because they carry large volumes of product that would otherwise have to travel via another mode in the absence of the pipeline capacity. For example, replacing a modest-sized pipeline transporting 150,000 barrels per day (approximately 7.3 million tons per year) would require 750 tanker truck loads delivered every two minutes around the clock or a 225-car train to arrive and be unloaded every day.²⁰

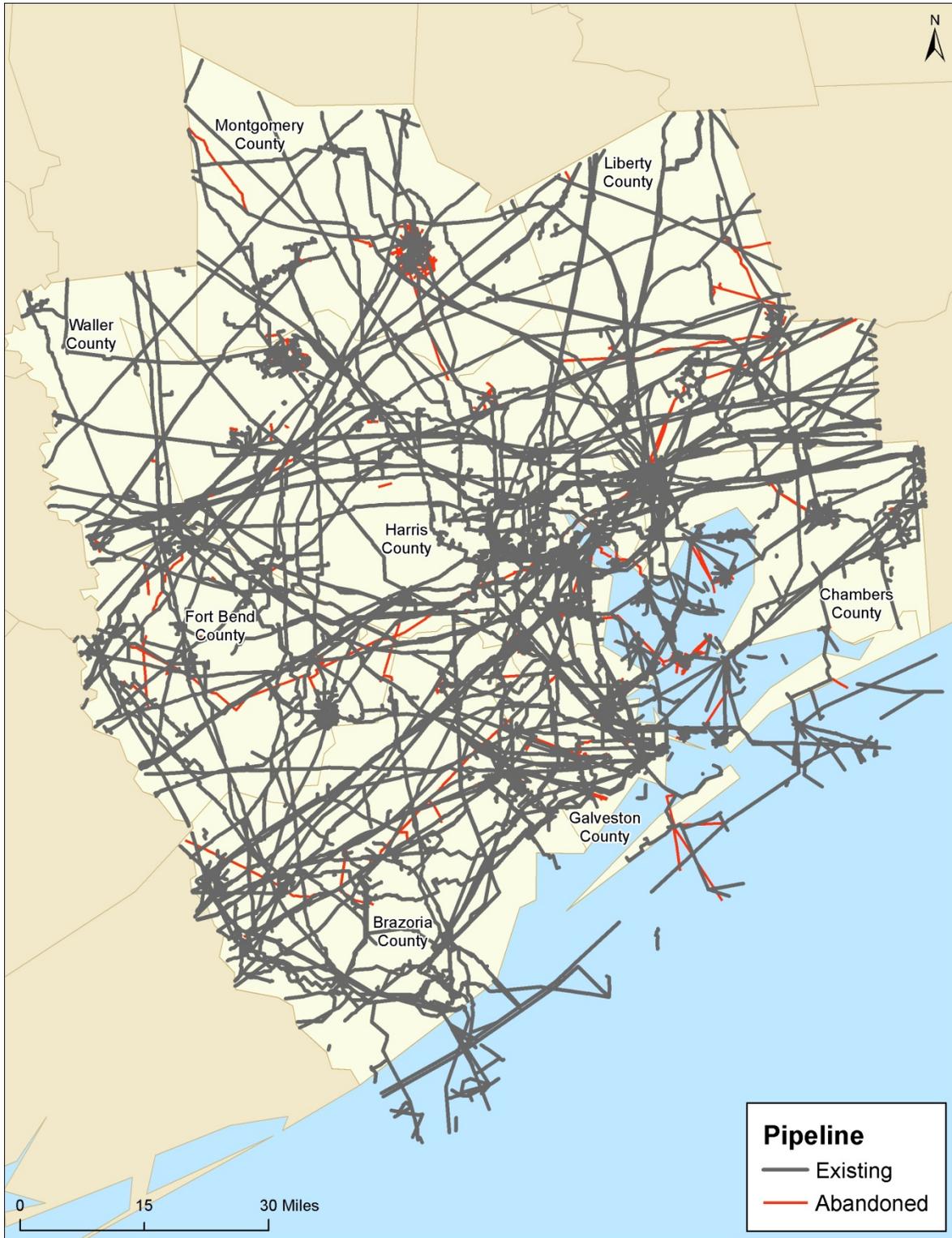
There are approximately 21,500 miles of product pipelines across the H-GAC 8-county transportation region (see Figure 2.7). About 6.6 percent of these pipelines are abandoned (1,418 pipeline-miles) and the rest are in service carrying liquids and gases, such as crude oil, refined product, and natural gas. The pipeline system in the H-GAC region carried more than 445 million tons of goods in 2007. Goods traveling into the region represented 41 percent of the pipeline volumes while those traveling outbound from the region comprised the remaining 59 percent of pipeline volumes. The volume of goods traveling via pipeline in the region is projected to grow by more than 20 percent to 540 million tons by 2035.²¹

Carrying more than 445 million tons of freight annually, the region's vast pipeline network carries nearly as much volume as all of the trucks in the region combined.

²⁰ Association of Oil Pipe Lines, <http://www.aopl.org/>.

²¹ *H-GAC Regional Goods Movement Study Regional Goods Movement Profile* technical memorandum, February 2011.

Figure 2.7 H-GAC Pipeline Network



Source: H-GAC Pipeline GIS Data.

Intermodal Connectors

Intermodal connectors are short roadway segments averaging less than two miles in length that link airport, seaport and rail terminal facilities to mainline transportation corridors. Some are designated by the Federal Highway Administration (FHWA) as part of the National Highway System (NHS), making them eligible for Federal aid highway funds. The FHWA identifies 21 freight-related intermodal connectors in the H-GAC region, shown in Table 2.1.²²

Table 2.1 Listing of National Highway System Intermodal Connectors H-GAC Region

Freight Facility	Location
AIMCOR Marine Terminal	Galveston, Old Port Industrial Boulevard (Harborside Drive to 28 th Street)
Bayport Terminal	Port Road between SH 146 and the terminal
Brazosport Turning Basin, Freeport	FM 1495 between SH 288 and the terminal
Bulk Materials Handling Plant, Houston	Penn City Road (from I-10 to 3100 block)
Care Terminal, Houston	Jacintoport Boulevard (between Beltway 8 and terminal)
Empire Truck Lines Container Yard, Houston	Wallisville Road (from I-610 to Oates)
GATX Terminals Corporation	Jefferson Road (from SH 225 to facility)
Houston Barge Terminal	Navigation Boulevard (between Engle and U.S. 90A)
Jacintoport Terminal	South Sheldon Road (between I-10 and the terminal)
M.P. GMAC Yard	Hardy Road (between Humble Westfield Road and the terminal)
Manchester Terminal Corporation	Manchester Street (between I-610 and the terminal)
Phillips Petroleum Sweeney Complex	SH 35 (between FM 524 and SH 36)
Richardson Steel Yard	Industrial Road (between Federal Road and the terminal)
S.P. Houston Intermodal Hub	Lockwood (between I-10 and the Wallisville); Wallisville (between Lockwood and the terminal)
Shell Deer Park Chemical Plant and Refinery, Houston	Center Road (between SH 225 and the facility)
Star Enterprise/Texaco, Houston	Quitman Street (between U.S. 59 and Stevens Street); Stevens Street (between Quitman Street and the terminal)
Turning Basin Terminal, Houston	75 th Street (between Navigation Boulevard and the terminal)
Union Pacific Settegast Yard, Houston	Kirkpatrick Boulevard (between I-610 and the terminal)
UPS Mykawa Road Facility, Houston	Mykawa Road (from I-610 to Wayside)
UPS Stafford Facility	Stafford Road (from U.S. 90A to Ellis)
UPS Sweetwater Lane Facility	West Canino (from I-45 to Sweetwater Lane); Sweetwater Lane (from West Canino to the facility)

Source: FHWA.

²² Official NHS Intermodal Connector Listing: Texas, <http://www.fhwa.dot.gov/planning/nhs/intermodalconnectors/texas.html>.

Hazardous Materials Routes

Hazardous materials (hazmat) fall into three broad categories: chemicals, petroleum products and “other.”²³ Due to the heavy concentration of petrochemical industries in the H-GAC region, more than 130 million tons of petroleum products, chemical products, crude petroleum and natural gas were moved across the region’s highway system in 2007.²⁴ Most of this material is categorized as hazardous by the Federal Motor Carrier Safety Administration (FMCSA). The FMCSA identifies 38 designated hazmat routes and six restricted routes for hazmat in the H-GAC region.²⁵ Tables 2.2 and 2.3 list the FMCSA-designated and FMCSA-restricted hazmat routes (respectively), also shown in Figure 2.8.

Table 2.2 FMCSA-Designated Hazardous Materials Routes

Connector	Description
10 th Street	South 4 th Avenue to South 6 th Avenue, Texas City, Galveston County
14 th Street	Loop 197 to 5 th Avenue South, Texas City, Galveston County
2 nd Avenue	Loop 197 to Bay Street, Texas City, Galveston County
4 th Avenue	Loop 197 to 10 th Street, Texas City, Galveston County
51 st Street/Seawolf Parkway	State 275 (Harborside Drive) to one-quarter-mile south of Seawolf Park, Galveston, Galveston County
5 th Avenue	State 146 to 14 th Street, Texas City, Galveston County
Broadway Avenue	(Entire Length), Galveston, Galveston County
Farm to Market 1266	Farm to Market 646 to Farm to Market 517, Dickinson, Galveston County
Farm to Market 1764	Entire highway within city limits, Santa Fe, Galveston County
Farm to Market 1764	Interstate 45 to State 146, Santa Fe, Galveston County
Farm to Market 517	Farm to Market 646 to West City Limits, Dickinson, Galveston County
Farm to Market 517	Entire highway, League City, Galveston County
Farm to Market 518	West City Limits to East City Limits, Pearland, Brazoria County
Farm to Market 519	State 146 to Loop 197, Texas City, Galveston County
Farm to Market 565	Loop 207 to East City Limits, Mont Belvieu, Chambers County
Farm to Market 646	Entire Highway Within City Limits, Dickinson, Galveston County
Farm to Market 646	Entire Highway, League City, Galveston County
Farm to Market 646	North City Limits to South City Limits, Santa Fe, Galveston County
Grant Avenue	5 th Avenue South to FM 519/SH 341, Texas City, Galveston County
Interstate 45	North City Limits to South City Limits, Conroe, Montgomery County
Interstate 45	Northwest City Limits to Southwest City Limits, Dickinson, Galveston County

²³ Some materials falling into the “other” category include hazardous waste, medical waste, and radioactive materials.

²⁴ IHS Global Insight.

²⁵ <http://www.fmcsa.dot.gov/safety-security/hazmat/national-hazmat-route.aspx>.

Table 2.2 FMCSA-Designated Hazardous Materials Routes (continued)

Connector	Description
Interstate 45	West City Limits to Farm to Market 188 (Teichman Road), Galveston, Galveston County
Interstate 45	Entire Highway, League City, Galveston County
Interstate 610	Entire Highway, Houston, Harris County
Loop 197	South City limits to 2 nd Avenue, Texas City, Galveston County
Loop 336	Entire Highway within City Limits, Conroe, Montgomery County
State 146	North City Limits to South City Limits, Mont Belvieu, Chambers County
State 146	North City Limits to South City Limits, Texas City, Galveston County
State 225	East City Limits to West City Limits, Deer Park, Harris County
State 275 (Port Industrial Boulevard and Harborside Drive)	Interstate 45 to 9 th Street, Galveston, Galveston County
State 342 (61 st Street)	Broadway Avenue to Seawall Boulevard, Galveston, Galveston County
State 35	North City Limits to South City Limits, Pearland, Brazoria County
State 6/Bus U.S. 290	North City Limits to East City Limits, Hempstead, Waller County
State 6	West City Limits to East City Limits, Santa Fe, Galveston County
U.S. 290	North City Limits to East City Limits, Hempstead, Waller County
U.S. 59	South City Limits to North City Limits, Rosenberg, Fort Bend County
U.S. 59	West City Limits to North City Limits, Stafford, Fort Bend/Harris County
U.S. 90A	West City Limits to East City Limits, Stafford, Fort Bend County

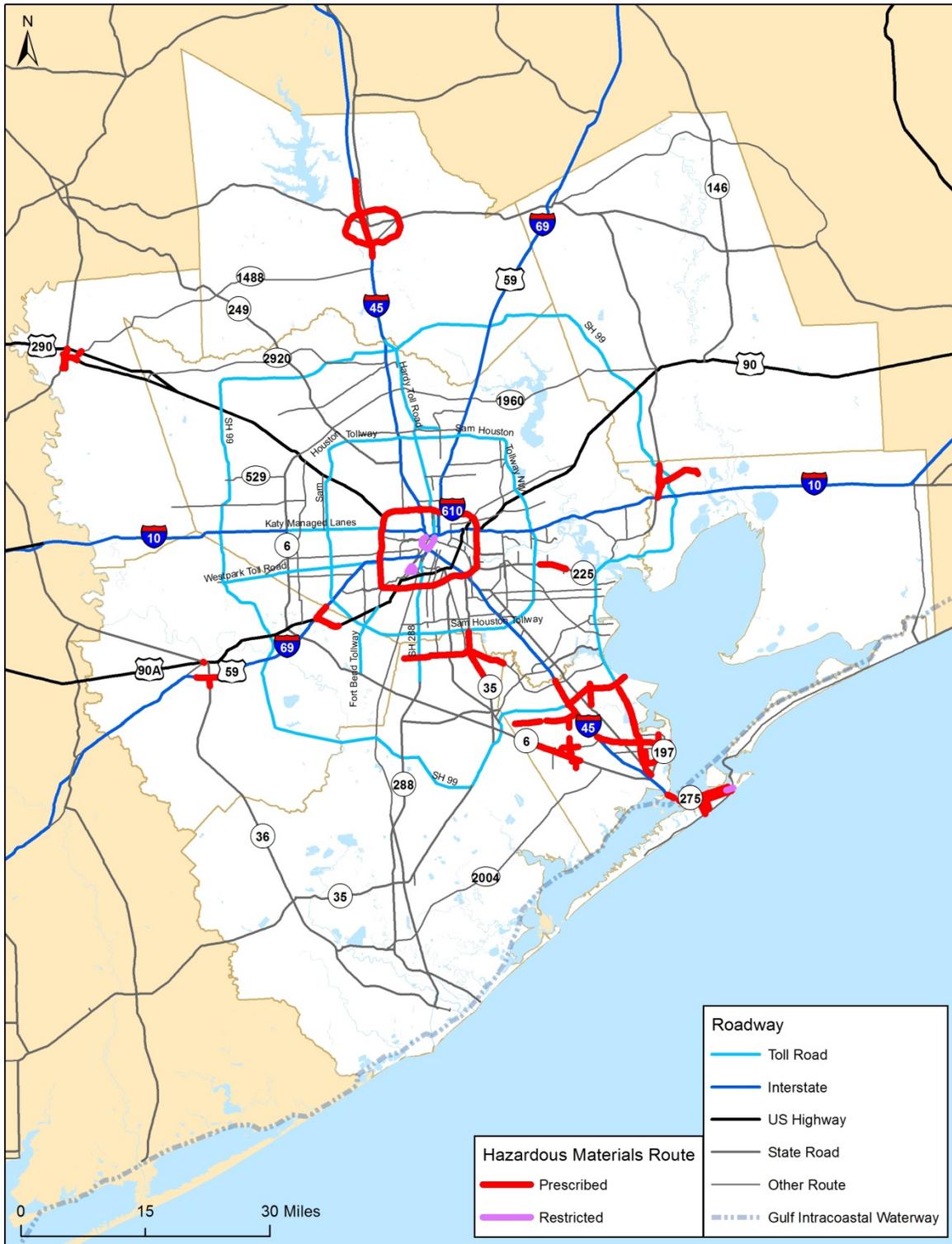
Source: Federal Motor Carrier Safety Administration/Research and Innovative Technology Administration's Bureau of Transportation Statistics (RITA/BTS)/Volpe NTSC.

Table 2.3 FMCSA-Restricted Hazardous Materials Routes

Connector	Description
Holcombe Boulevard	Main Street to South Braeswood Boulevard, Houston, Harris County
Interstate 45	Franklin Street to U.S. 59, Houston, Harris County
North MacGregor Way	South Braeswood Boulevard to Main Street, Houston, Harris County
North of Church Street	14 th Street to 2 nd Street, Galveston, Galveston County
South Braeswood Boulevard	Holcombe Boulevard to North MacGregor Way, Houston, Harris County
U.S. 59	Interstate 45 to Buffalo Bayou, Houston, Harris County

Source: Federal Motor Carrier Safety Administration/Research and Innovative Technology Administration's Bureau of Transportation Statistics (RITA/BTS)/Volpe NTSC.

Figure 2.8 Hazardous Materials Routes



Source: Federal Motor Carrier Safety Administration/Research and Innovative Technology Administration's Bureau of Transportation Statistics (RITA/BTS)/Volpe NTSC.



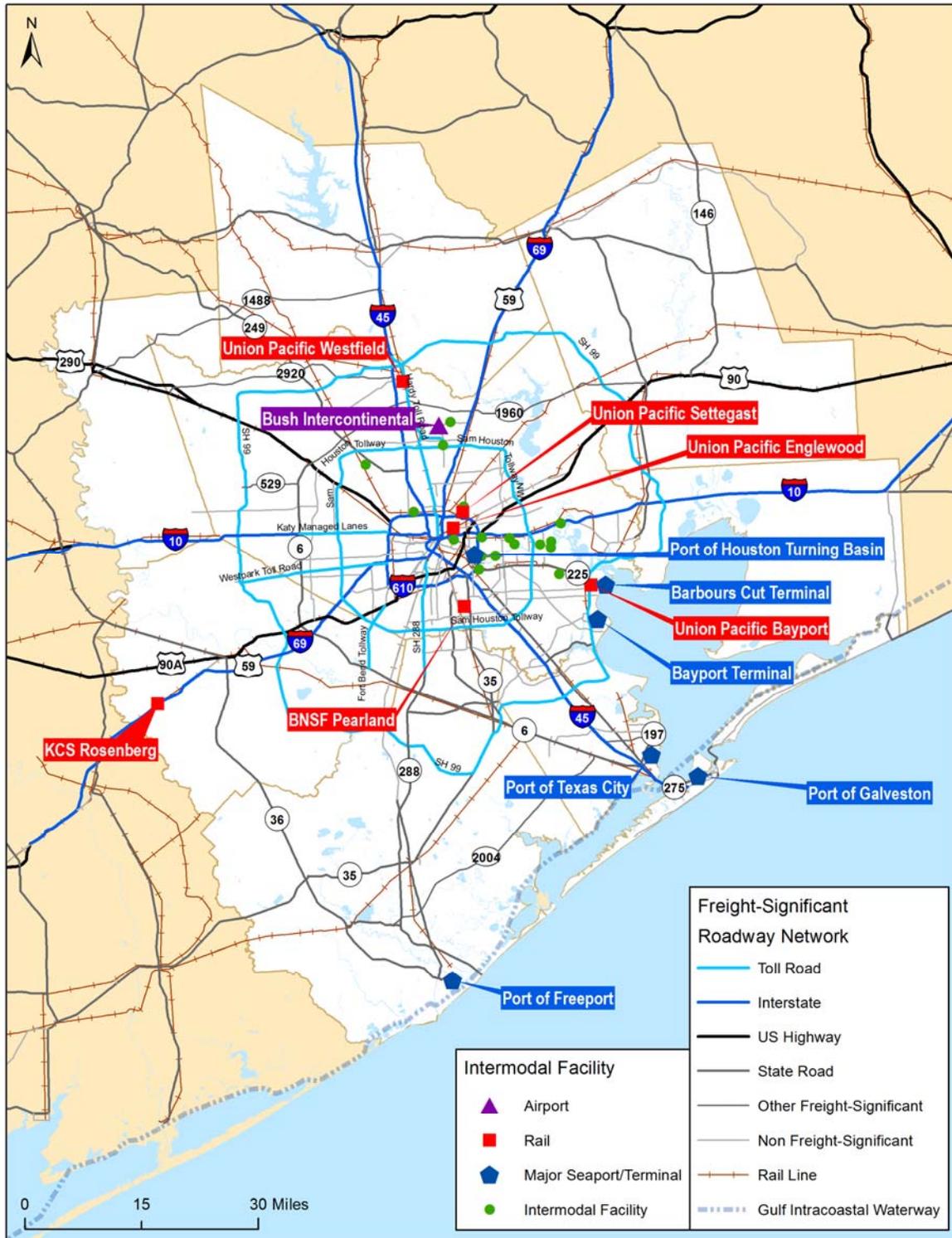
2.2 Freight Significant Corridors and Facilities

Freight significant corridors and facilities are a subset of the regional freight transportation system that are particularly important to freight and logistics activities. The road network carries both passenger vehicles and trucks but is not specifically designed for the express needs of freight transportation. Roadway corridors are part of a multimodal transportation system providing two primary goods movement functions: transport of wholly over-the-road shipments and road connection for intermodal shipments. Identification of freight significant corridors and facilities enables investments and operational strategies to center on the facilities that are most beneficial to regional goods movement activities overall.

Figure 2.9 presents the network of roadways identified by private sector stakeholders, including trucking and rail company representatives, industrial developers, and shippers and manufacturers, as significant for regional goods movement. They display the routes identified by stakeholders as critical for cross-regional travel and linkage, supplemented with intermodal connectors either mentioned in interviews, provided by or for facility operators or published by FHWA for the 8-county region. Figure 2.9 also depicts the relationship of the freight significant roadway network to the chief intermodal facilities, including major seaports, cargo airports, rail transfer facilities for containers, trailers and automobiles and a variety of pipeline and other private terminals. Each intermodal facility has connector roads that join it to the surrounding system and to the network of freight-significant corridors.

Focusing investments on the most critical elements of the freight system will help maximize

Figure 2.9 Freight-Significant Corridors and Facilities



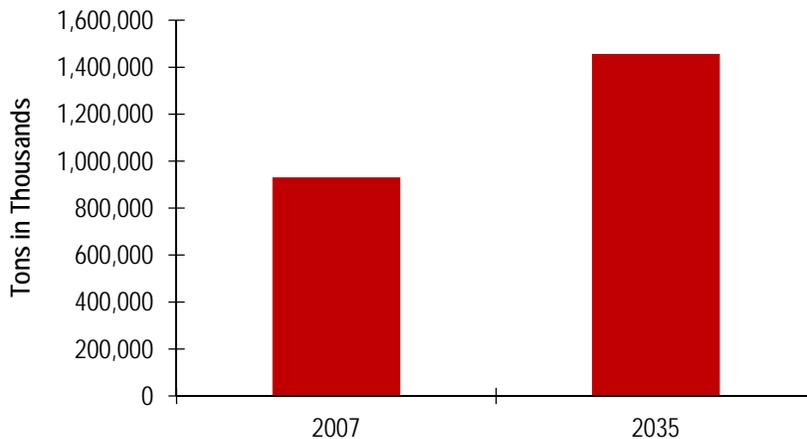
Source: Cambridge Systematics, Inc.

2.3 Commodity Flow Patterns

The commodity flows on the H-GAC freight system are significant. As shown in Figures 2.10 and 2.11, over 930 million tons of freight with a combined value of approximately \$1.6 trillion moved into, out of, within or through the H-GAC region in 2007.²⁶ By 2035, total freight movements are expected to grow to almost 1.5 billion tons valued at \$3.4 trillion, representing annual growth rates of 2.1 percent and 4.3 percent, respectively.²⁷ While these growth rates are not extraordinary (they generally track with expected economic growth in the same period and are consistent with national projections), they do imply that freight movements will become a greater part of the traffic mix in the H-GAC region in the coming years.

Regional freight movements are expected to grow by more than 56 percent (by weight) by 2035. The value of these shipments is expected to double to \$3.4 trillion.

Figure 2.10
Expected Growth of Regional Freight Flows
By Weight, All Modes (Excluding Pipeline)
2007-2035

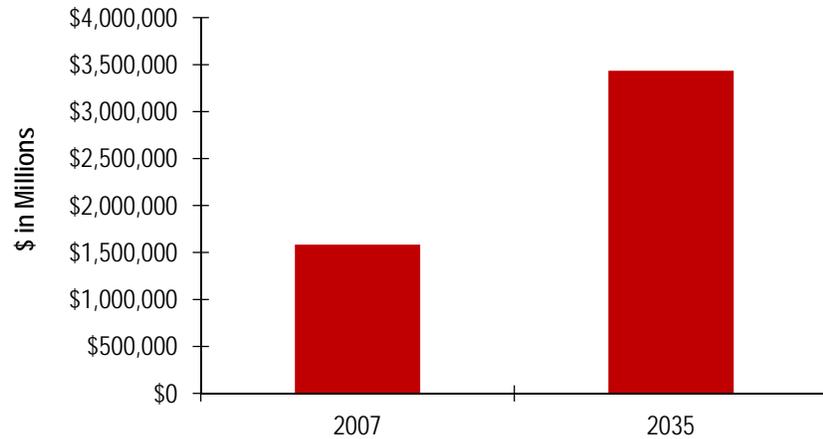


Source: Cambridge Systematics analysis of IHS Global Insight and U.S. Army Corps of Engineers data.

²⁶ All value figures in this report refer to current year dollars. 2007 figures are in 2007 dollars and 2035 figures are in 2035 dollars as estimated in the TRANSEARCH data.

²⁷ Regional freight flow projections developed by IHS Global Insight are based on economic, trade, and industry forecasting models using the best available data at the time of the forecast. Actual growth in freight demand is subject to change based on population growth rates, industry trends and trade patterns, and other economic factors.

Figure 2.11
Expected Growth of Regional Freight Flows
By Value, All Modes (Excluding Pipeline)
2007-2035



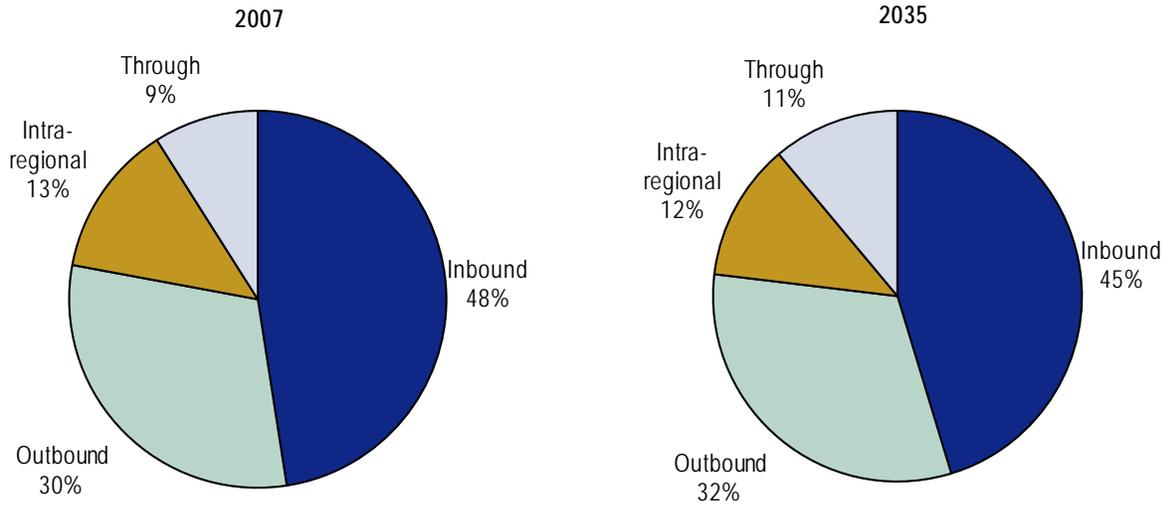
Source: CS analysis of IHS Global Insight and U.S. Army Corps of Engineers data.

Movement Types

Figures 2.12 and 2.13 show the total volume and value of shipments into, out of, through and within the H-GAC region for 2007 and 2035. These movements can be divided into 4 types:

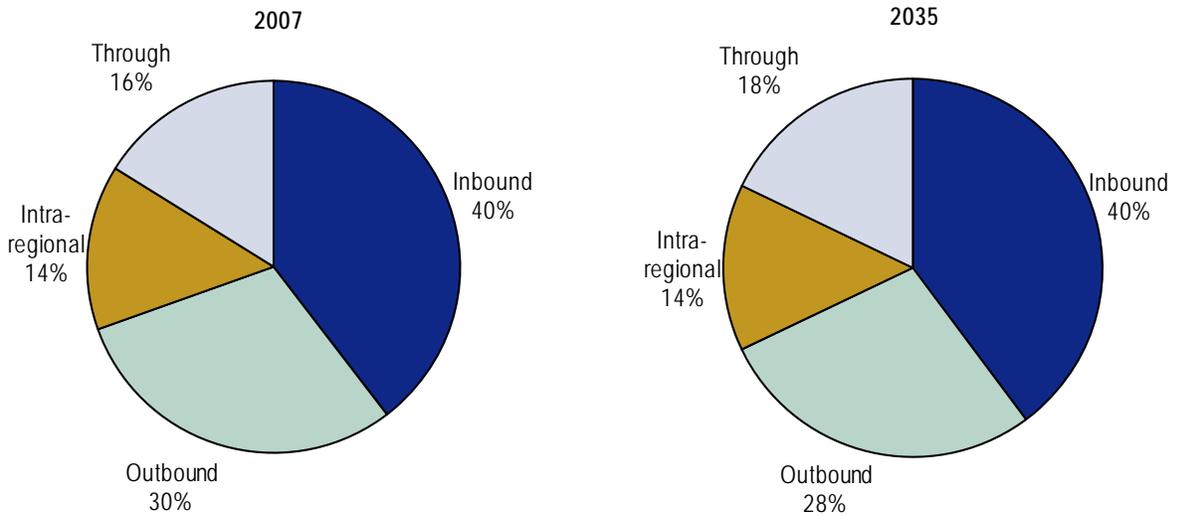
- **Inbound movements** originate outside of the region and terminate within the region. Inbound freight represents imports to the region; because consumers and businesses must pay for goods received, inbound freight also is associated with a corresponding outflow of dollars from the region.
- **Outbound movements** originate within the region and terminate outside of the region. Outbound freight represents exports from the region and is considered *wealth-generating* freight because it is associated with an inflow of dollars to the region.
- **Intraregional movements** originate and terminate within the region. Intraregional freight moves represent the degree to which the region is trading with itself. It is associated with neither imports nor exports but reflects the level to which the region is able to supply the goods it needs (both consumer and production materials) from within its boundaries.
- **Through movements** originate outside of the region, traverse the region and terminate outside of the region. Through freight movements, while very important for the national and global economy, do not directly impact the regional economy to a significant degree; however, the movement of through freight does utilize and impact the regional transportation system as a means to reach its final destination.

Figure 2.12
Direction of Total Freight Flows By Weight, 2007 and 2035



Source: IHS Global Insight.

Figure 2.13
Direction of Total Freight Flows By Value, 2007 and 2035



Source: IHS Global Insight.

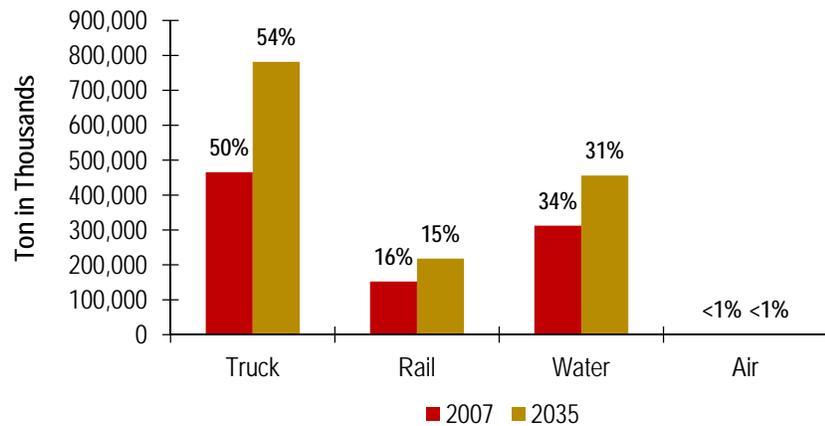
Trucking will continue to be the dominant mode of freight movements.

Mode Splits

By Weight

Figure 2.14 shows the mode splits by weight for all freight movements to and from the H-GAC region in 2007 and 2035. Clearly, trucks are the dominant mode, handling more than 465 million tons (50 percent of the regional total). This is expected to grow to about 781 million tons, or 54 percent, by 2035.

**Figure 2.14
Volume and Mode Share By Weight,
2007 and 2035**



Source: CS analysis of IHS Global Insight and U.S. Army Corps of Engineers data.

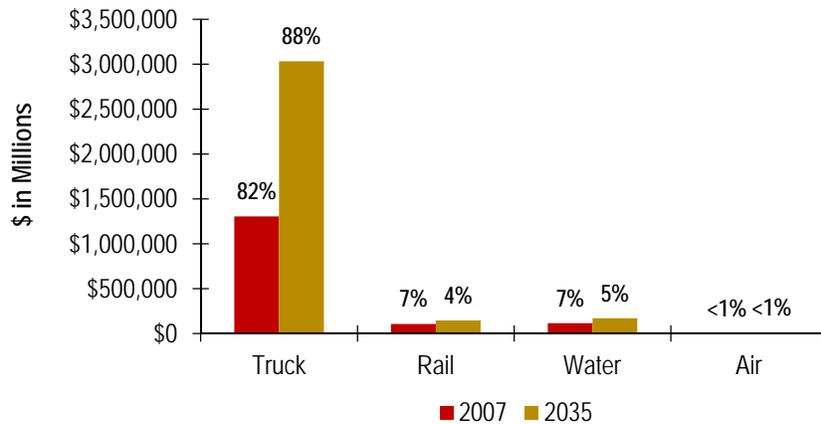
Rail had a much smaller share of the market than trucks in 2007 (152 million tons, or 16 percent). Total rail volumes are expected to increase to about 218 million tons in 2035 but market share will decline slightly to 15 percent. Due to the region’s proximity to the Houston Ship Channel and the GIWW, regional waterborne movements are much higher in the H-GAC region than in many of its peers. Total waterborne volumes in 2007 were approximately 312 million tons (34 percent), and are expected to grow to approximately 456 million tons in 2035 (and decrease to approximately 31 percent market share). Air cargo currently accounts for less than 1 percent of total H-GAC freight volumes; this proportion is expected to remain unchanged through 2035.

It is important to note that although overall volume handled by nontruck modes (waterborne and rail) is expected to grow between 2007 and 2035, overall market share for these modes is expected to decline from 50 to 46 percent. At the same time, the truck market share is expected to grow from 50 to 54 percent. This is an important finding, as increasing volume and decreasing market share indicate that the region’s rail and waterway system may not have sufficient capacity to absorb expected growth. As a result, some of this traffic may shift to truck, further fueling growth in that mode.

By Value

Figure 2.15 shows mode splits for 2007 and 2035 by value. Trucks again account for the largest share of the value of shipments to, from and within the region, handling 82 percent of shipments, valued at \$1.3 trillion. Rail handles a lower share of overall value, approximately 7 percent of shipments in 2007, valued at \$107 billion. Again, compared to its peers, the H-GAC region has a much higher percentage of regional waterborne movements, approximately 7 percent of all shipments, valued at \$116 billion.

Figure 2.15
Volume and Mode Share By Value, 2007 and 2035



Source: CS analysis of IHS Global Insight and U.S. Army Corps of Engineers data.

The trucking mode's dominance in the region is expected to continue in 2035, with trucks expected to handle approximately 88 percent of all shipment value. This growth will continue to place stress on the region's highway system. It is also important to note that air cargo movements are expected to nearly triple, from about \$3.3 billion in 2007 to over \$9 billion in 2035. Although small in absolute terms, this growth in air cargo traffic can have significant impacts for the region, as all are handled by truck on the front and back ends and the vast majority of air freight activity is concentrated at IAH.

The region's top 3 trading partners- Mexico, Dallas/Fort Worth, and Louisiana account for about one-third of all shipments.

Trading Partners

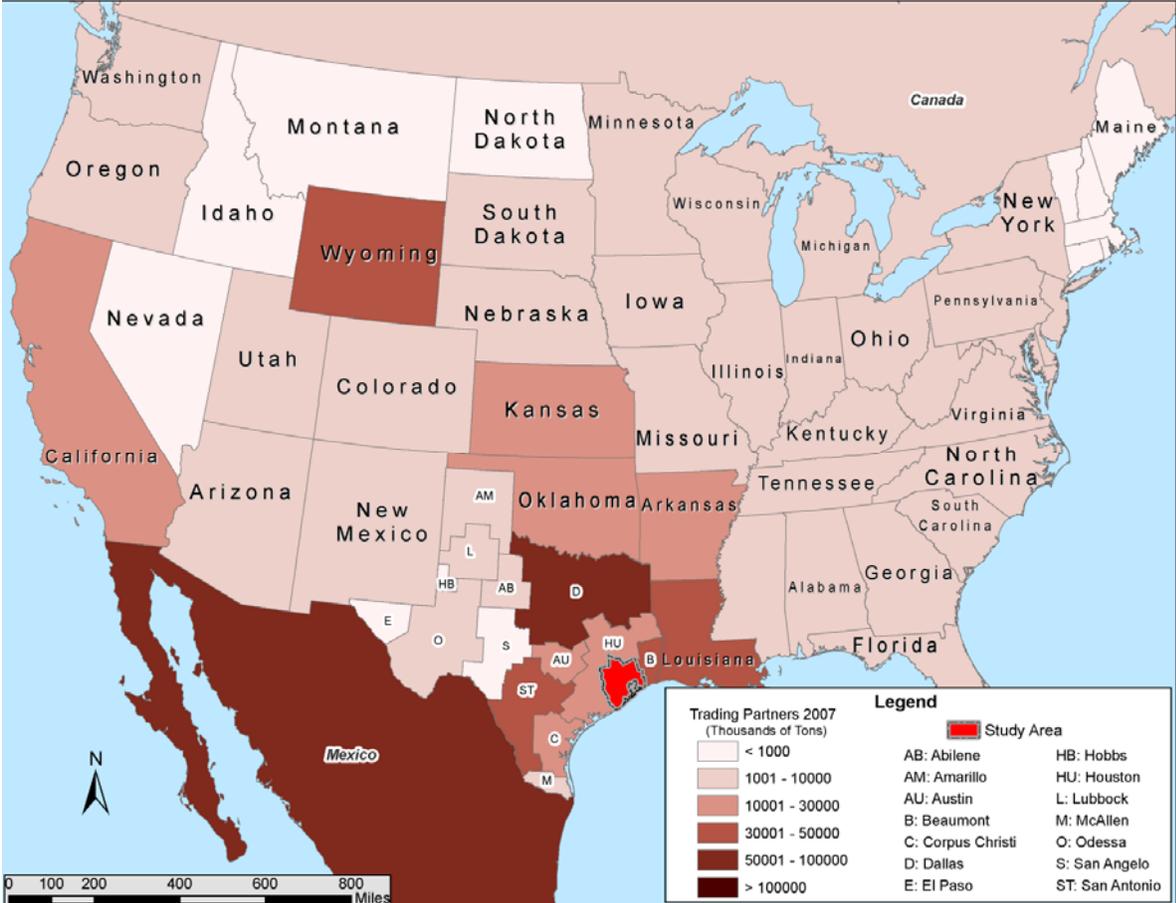
In addition to the analysis by mode and commodity summarized in the previous sections, it also is important to identify the region's key trading partners. Key trading partners are identified by combining the inbound and outbound freight flows between the study area and the trading partner region and highlighting the trading partner regions with the largest freight flows. Identifying major trading partners also helps to place the H-GAC region in the larger national economic landscape, describe its role within the national and global freight transportation system, and identify the corridors and facilities that are most important in supporting regional trade. The analysis also can help identify additional potential market opportunities for firms in the region.

Figures 2.16 and 2.17 display the region's most important trading partners (by total volume) in 2007 and (projected) in 2035.²⁸ Key partners for the region include:

- **Mexico**, which is one of the nation's and H-GAC's largest trading partner and accounted for 12 percent of all regional trade (by weight) in 2007 and is anticipated to account for approximately 16 percent by 2035. Trade with Mexico consists of large volumes of crude petroleum, petroleum and coal products, chemicals transported by water; and a variety of lighter-weight, higher-value commodities transported from Mexico by truck. This trading pattern is dependent on well-maintained shipping channels, terminal facilities, and pipelines as well as efficient highway connections between the region and the U.S./Mexico border (primarily I-10 and U.S. 59).
- **Dallas/Fort Worth**, which accounted for 11 percent of regional trade in 2007 and is expected to account for 12 percent in 2035. Trade with the Dallas region focuses on truck-based transport of secondary products (goods associated with warehouse and distribution activity) and petroleum products. This puts particular emphasis on I-45 and the various arterials that provide the last mile connection to port terminals, manufacturing facilities and warehouse/distribution facilities in the H-GAC and Dallas regions.
- **Louisiana**, which accounted for 5 percent of regional trade in 2007 and is expected to account for 3 percent in 2035. Trade with Louisiana is concentrated in waterborne petroleum and chemical products, chemical products shipped by rail and chemical products and secondary traffic hauled by truck. These trading patterns are impacted by the effectiveness of the port and rail operations in the region as well the efficiency of I-10 between Houston and points east.

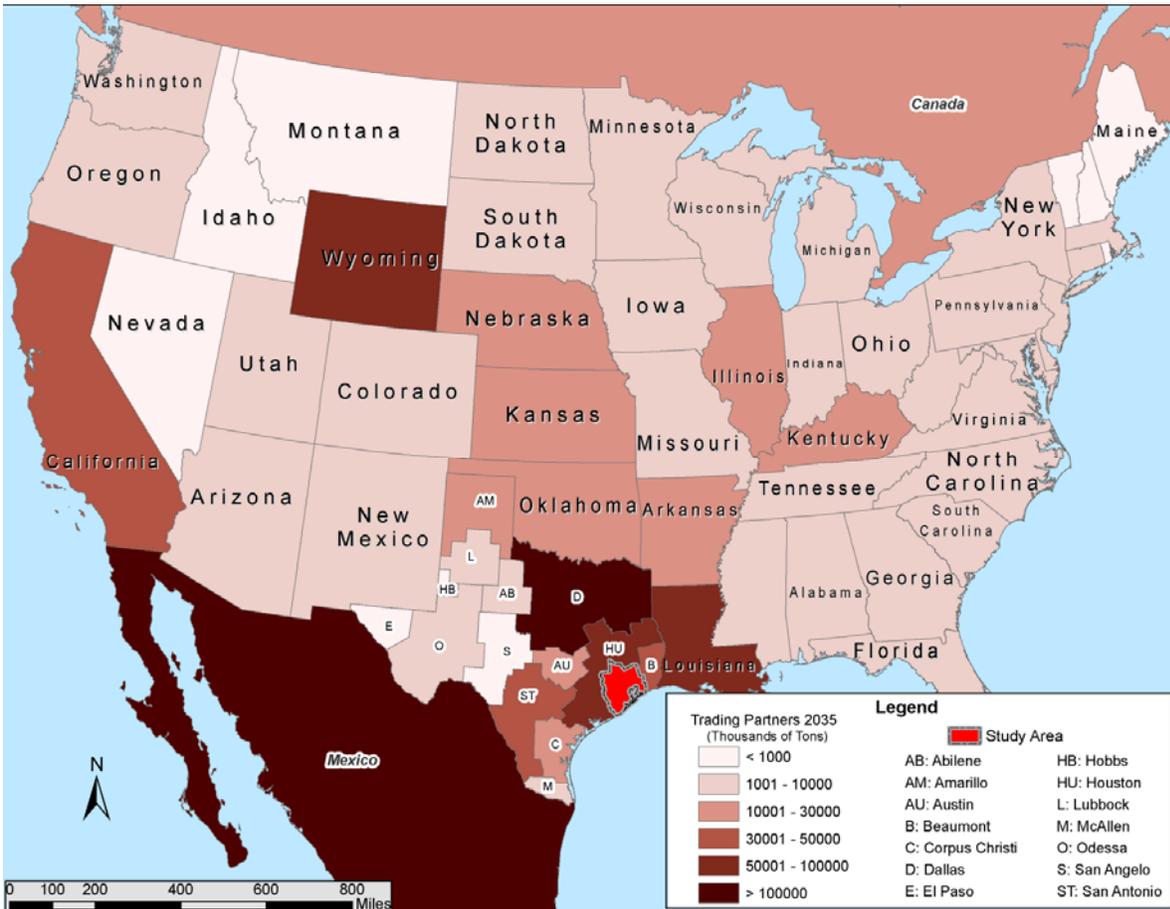
²⁸ The "trading partners" (external to the H-GAC region) consist of the 14 Bureau of Economic Analysis (BEA) regions within Texas, the rest of the states and the District of Columbia, and the neighboring countries of Canada and Mexico.

Figure 2.16 Trading Partners by Weight 2007



Source: IHS Global Insight.

Figure 2.17 Trading Partners by Weight 2035



Source: IHS Global Insight.

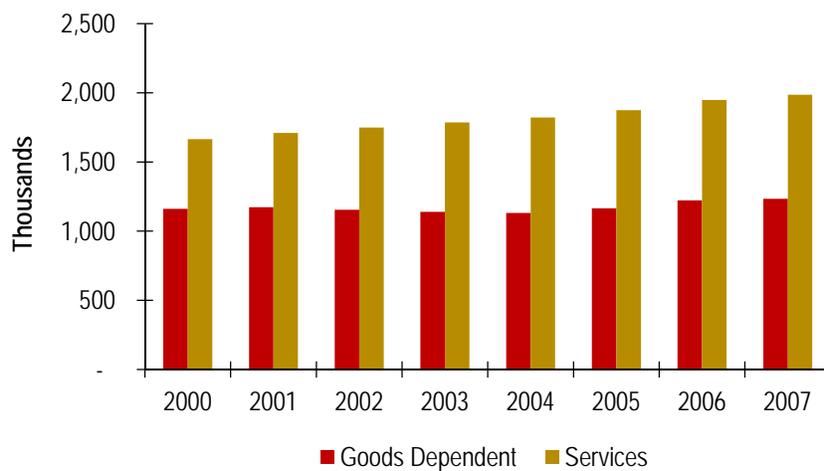
2.4 Key Industries

Demand for freight transportation is driven in large part by the characteristics of the regional economy. The H-GAC region's goods movement system therefore reflects the industries and businesses that make up its economy. These industries include:

- **Goods dependent industries**, or businesses that rely on the transportation system and logistics services to receive raw supplies and manufactured goods and to send their refined/finished product to market. This group includes industries such as natural resources and mining, retail and wholesale trade, construction, and transportation and warehousing.
- **Service industries** are not as dependent on freight movement, but do rely on shipments of materials, office products, or other small shipments of goods and supplies. This category includes industries such as government, education, health care, and other professional services. For these industries, freight can be thought of as a supply that facilitates business operations.

Similar to the U.S. economy as a whole, the H-GAC economy has been steadily transitioning from one that is heavily reliant on manufacturing to one that is driven by service-oriented industries, although the shift is not as pronounced in this region as it is in many others that do not share the same manufacturing base. Figure 2.18 highlights job growth trends in each sector from 2000 to 2007. As the chart demonstrates, the service industries have enjoyed greater job growth during this time. Employment in service-type industries expanded by 19 percent during this period (about 321,000 jobs), while goods dependent employment grew by 6 percent (adding 72,000 jobs).

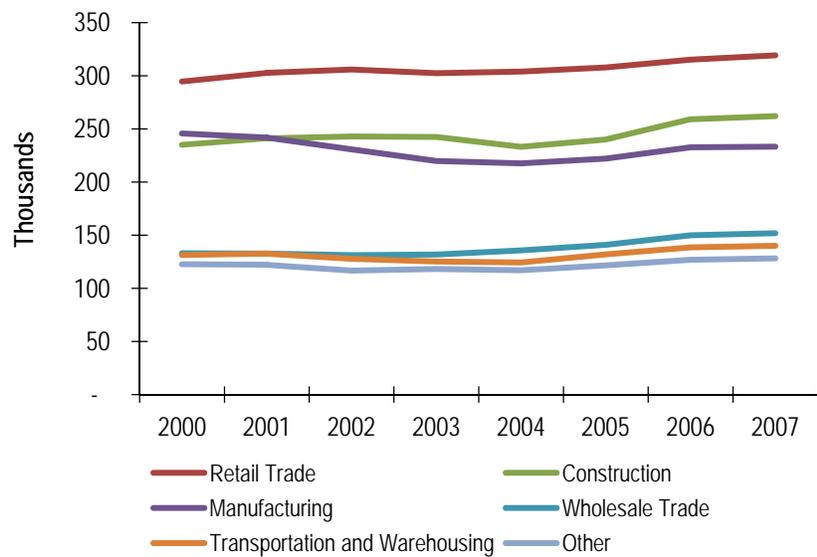
Figure 2.18
Relative Employment Growth in Goods Dependent and Service Industries 2000-2007



Source: Woods and Poole Economics, Inc.

Although the service sector has been growing faster than goods-dependent industries, both are contributing significantly to the region's economic output. The top five goods dependent industries in the H-GAC region, shown in Figure 2.19, accounted for 38 percent of the region's total employment and contributed more than \$200 billion to the region's total economic output, as shown in Figure 2.20. This makes the H-GAC region's economy much more goods-movement dependent than the nation as a whole²⁹ and, hence, much more reliant on an efficient freight transportation system.

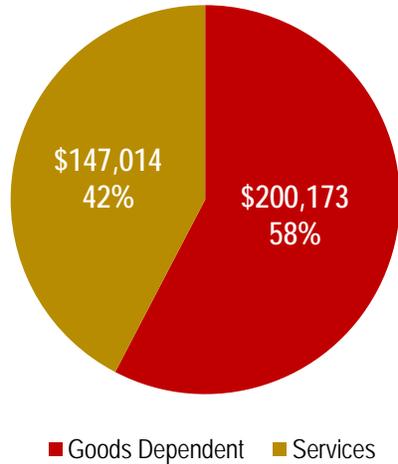
**Figure 2.19
Employment Growth in Top 5 Goods
Dependent Industries 2000-2007**



Source: Woods and Poole Economics, Inc.

²⁹ Only 40 percent of national GDP is from goods movement dependent industries.

Figure 2.20
Regional Goods Dependent and Service Sector
Gross Regional Product Chained
2005 Dollars, 2009

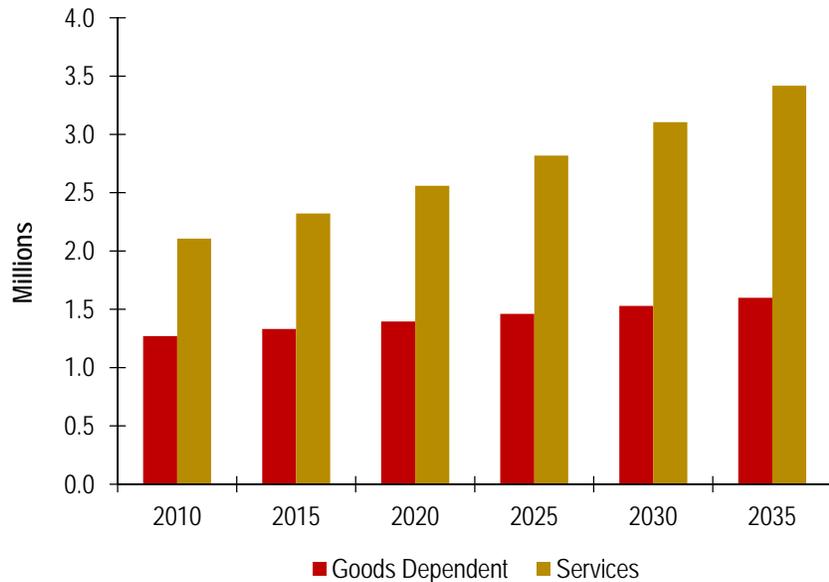


Source: Bureau of Economic Analysis.

Over the long term, the H-GAC region is expected to continue its traditional role as a major generator of jobs in Texas and the nation. From 2007 to 2035, the overall rate of job growth in the 8-county H-GAC region is forecast to be 15 percent higher than the rest of Texas and about 37 percent faster than the U.S. average.³⁰ Figure 2.21 shows projected employment growth in the H-GAC region goods dependent and services industries. While it is clear that the regional employment base will continue to shift toward service-oriented industries, there will still be employment growth in the goods dependent industries. By 2035, these industries are expected to add more than 328,000 jobs in the region (26 percent growth), and will still account for about 32 percent of the total job base.

³⁰ Woods and Poole Economics, Inc.

Figure 2.21
Forecast Employment Growth in Goods Dependent
and Service Industries 2010-2035



Source: Woods and Poole Economics, Inc.

Growth in output is just as important in these industries as employment growth. Output in manufacturing has been expanding even as the number of employees in the industry is falling – this suggests that manufacturers have invested heavily in automation and sophisticated process technologies, reducing their need for labor while maintaining and increasing output. This output growth translates directly to additional freight moving to, from, and within the region.

Moreover, transportation is a key contributor to manufacturing competitiveness. Increasingly, manufacturing industries depend on reliable transportation systems to support “just-in-time” (JIT) production methods that seek to minimize inventories and produce goods as they are needed by customers. Today, manufacturers draw on a worldwide supply chain and distribution network, hallmarks of JIT, which would not be possible without efficient transportation links. Manufacturers make extensive use of the region’s highway, rail and pipeline links, as well as the gateways to international markets provided by the Port of Houston and IAH. The region’s freight transportation system must maintain the capacity to deliver freight reliably in order to continue to attract and retain important industries.

3. Key Trends Impacting Goods Movement in the Region

Goods movement underpins and enables economic activity, particularly in the H-GAC region, which is home to a number of goods movement-dependent industries. However, the structure of local, regional and national economies are constantly changing and are highly sensitive to population growth, trade patterns, new technologies, and political forces. This Regional Goods Movement Plan must anticipate these changes in planning its goods movement system.

This section describes trends in the five factors that are most likely to shape freight demand in the region between now and 2035: 1) population and economic growth; 2) domestic and international trade patterns; 3) logistics strategies and supply chain strategies; 4) the transportation industry; and 5) policy and regulation. These and other trends and issues, individually and collectively, affect the vitality of the trade and transportation system within the H-GAC region. In some cases, these trends and issues have resulted in physical or operational chokepoints in the system. In other cases, they are impacting the ability of H-GAC, other public entities, and private sector freight stakeholders to effectively manage existing or add new transportation capacity. Regardless, these trends and issues will have important implications on the ability of the regional system to meet future freight mobility needs. Without a clear understanding of how these trends and system constraints are likely to affect the transportation system, neither H-GAC nor its regional partners will be able to effectively meet future needs and assure continued economic growth.

3.1 Employment and Population Growth

Current projections suggest that the national economy will expand at a compound annual growth rate of 2.5 percent to 2.6 percent through 2050, with rates of 3 to 4 percent through 2015 and lower rates thereafter, reflecting lower population growth rates in the out-years.³¹ The long-term average rates are considerably less than the average of about 3 percent experienced over the previous 30 years; however, employment in the H-GAC region is generally expected to exceed the national growth

³¹ The growth rates reflect recent estimates by IHS-Global Insight and other macro-economic forecasters. The rates incorporate the near-term effects of the recession and the longer-term effects of slowing population and workforce growth rates on the economy.

rates and grow from 2.7 million in 2010 to 4.3 million in 2040, an increase of 59 percent. All counties within the region will share in the growth as detailed in Table 3.1.

**Table 3.1
H-GAC Region Employment Forecast 2010-2040**

County	Employment		
	2010	2040	Percent Change
Brazoria	84,689	158,619	87%
Chambers	12,403	13,721	11%
Fort Bend	148,406	334,607	125%
Galveston	95,464	181,995	91%
Harris	2,232,835	3,349,628	50%
Liberty	14,313	36,268	153%
Montgomery	140,256	269,383	92%
Waller	11,241	25,402	126%
Total	2,739,607	4,369,623	59%

Source: H-GAC.

Employment in the H-GAC region’s freight-dependent industries described in Section 2.0 will grow apace with the overall economy, as shown in Table 3.2. Employment in the wholesaling, construction, and retailing sectors – all of which are supported by transportation and warehousing – will grow by about 40 percent. Even with its modest growth projections, the manufacturing sector is forecast to outperform that of the rest of Texas; manufacturing employment is projected to grow by 4 percent in the H-GAC region, but by only 1 percent statewide. And with a projected 10 percent growth rate, the H-GAC region’s retail and wholesale trade employment also will outperform the statewide rate of 2 percent.

Manufacturing activity in the region is expected to grow more quickly than the State as a whole, which will have impacts along the entire freight transportation system.

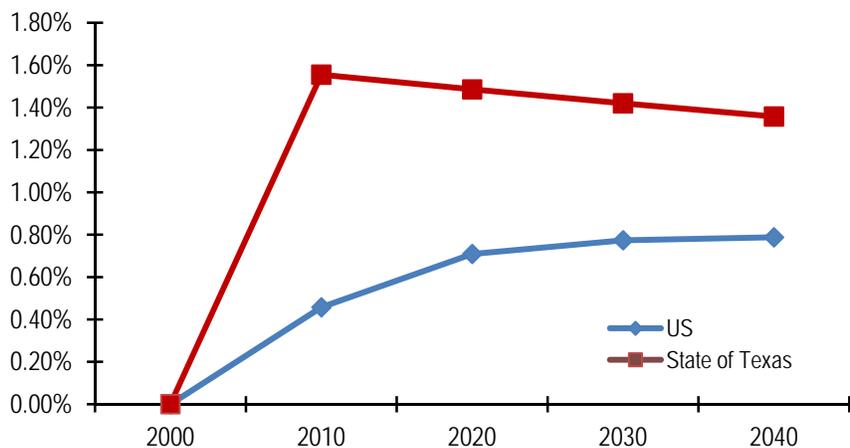
Table 3.2
H-GAC Region Employment in Freight-Dependent Industries 2007 and 2035

Industry	2007	2035	Percent Change	CAGR
Retail Trade	319,170	443,600	39%	1.2%
Construction	262,087	362,002	38%	1.2%
Manufacturing	233,232	243,185	4%	0.1%
Wholesale Trade	151,765	216,846	43%	1.3%
Transportation and Warehousing	139,959	183,367	31%	1.0%
Total	1,106,213	1,449,000	31%	1.0%

Source: Cambridge Systematics analysis of Woods and Poole data.

Texas’ population also is expected to grow more quickly than the United States as a whole, as shown in Figure 3.1, and the H-GAC region will be leading much of this growth. The regional population is expected to grow from 5.9 million in 2010 to 9.6 million in 2040, an increase of 60 percent. Figure 3.2 shows regional projected population and growth rates by county. By 2040, the region will account for 24 percent of the state’s overall population, projected to be 35.8 million people or roughly the size of present-day California.³²

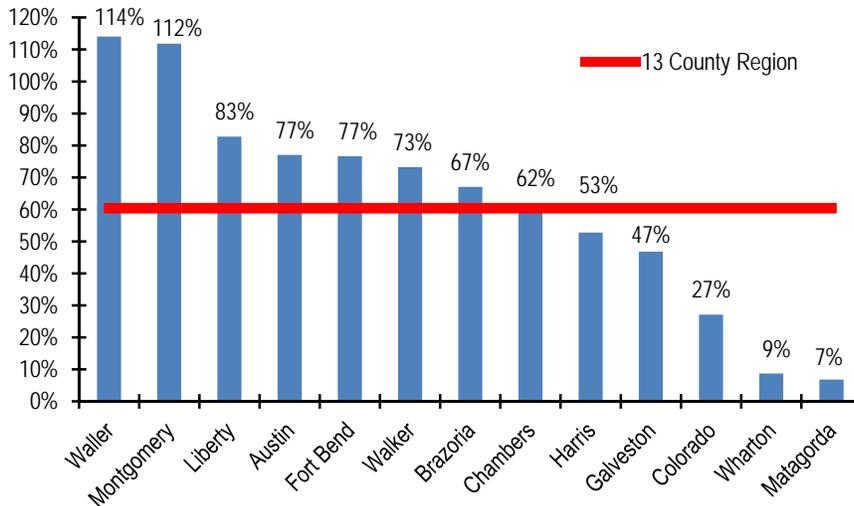
Figure 3.1
Texas and U.S. Population Growth Rates 2000-2040



Source: U.S. Census Bureau.

³² The Texas State Data Center releases multiple population projections and recommends using the “0.5 Scenario” for long-term planning purposes. This scenario assumes that long-term immigration will be half that of the 1990s, a period of high growth in the State.

Figure 3.2
Population Growth in H-GAC Region 2010-2040



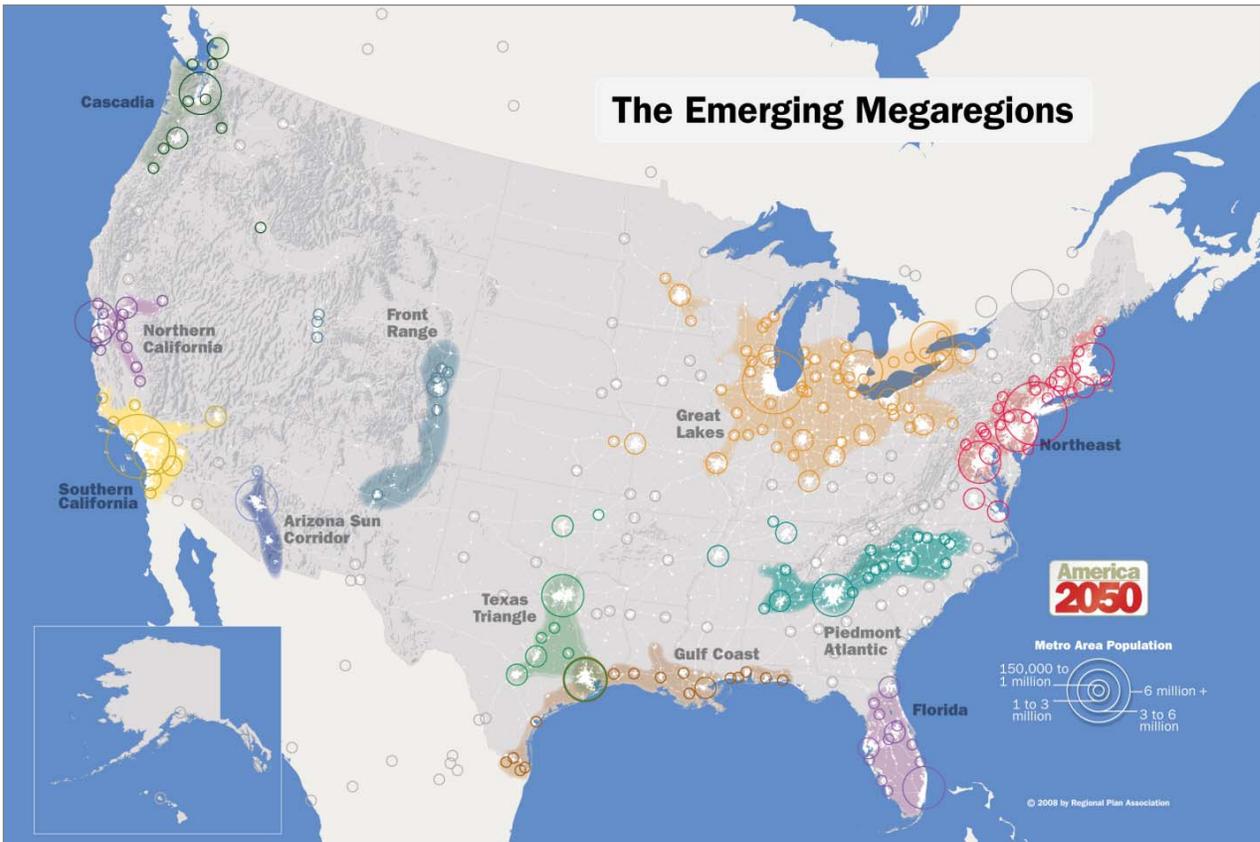
Source: H-GAC.

The employment and population trends described above will make the H-GAC region a key center within two emerging economic megaregions – the Gulf Coast and Texas Triangle, which are shown in Figure 3.3.³³ These megaregions – along with their national and global counterparts – are expected to be the economic engines of this century, generating hundreds of billions of dollars in economic output, accumulating the majority of the nation’s and world’s wealth, attracting a highly educated labor force, and spawning the technological innovations (and jobs) that spur further economic growth.³⁴

The continued emergence of economic megaregions will reinforce the economic links between the H-GAC region and its neighboring economic regions. Efficient freight transportation within the megaregion will become as critical to the future competitiveness of the H-GAC region as efficient freight transportation within the metropolitan region is today. As the major port area for the Texas Triangle megaregion and much of the Gulf Coast megaregion, the H-GAC region will be under increasing pressure to maintain the efficiency, reliability, and sustainability of its regional trade and transportation system amidst population and employment growth in order to support continued regional mobility and economic vitality.

³³ Unlike megacities, which are described simply by the size of their populations, megaregions are by definition places with large markets, significant economic capacity, substantial innovation, and highly skilled talent, as well as large overall populations ranging in size from 10 to 50 million people and producing hundreds of billions of dollars in economic output.

³⁴ Richard Florida, *The New Megalopolis*, *Newsweek*, July 2006.

Figure 3.3 Emerging U.S. Economic Megaregions

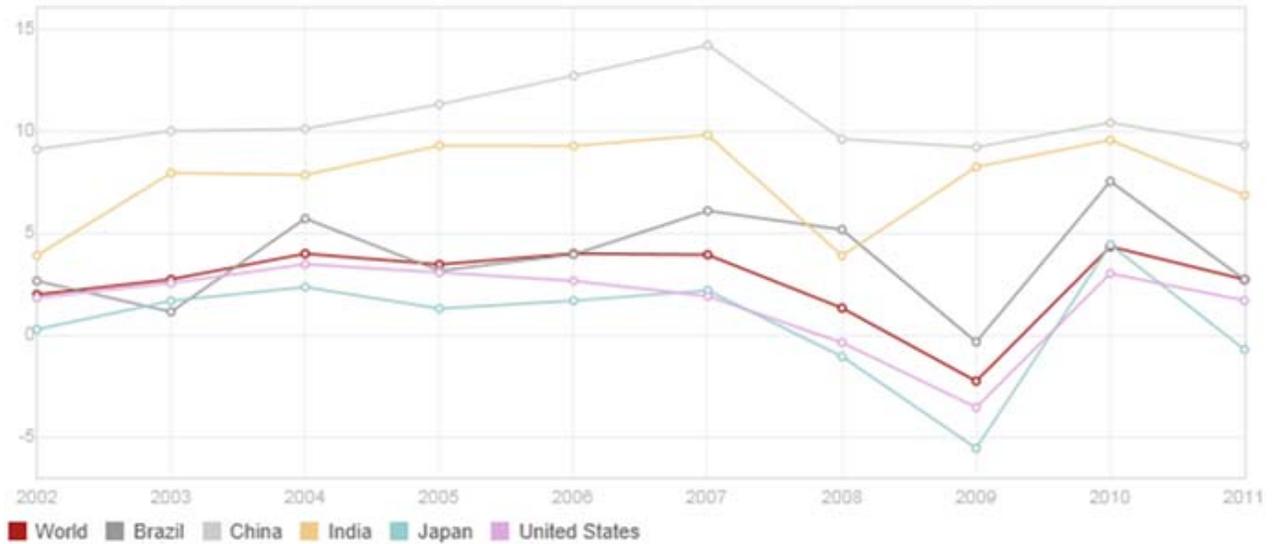
Source: The Regional Plan Association.

3.2 International Trade

In addition to growing domestic trade among megaregions, current data suggest a resumption of the long-term trend toward globalization and higher international trade volumes. The economies of the world's developing economies, particularly the "BRIC" countries (Brazil, Russia, India and China) are recovering from the recession faster than the economies of the developed countries (e.g., United States, Europe, and Japan), as shown in Figure 3.4. Within these countries, there is an emerging "middle class," whose increasing wealth will drive up consumption of housing, food and consumer products. The projected shares of middle-class consumption are illustrated in Figure 3.5. With global population projected to reach 9.3 billion by the year 2050, the overall demand for exports could be considerable.³⁵

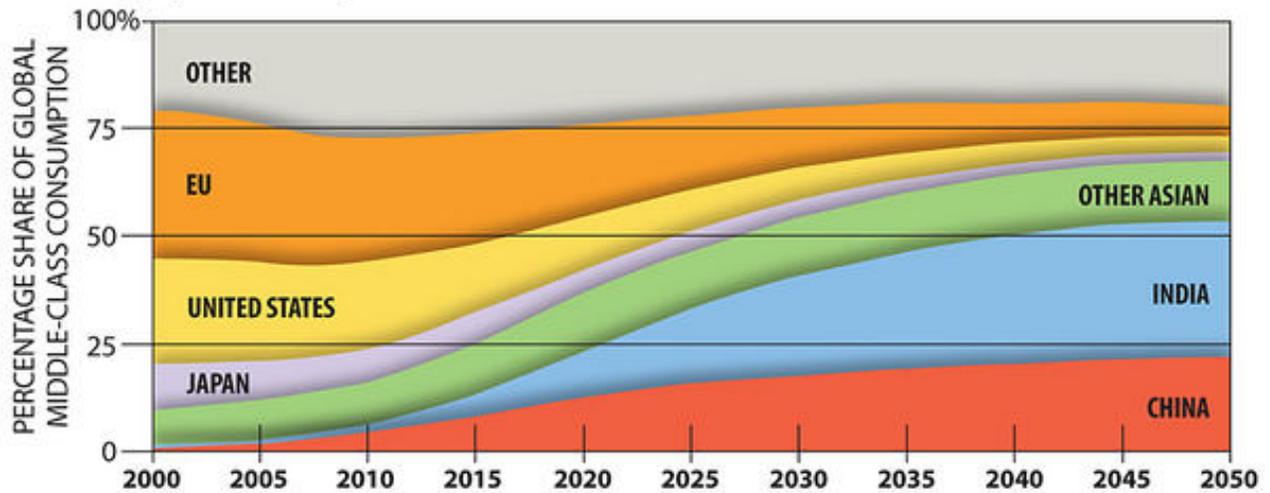
³⁵ "World Population Prospects, the 2010 Revision," U.N. Department of Economic and Social Affairs. http://esa.un.org/wpp/Analytical-Figures/htm/fig_1.htm.

Figure 3.4
Comparative Economic Growth Rates of U.S.
and Key Trading Partners 2003-2011



Source: World Bank.

Figure 3.5
Global Middle Class Consumption 2000-2050



Source: H. Kharas (2010), "The Emerging Middle Class in Developing Countries," OECD Development Centre Working Paper No. 285.

Given the global reach of U.S. businesses and the opportunities to export U.S. agricultural and manufactured products, world population growth may be the ultimate driver of U.S. and regional freight transportation demand. The agriculture sector will be the single largest source of

freight tonnage growth through 2040, with a projected increase of 1.1 billion tons.³⁶ The growth will be driven by rising standards of living in China and other developing countries, which is driving up demand for exports of meat and animal feeds from the United States.³⁷ In addition, three other commodities that are produced or shipped from the H-GAC region will be in strong demand by developing economies:

- **Petroleum coke** or “petcoke,” which is a byproduct of refining crude oil. Although it comes from liquid oil, petcoke is a solid rock-like material similar to coal and is used as fuel at power plants to generate electricity, by the smelting industry to create aluminum and steel, and as a fuel for making cement. There is strong demand for petcoke in China, India, Brazil, and Mexico. For the first time since 1949, the United States is now a net exporter of this material.³⁸
- **Wheat.** The United States is the world’s largest wheat exporter and has consistently provided between 20 and 30 percent of global wheat exports since the 1990s. Gulf Coast ports, including the Ports of Houston and Galveston, are important exporters of wheat from Texas, Oklahoma, Kansas, Colorado, eastern Nebraska, and other Midwest locations.³⁹
- **Steel.** Many of the world’s developing economies are making significant capital investments to keep up with their growing populations and economies. Infrastructure improvements use large volumes of steel, which is the largest general cargo commodity (by weight) handled at the Port of Houston. Total tonnage of steel throughput at the Port grew by nearly 60 percent between 2010 and 2011.⁴⁰

In addition, the combination of the recent boom in hydraulic fracturing (fracking) and the expansion of the Panama Canal provides an opportunity to facilitate the region’s liquefied natural gas (LNG) trade with the Pacific Basin. With U.S. LNG supply exceeding demand, the U.S. is now a potential low cost provider of LNG to many regions of the world. While there are currently no U.S. LNG export facilities (all current facilities were built for imports), several are being redeveloped to facilitate export cargo. At the same time, although no LNG carriers currently use the Panama Canal, approximately 80 percent of the world’s LNG tankers will be able to pass through the isthmus once expansion is complete.⁴¹ As a result of these changes, Houston ports are positioned to experience an increase in the export of LNG, its processed form, and byproducts in the coming years.

³⁶ http://nue.okstate.edu/crop_information/world_wheat_production.htm.

³⁷ <http://www.joc.com/economy/kemmisies-discusses-role-agricultural-exports-next-economy-cycle-video>.

³⁸ U.S. Energy Information Administration.

³⁹ National Association of Wheat Growers.

⁴⁰ Port of Houston Authority.

⁴¹ Details on the Panama Canal expansion are provided on page 3-12.



Increasing demand for these and other commodities will continue to place stress on the region's export gateways, particularly its seaports and related access routes.

3.3 Supply Chains

Thirty years ago, most businesses operated *push* supply chains. Suppliers delivered materials to a manufacturer, who pushed products to a distributor or retailer, and then to the customer. Each business maintained a large and expensive inventory of critical materials and products to protect against stockouts. Today, most businesses are moving toward *pull* or on-demand supply chains (JIT manufacturing and retailing), replenishing whatever the customer consumes as soon as it is sold. To ensure that inventory is available, businesses are tracking customer purchases as they occur, reducing and centralizing inventory at fewer locations, and managing in-transit inventory closely. Industries that once held large inventories of products and could tolerate delays in shipment and receipt of goods now demand greater reliability and visibility from their freight carriers. The trend toward pull or replenishment operations is expected to continue with some retrenchment and adjustment for the higher risk involved in operating long and complex supply chains (“just-in-case” supply chains).

In addition, there is increased interest among major shippers in “near-sourcing,” or the locating of production facilities in lower-cost labor areas close to customer bases. In the late 1990s, the rise of China as a major industrial power, coupled with its abundant, low cost and skilled labor force and relatively low global oil prices, caused many U.S. companies to relocate manufacturing activities to China, making it the world's product engine. This was particularly true for labor-intensive industries, like apparel, shoes, toys, and electronics. In fact, from 2000-2009, China's portion of global exports of apparel rose from 17.4 to 32.1 percent; exports of telecom equipment grew from 6.5 to 27.8 percent; and exports of furniture leaped from 7.5 to 25.9 percent.⁴²

In the last several years, however, China's advantages have begun to erode. In 2004, China passed its first minimum wage legislation, which allowed each province and autonomous zone to set its own minimum wage rates.⁴³ Due to increasing consumer prices, several provinces have drastically increased their minimum wage rates, including Guangdong, China's wealthiest province, which raised its minimum wage by 18 percent in 2008.⁴⁴ These changes have greatly eroded China's labor rate advantage relative to Mexico. While Mexican workers made double the wages of their Chinese counterparts in 2003, that gap has shrunk to

Near sourcing will have important implications on MPOs, including H-GAC, as there will be pressure to improve intermodal connections, improve system reliability, and make other investments to allow the system to absorb both passenger and freight growth.

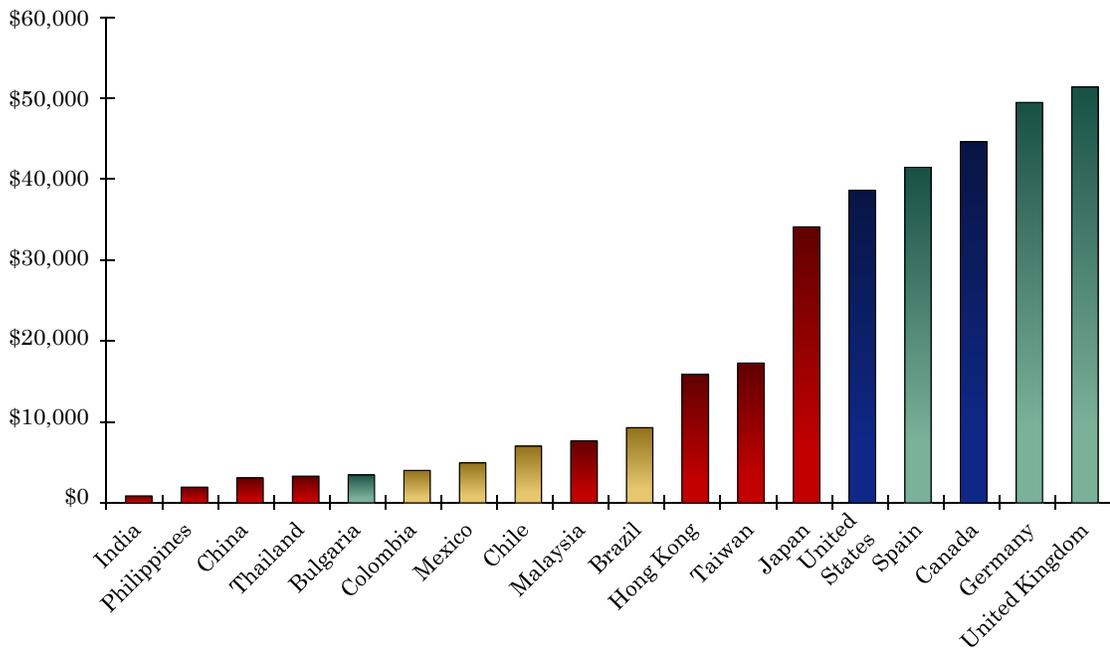
⁴² Boston Consulting Group, *Made in America, Again*, 2011.

⁴³ Rick LeBlanc, “Markets in Transition: Near Sourcing: Logistics Changes Have Implications for Pallet Demand,” *Pallet Enterprise*. November 1, 2009.

⁴⁴ *Ibid.*

only 15 percent today.⁴⁵ Figure 3.6 provides a comparison of the prevailing manufacturing wages in the United States, Mexico and other key manufacturing economies. Average manufacturing wages in Mexico, Columbia, Chile and Brazil are all competitive with wages in the Asian countries that have traditionally supplied the United States with low-priced manufactured goods.

Figure 3.6
Manufacturing Wage Comparisons in U.S. Dollars
at Prevailing Exchange Rates



Source: UN-ILO, Business Monitor, Moffatt & Nichol, as cited by Walter Kemmsies, Moffatt & Nichol, "Shifting International Trade Routes." AAPA presentation, January 25, 2010.

These trends, coupled with increased product quality and security concerns and higher inventory carrying costs, have caused shippers to actively consider alternatives to China and "near sourcing" is making a comeback among domestic manufacturers. A recent survey of senior manufacturing executives showed that 35 percent will have completed or are in the process of moving production closer to home.⁴⁶ Concerns about "stock-outs," payment delays, and product quality have caused some computer and electronics component manufacturing to relocate to other markets. Foxconn, which supplies components to Apple, Nintendo, Sony, Dell and others, is consolidating its manufacturing operations along the

⁴⁵ Mark B. Solomon, "Fleeing China? Look Before You Leap," *DC Velocity*. January 1, 2009.

⁴⁶ *Right Shoring*, Eric Kulisch, page 9, *American Shipper*, June 2012.



U.S.-Mexico border⁴⁷ and “white goods” (i.e., refrigerators, washers, dryers, ovens) will increasingly use Mexico’s abundant workforce. In addition, the apparel industry in the Caribbean and Latin America will continue to expand – Honduras, El Salvador, Nicaragua, Guatemala and the Dominican Republic already account for 12.5 percent of U.S. textile imports, and exports from this region are growing by nearly 20 percent per year.⁴⁸ These sourcing shifts, which already have begun, will accelerate by 2015 and show progressive growth through 2025.

Furthermore, ports located within the H-GAC region, as well as its regional economy, would likely benefit from a shift of production from China to Mexico and Latin America. The region’s location would be a major asset in the Latin America-U.S. container trade. At the same time, these shifts would place additional strain on the condition and performance of the region’s freight system because, in general, changes in supply chains and sourcing locations will expand the use of truck and air transportation at the expense of rail and waterborne transport.

3.4 Transportation Industry Trends

There continue to be significant changes in the transportation industry itself, including investments in technology and infrastructure, and shifting operational patterns. Collectively, these trends impact the overall distribution pattern of freight movement.

Motor Carrier Industry

Economic deregulation of the motor carrier industry in the 1980s triggered massive restructuring of trucking firms and services, a process that is still evident today. Industry observers expect that the trucking industry will see further consolidation and restructuring. The industry has been aggressive in incorporating global positioning systems (GPS) and other tracking and shipment management technology into their operations; however, most trucking companies are small (approximately 80 percent of motor carrier firms own 5 to 10 trucks) and operation of GPS technology requires sophisticated personnel.

Small, independent trucking companies will continue to exist; however, they will contract to large carriers or subscribe to dispatching or load matching services to ensure that capital is utilized effectively. Information-technology-intensive firms will generally prosper at the expense of less information-technology-intensive firms – a trend that will favor large firms. Structural shifts in the economy that generate more high-value, lower-weight, time-sensitive goods should mean that the overall demand for trucking will be high. Driver shortages are not expected to be an intractable problem but will be a recurring issue given the unregulated economic entry and boom-and-bust nature of the industry. Nevertheless, price competition with rail (because of the higher

Access to information, including travel time, crashes, and delays, is increasingly important to shippers and carriers

⁴⁷ Maquila Industry News, 2011.

⁴⁸ Central American and Dominican Republic Apparel and Textile Council.

fuel cost and labor shortages incurred by long-haul trucking) will squeeze some transcontinental truckload operations out of business.

Railroad Industry

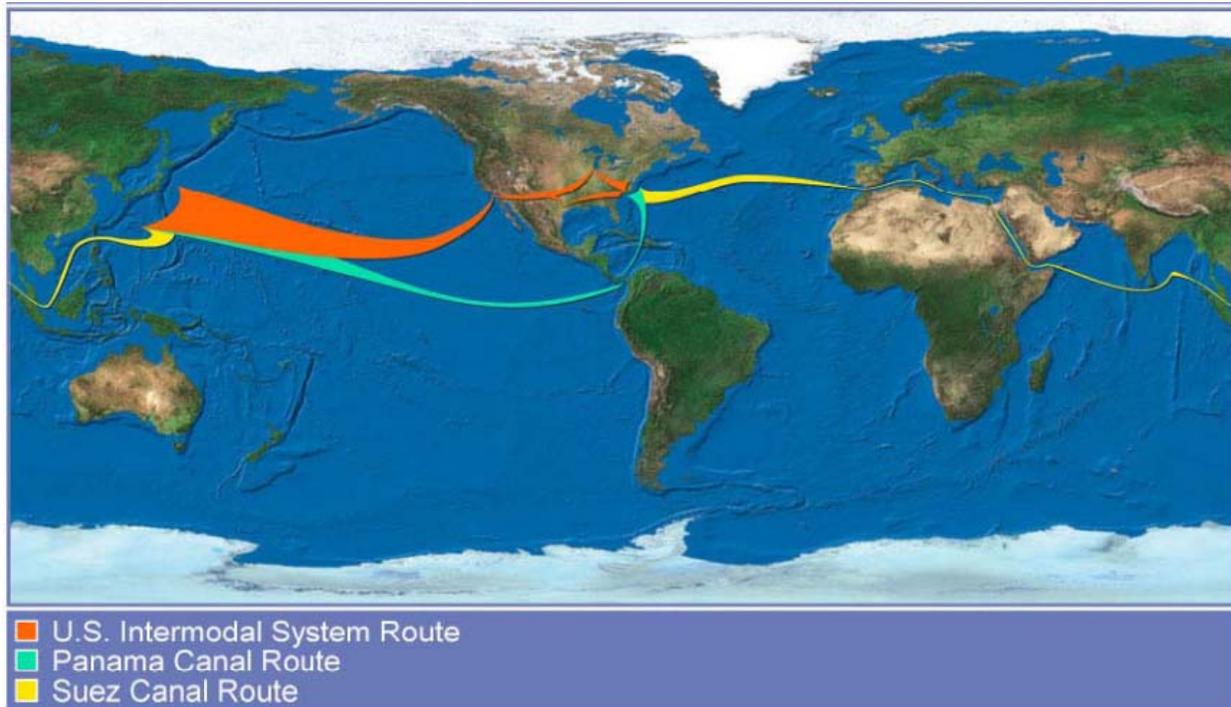
The railroad industry has realized steady productivity improvements since the economic deregulation of the industry in the 1980s. The improvements have been achieved by restructuring the rail system and creating new business lines serving long-haul intermodal freight demand and coal movements out of the Powder River Basin in Montana and Wyoming and by increasing the number of tons carried per railcar, the number of railcars moved per train and – with more sidings and better signal systems – the number of trains moved over a line. The railroads are also upgrading track to handle heavier cars along many lines, thereby allowing more tonnage to be handled over existing corridors.

Current business forecasts anticipate that the freight railroads will retain their market share and perhaps capture more of the long-haul freight demand market. To compensate for lower coal traffic volumes and revenue, the freight railroads will push to expand intermodal services into 400- to 700-mile freight transportation markets. Long-haul intermodal service (over 700 miles) is profitable because the railroads can achieve considerable economies of scale in long-distance moves; however, shorter distances are less profitable and the reliability of transit times is harder to maintain. Building new services will be a significant challenge, involving redesign and repositioning of older yards as intermodal terminals to support the development of new, scheduled intermodal services.

Shipping Industry

Ships continue to grow in size as shipping lines seek economies of scale to reduce to the unit cost of moving containers and other commodities. An expansion of the Panama Canal is underway to accommodate these larger ships. Eventually, however, the capacity of harbors to accommodate the larger, deep-draft ships will slow the growth in ship size. The supersizing of ships already has reached equilibrium in the tanker industry and a similar trend may emerge for the container fleet. The Port of Galveston, the Port of Houston, and Port Freeport, along with their competitors along the Gulf Coast and Atlantic seaboard, have the capacity to serve the larger container ships and are undertaking major capacity enhancement projects to enhance their ability to attract a portion of the Canal's new traffic, whose general route is shown schematically in Figure 3.7.

Figure 3.7
Asia to U.S. Shipping Routes



Source: Panama Canal Authority, 2006.

The trend toward larger ships will concentrate freight movements into deepwater ports with the largest ships making the highest volume ports their first port of call (both because of market demand and because offloading at the first port of call allows access to second ports of call that may have shallower channels and berthing areas). Expansion of the Panama Canal will trigger some diversion of West Coast traffic from the Ports of Los Angeles and Long Beach to U.S. Gulf Coast and East Coast ports, but the railroads will likely lower rates for transcontinental intermodal service, counteracting some of the potential diversion. Exports from Houston-area ports are likely to increase following Panama Canal expansion, with growth in the export of dry bulk (bulk grains and coal), liquid bulk (LNG, petroleum and petrochemical products), value added manufacturing and break bulk cargo, and containers to existing and new markets.⁴⁹

3.5 Regulations and Policy

Goods movement operates within a framework of institutional and commercial relationships governed by statutes, regulations, standards,

⁴⁹ Texas Transportation Institute, Report from the Panama Canal Stakeholder Working Group, November 2012

policies, established practices, and tariffs. Policies and regulations established at the national, state, and local levels all have a direct impact on freight transportation demand – through policies and taxes that subsidize the growth of some industries and transportation modes over others; through regulations that affect the relative prices of freight transportation; and through programs that invest in transportation infrastructure.

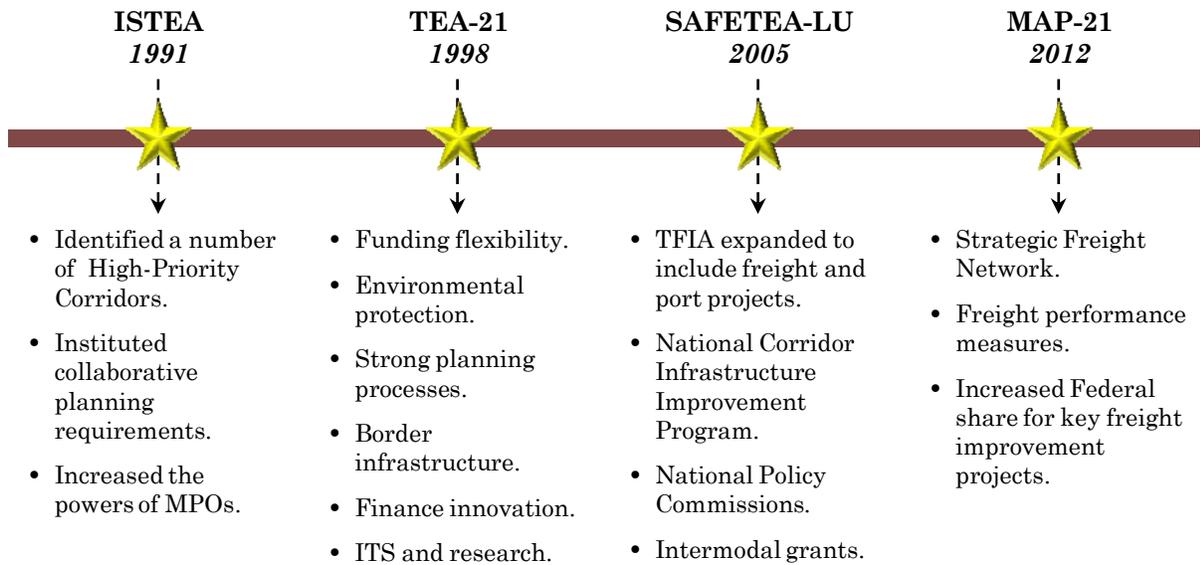
Transportation Policy

As the economy recovers, demand for freight transportation will again press the capacity of the freight transportation system. The resulting congestion will undermine the reliability and connectivity of freight movements, which are essential to the nation's economic well-being, and renew calls for more investment in transportation infrastructure. Federal policy recognized the importance of the Interstate Highway System program to economic development and freight transportation in the 1960s; and in the 1980s, Federal policy supported deregulation of the freight transportation industry as a means of restructuring the industry and reestablishing market rates for freight transportation services.

Starting with the reauthorization of the Federal funding for surface transportation by the Intermodal Surface Transportation Efficiency Act of 1991 (ISTEA), successive reauthorizations have recognized the need for a more explicit and detailed national freight transportation policy, but made limited headway toward enacting specific policies and programs, as shown in Figure 3.8. This trend held true until the Moving Ahead for Progress in the 21st Century Act (MAP-21), which was enacted in 2012. MAP-21 mandated that U.S. DOT develop a national freight policy and goals, designate a national freight network, and produce a periodic report on the condition and performance of the national freight systems.

Congress is edging toward a broad policy debate about the role of the Federal government in transportation and the importance of maintaining national freight transportation capacity and connectivity. MAP-21 is a start and foundation for more comprehensive national freight policy and supporting programs. The expectation is that within one or two reauthorization cycles (6 to 12 years) the nation will have a freight transportation policy and one or several freight investment programs in place targeted at projects of national and regional significance. However, given the dominant role of trucking and highways in the U.S. freight transportation system, the policies will likely favor continued investment to maintain highway capacity for trucking.

**Figure 3.8
Federal Surface Transportation Acts Since 1991**



Taxation Trends

There is a broad need to increase private and public investment in the freight transportation systems to keep pace with economic growth and demand. Funding for freight transportation improvements has lagged behind demand. The Federal motor fuel tax was last increased in 1993, but because it is not indexed to inflation, motor-fuel-tax revenues have lost about one-third of their purchasing power.

Tolling and congestion pricing have helped states and regions – including the H-GAC region – manage demand on the most congested roadways and generate revenue to expand capacity, but tolling and pricing will not address the need to maintain connectivity across the full spectrum of the regional freight network. Politically unpalatable fuel tax increases and sales taxes may bridge the funding gap for a short time, but energy policies and greenhouse gas (GHG) emission regulations will reduce the long-term yield from fuel taxes.

Lawmakers are considering new revenue mechanisms such as mileage-based or vehicle-miles traveled (VMT) user fees (already a partial source of revenues from the trucking industry) along with freight-related user fees and taxes (e.g., port facility charges, conveyance fees at terminals, and value-added taxes on shipments) to fund critical national and regional freight projects. Mileage-based or VMT user fees have the potential to generate considerable revenue, but unlike today’s motor fuel taxes, which are collected from major oil distributors, VMT user fees must be collected from individual drivers. However, the cost of administering and enforcing VMT user fee programs may prove too costly, limiting their effectiveness. These mechanisms will be paired with investment tax credits and other forms of public support of private sector investment to increase and accelerate private investment in rail

In an era of constrained resources, innovative funding and financing techniques will continue to be investigated

systems and other freight infrastructure. Most of the cost will be passed along to shippers, receivers and consumers, affecting the demand for specific commodities in ways that cannot be reliably predicted.

Environmental Regulation

The U.S. Environmental Protection Agency (EPA) has moved to introduce new truck fuel-efficiency standards, and high fuel prices and consumer demand for “green” products have encouraged companies to adopt fuel savings strategies on their own. EPA’s SmartWay Transportation Partnership program and the experience of its partners in demonstrating the fuel-saving technologies and strategies that the program tests and promotes have facilitated the EPA’s development of the new standards. Wal-Mart, for example, set a goal several years ago of doubling the fuel economy of its truck fleet by 2015, and had achieved a 25 percent fleetwide improvement by 2008.⁵⁰ Given the anticipated increase in truck traffic, diesel fuel consumption, and GHG emissions, it is likely that EPA will tighten truck fuel-efficiency and GHG emission standards by 2050.

The impact of stricter truck fuel-efficiency standards on freight demand and distribution will depend somewhat on the ability of engine manufacturers to meet the standards without significantly increasing the cost of truck engines and fuels. If truck costs increase substantially, “contestable” freight, especially longer-haul freight, could shift from truck to rail or water. There will be less opportunity to shift mid-range and short-haul freight from truck to rail. If significant cost increases are persistent (lasting 3 to 5 years or more), businesses will redesign their supply chains to minimize total logistics costs, but also will pass the increased costs on to customers and consumers. Conversely, if the standards lead to technological breakthroughs and lower engine and fuel costs, then the pattern could reverse with freight shifting back from rail to truck. It is important to note, however, that the degree of mode shift is dependent on the commodity, the availability of alternative modes, service performance, and general market behavior (e.g., how carriers respond to changes in costs, and how shippers respond to changes in rates).

⁵⁰ Wal-Mart collaborated with EPA on testing and evaluation of fuel efficient technologies. Wal-Mart adopted a range of these SmartWay technologies on its trucks in order to reach that sustainability goal.

4. Key Issues and Challenges

Approximately 70 percent of drivers polled in a 2010 motor carrier survey described highway congestion as a “serious problem,” and more than 50 percent experience heavy congestion on at least half of their trips.

The growth in regional population and employment described in Section 2.0, paired with national and regional trends described in Section 3.0 will contribute to the overall impact of freight demand in the region. By 2035, regional goods movement is projected to grow by nearly 60 percent to more than 1.2 billion tons meaning that freight movements will become a larger component of the traffic mix within the H-GAC region. Continued growth in domestic and international trade will place stress on the region’s freight transportation infrastructure as well. Overall, this increase in freight will have a dramatic impact on the performance and capacity of the intermodal freight transportation system, as described in the sections below.

4.1 Growth Will Strain the Condition and Performance of the Regional Freight System

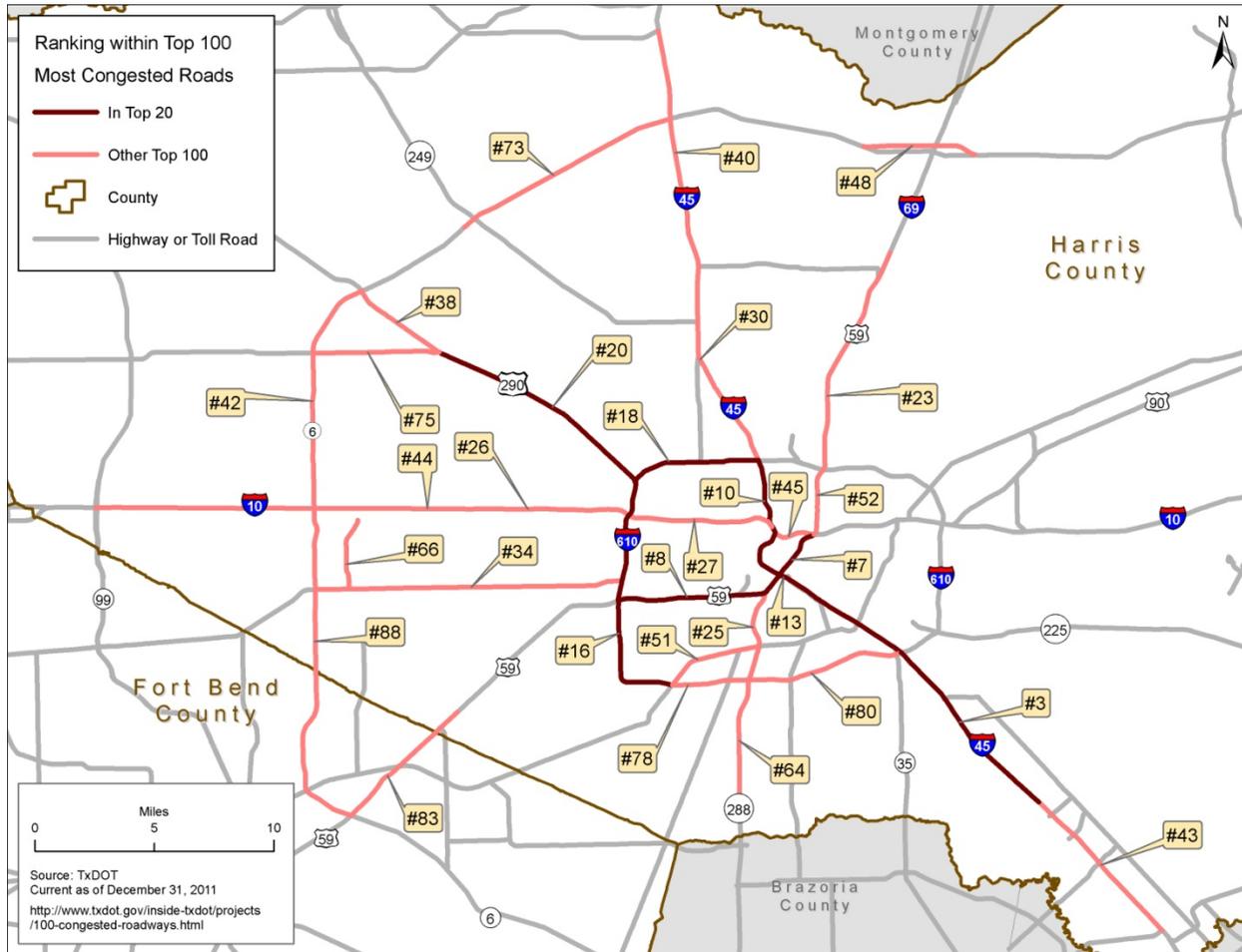
The region’s transportation system is struggling to keep up with current demand, evident in part through the numerous chokepoints and bottlenecks throughout the region. Continued growth in freight and passenger traffic will strain the condition and performance of the region’s freight system in several key areas, including highway interchanges and corridors, intermodal connectors, bridges, and the regional freight rail system.

Highway Interchanges and Corridors

The H-GAC region is home to almost one-third of the State’s 100 most congested roadways and four of the top ten, as shown in Figure 4.1.⁵¹

⁵¹ Texas Department of Transportation, *100 Most Congested Roadway Segments in Texas*, August 2012.

Figure 4.1 Most Congested Roadways in Houston



Source: Cambridge Systematics based on TxDOT data, August 2012.

Note: Numbers indicate rank on the TxDOT 100 Most Congested Roadway List.

These segments are not only important for freight shipments moving into, out of, through and within the region, but are also major commute corridors. The LOS on significant portions of key highway corridors such as I-10, I-45, I-610, and U.S. 59 is D or F, indicating volumes are approaching or exceeding capacity. And regional traffic congestion (including nonrecurring congestion caused by traffic crashes) contributed to more than 153 million hours of delay in 2010, resulting in an estimated \$3.2 billion in losses.⁵²

Of particular concern are Interstate interchanges and associated driver behavior issues. Lane drops and truck-automobile interactions that have resulted from merging and weaving are two examples of systemic

⁵² Texas Transportation Institute, *2011 Urban Mobility Report*, September 2011.

What Makes a Bottleneck?

Traffic bottlenecks are generally location-specific roadway sections that carry substantially fewer vehicles per day or operate at substantially lower speeds than other sections of the same roadway. Freeway interchanges, where both freeways carry extremely high traffic volumes, are common bottleneck locations. Factors that contribute to bottlenecks include lane reductions due to construction, traffic in-cidents, narrow passageways, freeway merge/diverge areas, and reduced speed zones.

deficiencies contributing to this congestion. Table 4.1 shows the top 10 freight interchange bottlenecks ranked by highest truck delay (based on number of trucks and the differences between posted speeds and achieved speeds). For each interchange, the peak and nonpeak average speeds are listed as well as the ratio of nonpeak to peak speeds. The I-10/U.S. 59 interchange experiences the highest truck delay compared to any other interchange studied and has the second highest nonpeak to peak ratio.

**Table 4.1
Freight Interchange Bottleneck Locations
in the H-GAC Region**

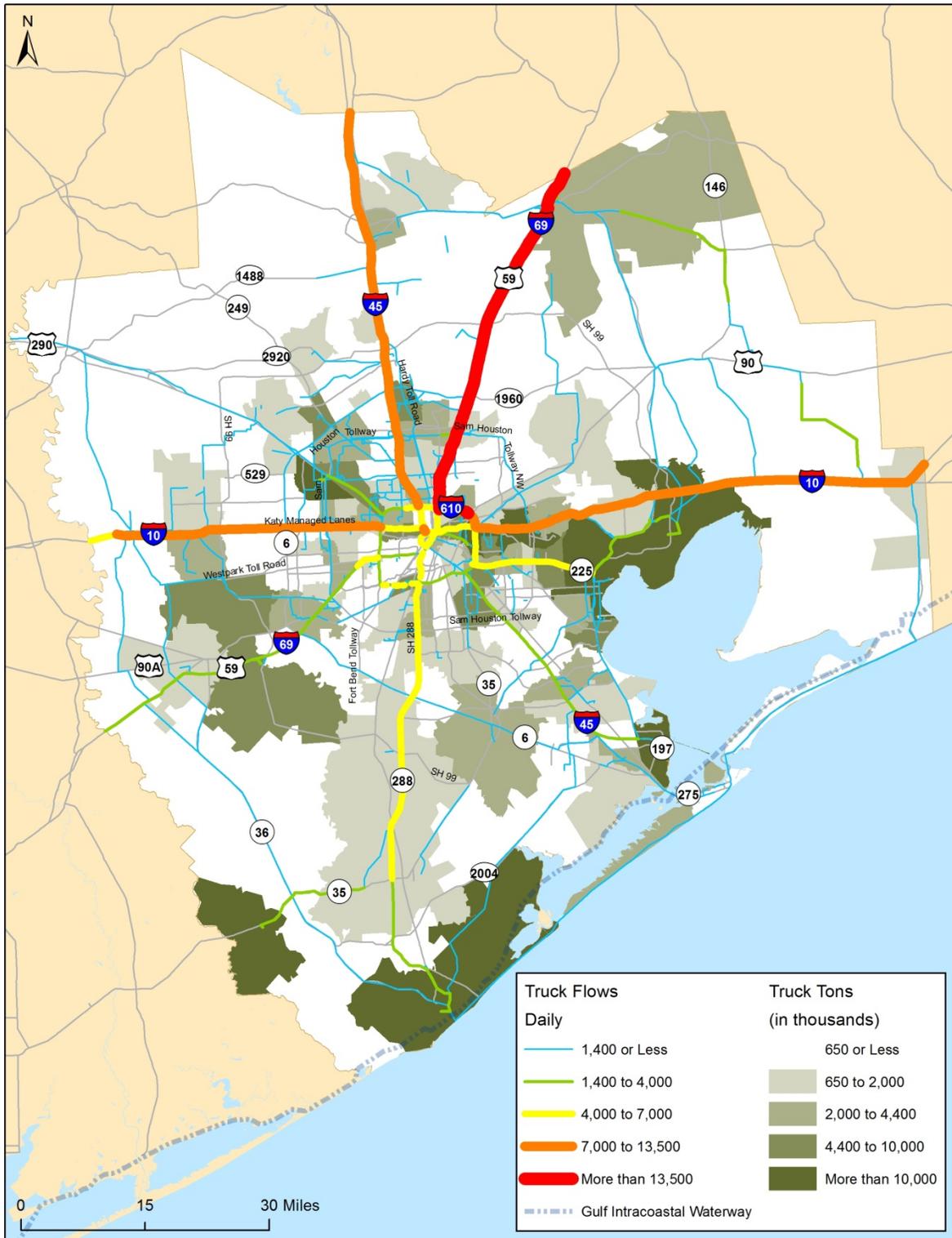
Rank	Location	Average Speed	Peak Average Speed	Nonpeak Average Speed	Nonpeak/Peak Speed Ratio
1	I-10 at U.S. 59	38.6	29.5	43.5	1.48
2	I-45 at U.S. 59	37.1	29.4	40.7	1.38
3	I-10 at I-45	39.6	29.7	44.6	1.50
4	I-45 at I-610 (N)	41.5	33.8	45.2	1.34
5	I-610 at U.S. 290	44.6	35.3	49.1	1.39
6	I-45 at I-610 (S)	49.3	41.7	53.1	1.27
7	I-10 at I-610 (E)	49.8	45.1	51.9	1.15
8	I-610 at U.S. 59 (W)	43.8	38.3	46.0	1.20
9	I-10 at I-610 (W)	50.4	43.6	53.2	1.22
10	I-45 at Sam Houston (N)	51.1	44.4	54.2	1.22

Source: ATRI.

Note: The top 10 bottlenecks emerged from a list of the region’s 18 highest volume interchanges based on the ratio of nonpeak average speed to peak average speed combined with the volume of trucks at each interchange. The higher the ratio, the greater the difference in average speeds during peak and nonpeak periods and the higher the level of congestion.

Some of these corridors, such as I-10 and I-45, already see more than 15,500 trucks per day and are anticipated to handle even greater volumes by 2035, as shown in Figure 4.2. If left unaddressed, the anticipated increase in truck traffic, coupled with continued growth in population and resulting passenger demand, will further exacerbate the chokepoints at these Interstate interchanges and corridors.

Figure 4.2 Growth in Average Annual Daily Truck Traffic All Commodities, 2007-2035



Source: Cambridge Systematics, Inc., based on IHS Global Insight TRANSEARCH data.

Intermodal Connectors

In addition to major interchanges and highway corridors, many of the region's intermodal connectors have existing condition and performance issues that will be exacerbated by projected increases in freight volumes. Intermodal connectors provide critical connections between high-volume highway facilities and port terminals, rail yards, or other freight generators, yet many of the region's existing intermodal connectors are local thoroughfares or city streets that were not designed to handle significant volumes of freight traffic. As such, several connectors in the H-GAC region suffer from:

- Geometric design deficiencies (e.g., limited turning radii, lack of shoulders, and inadequate ramp length);
- Inadequate truck capacity (e.g., limited turn lane storage length);
- Poor pavement quality;
- Safety issues (e.g., poor lighting, roadside hazards);
- Inefficient access control (driveway density);
- Poor drainage; and
- Limited driver wayfinding, such as directional signage, which is often necessary to help drivers navigate to designated truck routes and locate key facilities.⁵³

Although these conditions occur in locations throughout the region, they are most pronounced in and around the region's ports, along the Ship Channel, and at major freight rail yards and intermodal facilities, as listed in Table 4.2.⁵⁴

⁵³ H-GAC Regional Goods Movement Study, *Intermodal Connectors Inventory and Assessment*, September 2011.

⁵⁴ A full list of the priority and non-priority intermodal connectors is provided in Appendix A.

Table 4.2 Priority Intermodal Connectors and Freight Impacted Roads

Connector Name	Description	Primary Facility Served
Industrial Boulevard	Industrial Boulevard between Federal and the Terminal	Houston Ship Channel Port Terminals and Truck/Rail Facility
Jacintoport Boulevard	Jacintoport Boulevard between Beltway 8 to Terminal	Houston Ship Channel Port Terminal
John F Kennedy Boulevard	Served by an Existing NHS Route/Will Clayton Parkway and JFK	George Bush Intercontinental Airport
Kirkpatrick Boulevard	Kirkpatrick Boulevard between the Terminal and I-610	UP Settegast Rail Yard
Lockwood Drive	Lockwood between I-10 and Wallisville (0.875 miles); Wallisville between Lockwood and the Terminal (0.15 miles)	Englewood Intermodal Facility
Old Port Industrial Boulevard (Galveston)	Old Port Industrial Boulevard (Harborside Drive to 28 th Street)	Galveston Port Terminals
Penn City Road	Penn City Road (I-10 FR to 3100 Block)	Houston Ship Channel Port Terminal
Pine Street (Freeport)	FM 1495 between SH 288 Northerly to the Terminal on Pine Street	Port Freeport
Port Road	Port Road between SH 146 and the Terminal	Bayport Container Terminal
South Sheldon Road	South Sheldon Road between I-10 and the Terminal	Jacintoport Cluster, Truck/Pipeline Terminal
Wallisville Road	Lockwood between I-10 and Wallisville (0.875 miles); Wallisville between Lockwood and the Terminal (0.15 miles)	Englewood Intermodal Facility
Will Clayton Parkway	Served by an Existing NHS Route/Will Clayton Parkway and JFK (from U.S. 59 to JFK Boulevard)	George Bush Intercontinental Airport
Hardy Road	Hardy Road to East Louetta (from East Louetta to Cypresswood)	Westfield Freight Rail Facility
Barbours Cut Boulevard	Barbours Cut Boulevard between SH 146 and the Terminal	Barbours Cut Container Terminal
U.S. 59 (Kendleton)	Gin to Darst Road to U.S. 59	Kansas City Southern Railway Company Intermodal Facility
Airport Boulevard	Airport Boulevard from I-45 to Telephone Road	William P. Hobby Airport
SH 288 (Lake Jackson)	Nolan Ryan Expressway from BASF Chemicals to FM 1495 (288 South) (Freeport)	Brazosport Turning Basin, Freeport Port Terminal
Clinton Drive	Clinton Drive to I-610 (I-610 to Federal Road)	Houston Ship Channel Port Terminals
Battleground/Independence Parkway	Battleground Road/Independence Parkway (SH 225 to Lynchburg Ferry)	Lynchburg Ferry, Houston Ship Channel Port Terminals

Source: Cambridge Systematics.

Because intermodal connectors provide the critical link between intermodal facilities and the strategic freight system, reliability issues and delays on these connectors can have impacts that reverberate

regionally, nationally, and even internationally. Focusing investments on these types of bottlenecks often leads to significant improvements to freight mobility and reductions in community impacts at relatively low costs. Additionally, improving throughput on these facilities also can lead to reduced pressure on other local and regional roadways. Some examples of the benefits that result from intermodal connector improvements are described below.

THE BENEFITS OF INTERMODAL CONNECTOR IMPROVEMENTS

Kedzie Avenue Access Road, Chicago, Illinois – To improve access from I-55 to the BNSF Corwith Intermodal Rail Yard, the Chicago DOT implemented a \$4.7 million improvement project along a 1.5-mile segment of Kedzie Avenue. Improvements included road widening and reconstruction, modern-ization and synchronization of traffic signals, substandard pavement replacement, and improved lighting and drainage. This project reduced long truck lines into and out of the terminal, improved access to the rail yard, reduced a bottleneck for residential traffic, and improved air quality.¹

Tchoupitoulas Corridor, Port of New Orleans, Louisiana – To remove trucks coming into the port from the local neighborhood, the Port of New Orleans led the construction of a new port access road exclusively for port truck traffic. At the same time, the New Orleans Department of Public Works oversaw the rehabilitation of Tchoupitoulas Street, a major city thoroughfare, which included widening from 2 to 3 lanes and accompanying sewer, drainage, and flood wall improvements to provide security and protection for the port. The actual capital costs of the combined project were \$60.4 million; however, the benefits quantified over a 25-year timeframe are estimated at \$15.9 million in truck travel time savings, \$99.3 million in truck operating cost savings, \$21.0 million from increased freight inventory/reliability, \$1.6 million in accident savings, \$0.6 million in emissions savings, and \$6.4 million in noise savings.²

¹NCHRP Report 497, *Financing and Improving Land Access to U.S. Intermodal Cargo Hubs*, 2003.

²NCFRP Report 12, *Framework and Tools for Estimating Benefits of Specific Freight Network Investments*, 2011

Bridges

FHWA's National Bridge Inventory documents the conditions of bridges on all public roads, regardless of ownership. Bridges are rated as either "not deficient," "functionally obsolete," or "structurally deficient." A bridge rated "functionally obsolete" or "structurally deficient" is not necessarily unsafe. Rather, it typically has an older design that lacks modern safety features such as adequate shoulder space, an appropriate railing system, or other features.⁵⁵ Figure 4.3 displays each of the functionally obsolete and structurally deficient bridges in the H-GAC region. While there are a significant number of functionally obsolete and structurally deficient bridges in the region, these represent a relatively small percentage of total regional bridges.

While many of these bridges are not currently impeding freight flows, if left unaddressed, they could give rise to bottlenecks as they become unsafe or impassable for trucks. In addition, the limited safety features of these bridges – particularly the lack of appropriate shoulders – could have implications for both truck and auto safety as volumes continue to grow. This is particularly true in Harris County, the largest county in the region, which currently handles more than three-quarters of all freight tonnage in the region.⁵⁶

PELICAN ISLAND CONTAINER TERMINAL

In May 2007, the Ports of Houston and Galveston signed a Memorandum of Understanding (MOU) for the ports to construct a container terminal on Pelican Island

with the understanding that financing and development would not begin until the Bayport Container Terminal is fully built out in 2015. A total of 1,200 acres are held by the ports (1,100 acres by the Port of Houston and 100 acres by the Port of Galveston). The new container terminal would provide additional capacity to accommodate the expected growth in container traffic in the H-GAC region.

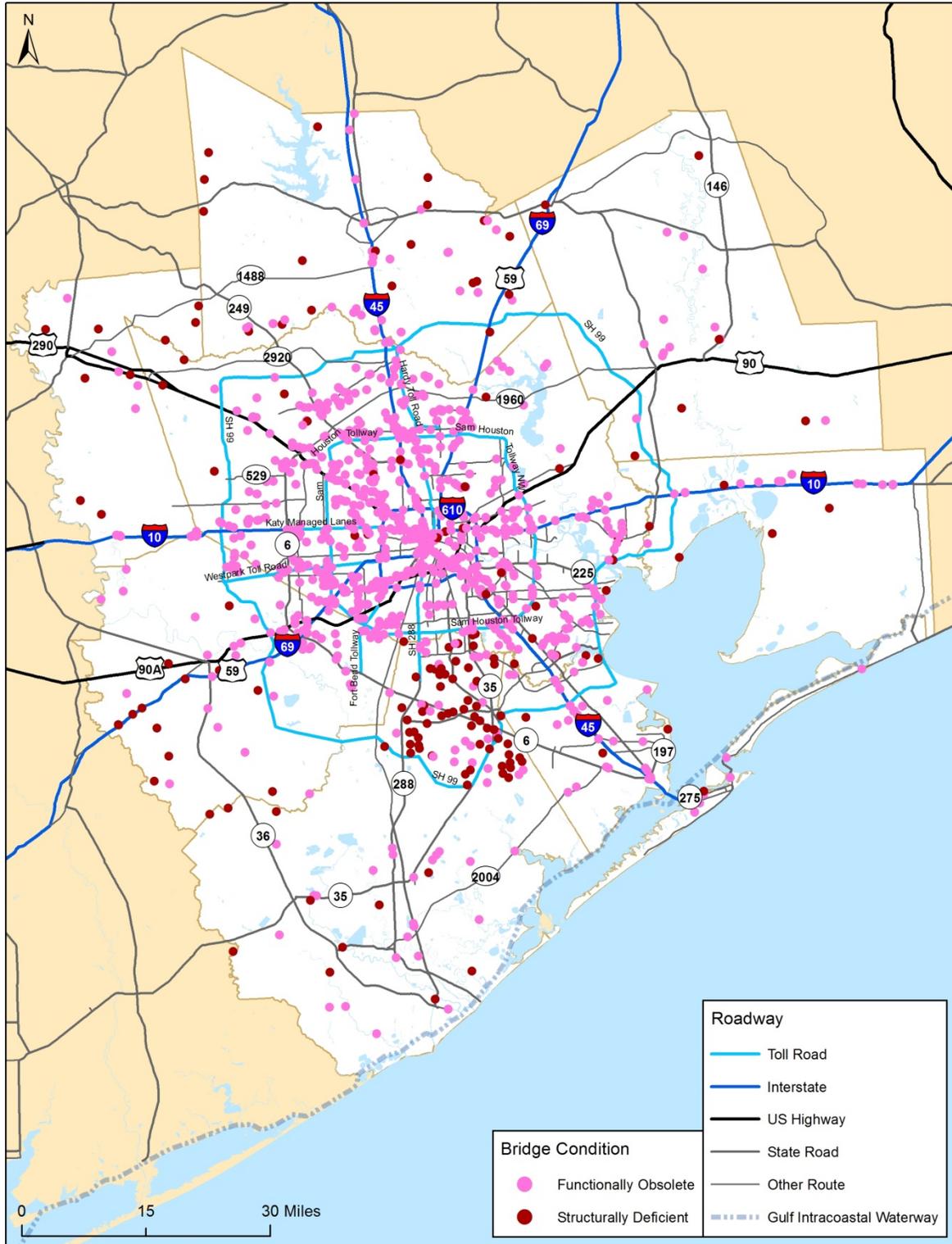
However, a new bridge may be needed to efficiently connect Pelican Island to the rest of the H-GAC freight transportation system. The existing causeway connecting Pelican Island to Galveston was built in 1957 and is currently rated as structurally deficient due to a substandard load carrying capacity and narrow width. The existing bridge also causes traffic delays when its drawbridge is open to allow vessels to pass underneath. The proposed bridge would double the width of the current 22-foot wide structure and provide an arc with 150-foot vessel clearance to prevent traffic interruptions on the bridge.¹

¹ <http://www.houstonchronicle.com/news/houston-texas/houston/article/Proposed-bridge-could-boost-island-economy-4181107.php>

⁵⁵ http://www.fhwa.dot.gov/policyinformation/pubs/pl10023/fig7_3.cfm.

⁵⁶ *H-GAC Regional Goods Movement Plan, Commodity Flow Analysis*, February 2011.

Figure 4.3 Functionally Obsolete and Structurally Deficient Bridges in the H-GAC Region



Source: FHWA National Bridge Inventory.



Rail System Capacity Constraints

Congestion on the region's rail system already results in 300 daily train hours of delay, which leads to increased cost and shipping times for regional shippers.⁵⁷ Recognizing the importance of freight rail to the regional economy, the Texas Department of Transportation (TxDOT) recently completed a comprehensive Houston Region Freight Study (HRFS) which revealed that the region's rail capacity bottlenecks include single track mainlines and bridges, inadequate siding lengths and rail yards at or nearing capacity. The HRFS, coupled with more recent interviews with the Gulf Coast Rail District and representatives from the region's Class I railroads, describes the top rail network deficiencies and bottlenecks in the region as:

- **Single track bridges and lines**, particularly over the Buffalo Bayou (Bridge 16 on the East Belt Junction and Bridge 5A), along the West Belt Subdivision north from Freight Junction through Belt Junction, between Galena Junction and Manchester Junction, between Sinco Junction and Deer Park Junction, and east from Dawes to Sheldon.
- **Capacity constraints at rail yards inside I-610.** The concentration of the region's rail yards, and the related concentration of traffic in a district whose infrastructure was designed many decades earlier, are conditions that create congestion and delay. Delays result from repetitive switching by yard engines competing for track space with local and road trains, and the capacity consumed by the length of contemporary trains (more than a mile in many cases) and the time it takes to stage them.
- **Numerous at-grade crossings.** There are an estimated 1,200 at-grade rail crossings in the H-GAC region, with a daily road volume approaching 5 million cars and trucks.⁵⁸ Of particular concern are the at-grade crossings in the industrial and port districts of east Houston and along the West Belt Subdivision, which cause significant delays for truckers due to crossing queues that occur almost daily.
- **Siding capacity.** Many of the sidings and spurs serving major industrial customers are too short to accommodate today's longer trains. This results in excessive switching times and delay waiting for oncoming trains to pass, both of which constrain network capacity. In addition, it can lead to longer delays for roadway users and increased safety and air quality impacts due to increased blockage of at-grade crossings. The railroads and shippers (such as the petrochemical firms) combined store upwards of 20,000 rail cars at any given time. The storage of these cars consumes valuable real estate and trackage, yet it is necessary to meet the market demand of key industries.

Failure to invest in additional capacity, including yard and storage capacity, will result in increased inefficiencies and shipper costs as well

⁵⁷ Texas Department of Transportation, *Houston Region Freight Study*, 2007.

⁵⁸ Ibid.

as diversion to truck, all of which will decrease the economic competitiveness of the region. Failure to address these capacity challenges could also hinder the ability of the region to invest in passenger service along some or all of these corridors.

4.2 Managing Existing Capacity and Adding New Capacity to the System Is Difficult

The H-GAC region understands the importance of investing in the regional trade and transportation system, and stakeholders in the region have recently undertaken or will soon undertake a number of important investments, including:

- **Bayport Container Terminal**, which has been underway since 2007. In 2011, the Port Commission approved nearly \$35 million in contracts for Bayport improvements.
- **Wallisville Road** – The City of Houston recently completed preliminary engineering for the reconstruction of a three-mile segment of Wallisville Road from Lockwood Street to I-610, an intermodal connector serving the Englewood Intermodal Facility. Construction is scheduled to begin in 2014.
- **Sheldon Road** – Harris County recently completed construction to increase left turn capacity at the Jacintoport/Sheldon intersection, 2 intermodal connectors serving the Port of Houston. To help fund the necessary reconstruction of Sheldon Road, the County recently applied for a grant through H-GAC's 2013-2016 Transportation Improvement Program (TIP) call for projects.
- **Clinton Drive** – The City of Houston and Harris County recently completed a repaving project on Clinton Drive, an intermodal connector serving the Houston Ship Channel, from I-610 to Federal Road. Additional improvements, jointly sponsored by the City of Houston, Travis County, and TxDOT and estimated to cost \$18.1 million, are currently under design.
- **West Belt Subdivision** – The Gulf Coast Rail District recently completed a feasibility study that examined options for development of a series of grade separations and road closures between the Terminal and Glidden Subdivisions.⁵⁹

But while these and other planned freight improvement projects would increase the overall capacity and efficiency of the system, there are a number of policy and institutional issues, i.e., key social, financial, legal and environmental matters, that combine to limit the ability of the region to add or enhance the transportation system capacity in a meaningful way. These are described in the following sections.

⁵⁹ Gulf Coast Rail District, *HB&T West Belt Improvements Study*, January 2012.

Regulatory Bottlenecks are Impacting System Operations

Overall the trucking community reports good operating conditions on the region's major highway facilities and for the most part, they are able to provide service to their customers effectively. However, some constraints are beginning to negatively impact system operations. These include:

- **Overdimensional load operations.** Movement of overdimensional loads (overheight, overweight, or overbreadth), such as large pieces of equipment and materials, is critical for the region's petrochemical and other industries. However, as the region's roadway system has evolved, many of the corridors traditionally used for these shipments have been lost due to obstructions like overpasses. These and other issues have reduced the overall capacity in the region to handle these cargoes.
- **Overweight load operations and permitting.** A related, but separate, issue is the operation of overweight trucks in the region. There currently is no state-designed truck heavy-haul routes around the Port of Houston. These heavy haul routes allow operation of overweight shipments (more than 80,000 pounds gross) without a permit and already existing in several locations in Texas (Brownsville, Chambers County, Corpus Christi, and Freeport). Overweight shipments can be transported outside of these corridors, but require a state-issued permit if hauled on the state system. Cities and counties also may have a permitting process, but there is no coordination between the State and localities. Counties do not have the legal authority to designate truck routes, but cities do through their ordinance-making authority. This web of regulations can make it difficult for truckers handling overdimensional loads to identify preferred routes and can hinder overall traffic management and enforcement activities in the region. As the region's petrochemical and heavy manufacturing industry base continues to grow, these operational issues could be exacerbated in key parts of the region.
- **Local ordinances,** which place specific conditions on commercial vehicle operations. In most cases, these ordinances are politically driven and address specific concerns of a single community or jurisdiction. Examples include regulations to protect the community by restricting the presence of commercial vehicle parking or movements that address such things as safety, security and community livability. However, some of these local ordinances can have unintended consequences that may outweigh the benefits. For example, League City prohibits commercial vehicles carrying hazardous substances from parking on "any highway, road, street or alley within the city, except in an emergency which occurs while making a lawful delivery."⁶⁰ However, these restrictions could hinder the ability of some drivers to comply with Federal hours-of-service (HOS) regulations, which limit when and how long commercial motor vehicle drivers may drive. Current HOS regulations state that truck drivers have an 11-hour daily driving

Fort Bend County bridge restrictions are restrictive to some cargoes. Operators wishing to carry loads over 50,000 pounds across county bridges must write a letter of intent to the County, include a map with route designations, and provide a bond for County approval.

⁶⁰ League City Code 1968, §8-53; Ord. No. 90-82, §1, 1-10-1991; Ord. No. 95-96, §2, 7-25-1995.

limit and 70-hour work week limit. In addition, truck drivers cannot drive after working 8 hours without first taking a break of at least 30 minutes. Ordinances that limit the number of acceptable rest locations in the region could potentially delay some types of shipments, introducing inefficiencies to the system.

- **Limited freight traveler information.** Traveler information in the region is provided by Houston TranStar, a consortium of TxDOT, Harris County, Metropolitan Transit Authority of Harris County (METRO), and the City of Houston to provide transportation and emergency management services to the region. Although TranStar uses a wide range of technologies and operational strategies to inform travelers about expected travel times and anticipated response time to incidents, not all of that information is useful to freight stakeholders, which are increasingly interested not only in travel time information, but also route guidance and drayage optimization. Providing more specialized freight operations information, such as truck rest stop area locations and parking availability, truck-specific zones and route restrictions, oversize/overweight restrictions, and dynamic route guidance, can help regional stakeholders coordinate movements between freight facilities to maximize loaded moves and minimize unproductive moves, improving overall freight mobility.

There Is Insufficient Funding to Address System Chokepoints

Another key institutional issue is the availability of funding resources with which to make system improvements. TxDOT, H-GAC's member governments, and other entities in the region already commit a large portion of their budget to the maintenance and preservation of the regional transportation system, and (as described earlier) many have been investing significantly in a variety of freight infrastructure projects that have local, regional, and national benefits. In 2011, the TxDOT Houston District spent approximately 29 percent (\$249 million) on maintenance expenditures, as compared to 71 percent (\$856 million) on construction.⁶¹ Expenditures by county in the H-GAC region are shown in Figure 4.4.

In the future, however, the total amount of funding available to address critical transportation needs will be significantly less than what is needed. The region's vehicle fleet, in aggregate, is becoming more fuel efficient and these efficiency gains are outpacing growth in vehicle-miles traveled on the system. Improvements in fuel efficiency will continue to decrease overall gas tax revenues, particularly at the Federal level; and there is little appetite among many state and national transportation decision-makers in modifying existing gasoline or diesel tax rates. All of this is exacerbated by the fact that Texas is a "donor" state – paying more in Federal gas tax than it receives back in Federal transportation aid – leaving less for the region to invest in the system.

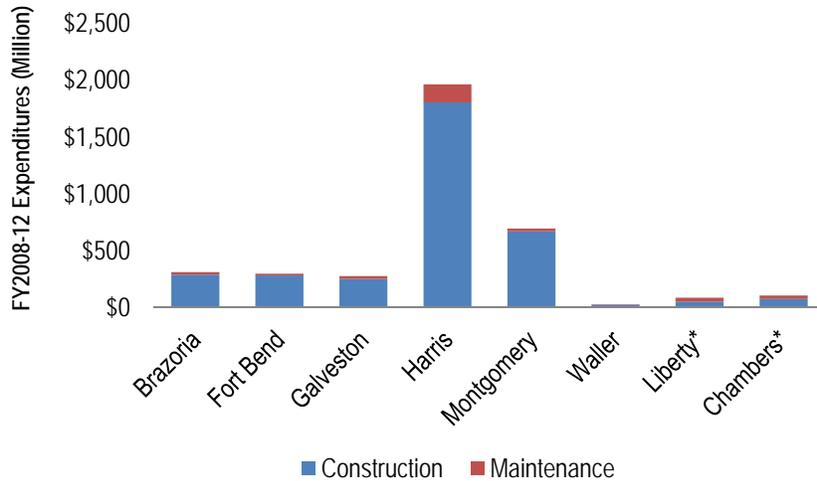
"TxDOT needs an additional \$1 billion per year to keep up with maintenance on 80,000 miles of roads in the State.

TxDOT also noted that it is likely to need an additional \$3 billion a year to deal with growing congestion on interstates and other roads."

*Austin American Statesman
January 11, 2013*

⁶¹ Texas Department of Transportation, "District and County Statistics (DISCOS)," FY2008 - 2011.

**Figure 4.4
TxDOT Expenditures in H-GAC Counties
FY 2008-2012**



Source: TxDOT DISCOS.

Note: Liberty and Chambers Counties are located in the Beaumont District. All other counties are located in the Houston District.

Policy and Investment Decisions are Not Made at the System Level

The H-GAC region's trade and transportation system is highly interconnected. International and domestic freight shipments in the region often involve more than one mode, travel through several jurisdictions in the region and serve far-flung national and international markets. However, operations, management, and investment decisions affecting this system are often made by a wide variety of agencies and entities at the state and local levels (for highways and intermodal connectors), at the facility level (for ports and airports), or at the national corridor level (for railroads).

Although investments within the region are effectively coordinated through H-GAC and its member governments, there are many instances where policy, infrastructure, or operations decisions in one jurisdiction (or mode) would impact key bottlenecks in another. No effective institutional arrangement exists to discuss or coordinate these system-level decisions that cross jurisdictional or modal boundaries outside the region, although senior officials have recently begun meeting regularly to address this need. Although H-GAC is making strides in fully integrating freight issues within its comprehensive planning processes, through the completion of this plan and the ongoing development of a regional truck travel demand model, it will be critical for the agency to continue to coordinate its state, regional, and local partners in addressing freight needs at a regional, systemwide level.

No effective institutional arrangement exists to discuss or coordinate system-level decisions that cross jurisdictional or modal boundaries outside the region.

4.3 There Are Community and Environmental Issues That Will Impact Freight Investments

As discussed above, the growth in international and domestic trade and the corresponding increase of inland highway freight and rail traffic will exacerbate congestion at key Interstate interchanges and corridors and along important intermodal connectors in the region. Though system capacity expansion is a logical solution to manage the increases in freight volumes expected over the next several decades, there are a number of ecological, historical, or cultural issues that will influence the locations, timelines, and costs of potential investments.

Air Quality

The H-GAC region has localized air emission concentrations that contain pollutants of significant concern to public health, including: nitrogen oxides (NO_x), particulate matter (PM_{2.5} and PM₁₀), carbon dioxide (CO₂), and volatile organic compounds (VOCs). Trucks contribute a considerable share of pollutants to the regional atmosphere and emit 72 percent of the region's transportation-related NO_x, 68 percent of the transportation-related PM_{2.5}, 53 percent of the region's transportation-related CO₂, and 37 percent of the region's VOCs.

These pollutants also lead to excess ground-level ozone. Ozone (O₃) is formed when emissions of NO_x chemically react with VOCs under conditions of heat and light (i.e., sunshine). The region has been designated as a severe nonattainment area in terms of the 8-hour ozone National Ambient Air Quality Standard (NAAQS) standard, and is facing a Federal attainment date of June 15, 2019.⁶²

H-GAC, in coordination with its state and Federal partners, has developed a diverse range of strategies to reduce emissions and improve regional air quality. Strategies include education and outreach strategies, encouraging alternative commuting methods, and replacing and retrofitting older vehicles and equipment with cleaner vehicles. Specifically targeting the freight industry, H-GAC has initiated a Drayage Loan Program that provides low-interest loans to independent owner operators and trucking companies servicing the ports in the region to finance the purchase of newer, more environmentally friendly trucks. H-GAC was awarded \$9 million from the U.S. Environmental Protection Agency (EPA) to establish the program.

The region is in air quality “non-attainment” for a number of pollutants. Growth in freight traffic could exacerbate these issues.

⁶² Texas Commission on Environmental Quality. “Houston-Galveston-Brazoria: Current Attainment Status,” <http://www.tceq.texas.gov/implementation/air/sip/texas-sip/hgb/sip-hgb/>.



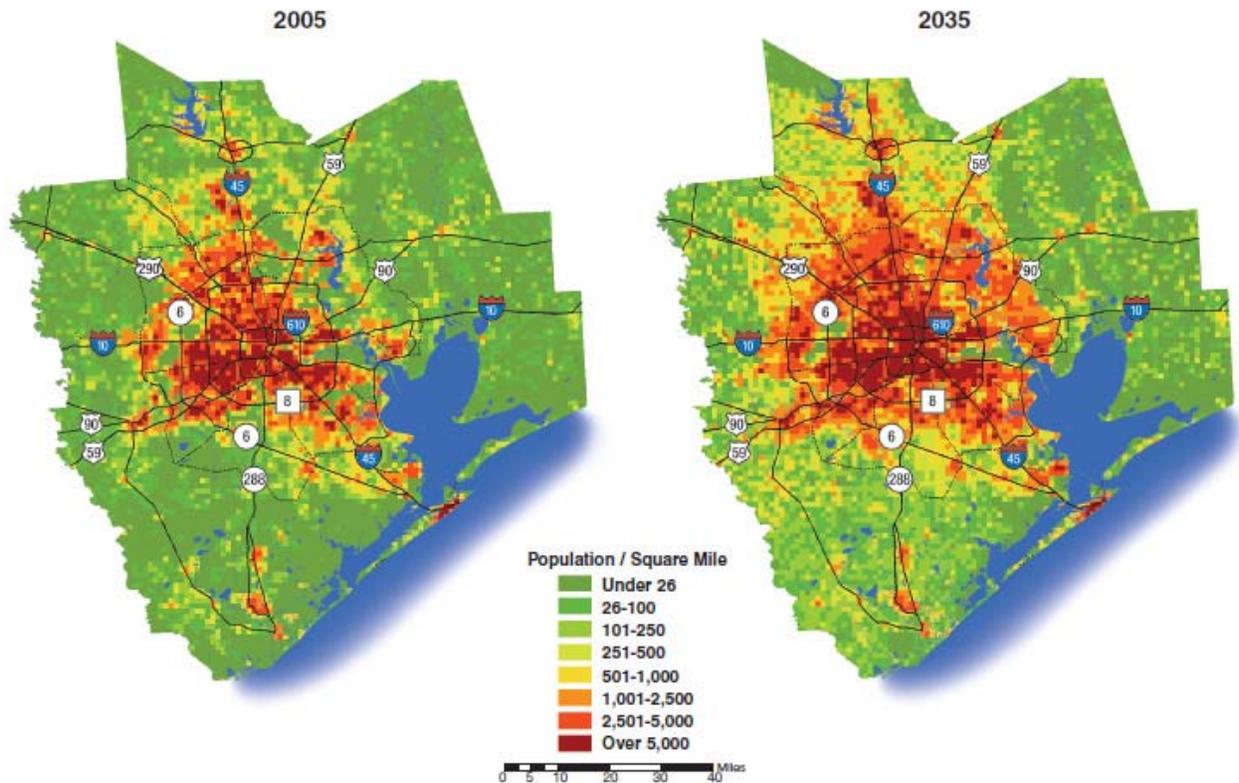
The region's air quality designation will also impact its ability to make freight system investments. There are always a variety of state, Federal, and local agencies involved in the planning and approval of freight systems improvements and in an area in air quality nonattainment, like the H-GAC region, these approvals are even more intense. Interlocking requirements for coordination among Federal, state, and local agencies, along with permit and environmental approvals, can significantly expand the time required to plan and implement projects, often driving up the cost of a project significantly. Although these reviews and approvals serve an essential function, the costs of the reviews themselves, in dollars, time to complete, and uncertainty, are substantial.

Regional Growth Patterns

As described in Section 2.0, the H-GAC region has a robust freight network of highways, railroads, airports, seaports, pipelines, and freight terminals. However, the system is organized such that freight traffic tends to be funneled into and then out of the urban core, which currently experiences heavy congestion with many segments of the freeway system operating at or above capacity.

The parts of the region experiencing the fastest growth tend to be in the outlying areas to the north, west, and southwest of the region's core (see Figure 4.5). These growth patterns have significant implications on the demand for and distribution of freight shipments. As population density increases outside the urban core, so will the demand for retail goods and services. This translates into increased demand for warehousing and distribution facilities, and an increase in truck traffic to serve growing populations and businesses. All of this means that communities in the high-growth suburban counties that currently experience little freight activity and truck traffic will see significant increases over the next 20 years.

Figure 4.5
Population Density 2005-2035



Source: H-GAC 2035 Regional Growth Forecast.

Houston is one of the largest U.S. cities without a comprehensive zoning ordinance and Pasadena and Baytown also do not have zoning.

As a result, deed restrictions written by developers and homeowners' associations play an important role in how the region is developed.

Jack Poe Company, Inc.

Land Use Patterns

Industrial and residential land uses are not traditionally thought of as “good neighbors.” In addition to congestion and air quality concerns, residents living near freight facilities tend to be impacted by light pollution, noise and excessive vibration. The region has several pockets of development that give rise to these conflicts, including the east Houston area (including the City of Baytown where demand for industrial land continues to expand); along the Gulf Intracoastal Waterway, where there is intense competition for waterfront property from commercial, industrial, and residential users; and in north Houston suburbs, where there is demand for expanding warehousing and distribution facilities surrounding the IAH air cargo facilities.

As the region continues to grow and develop – particularly outside the urban core – these commercial and residential land use conflicts will become more prevalent (see Figure 4.6). This is particularly true between U.S. 290 and I-45 in Harris and Montgomery Counties and between U.S. 90 and I-10 in Fort Bend County. If the H-GAC region follows the pattern of other U.S. metropolitan areas, it will see a steady migration of major distribution centers outward in search of lower-priced land in the suburbs and exurban areas and increased truck traffic and



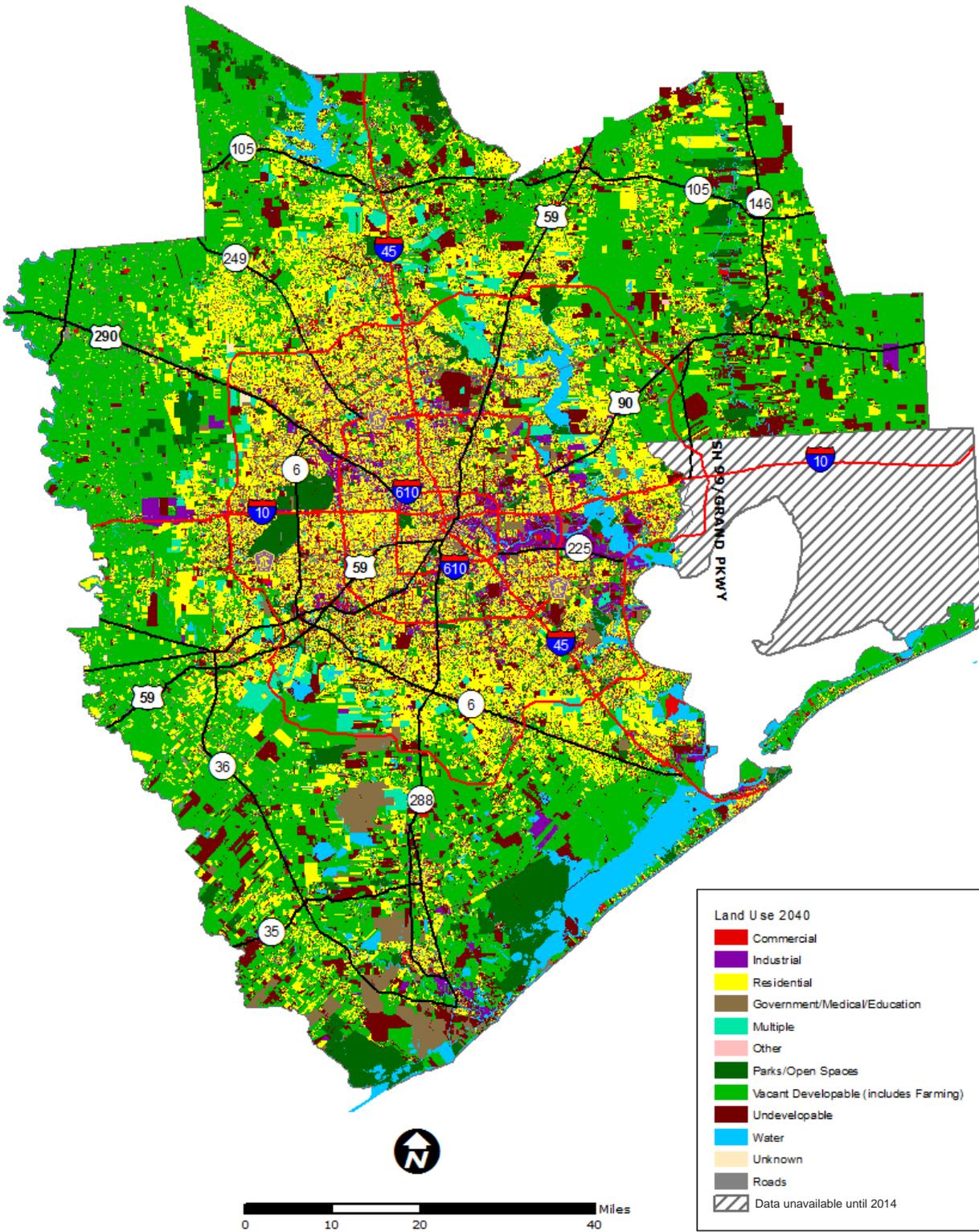
congestion as trucks move back and forth between suburban distribution centers and urban and inner-suburban markets. This will increase truck-miles of travel, energy consumption, GHG emissions, pavement and bridge wear-and-tear, and the risk of truck-involved crashes.

These development patterns pose two important questions for the region. First, how can potential environmental and livability issues (e.g., emissions, noise pollution, light pollution, safety) be mitigated in these areas while still ensuring passenger and freight mobility? And second, what types of intermodal infrastructure investments might be necessary to ensure that these regions are effectively connected to mainline trade and commute corridors in the region to help ensure the continued efficiency of the overall system?

Environmental Justice

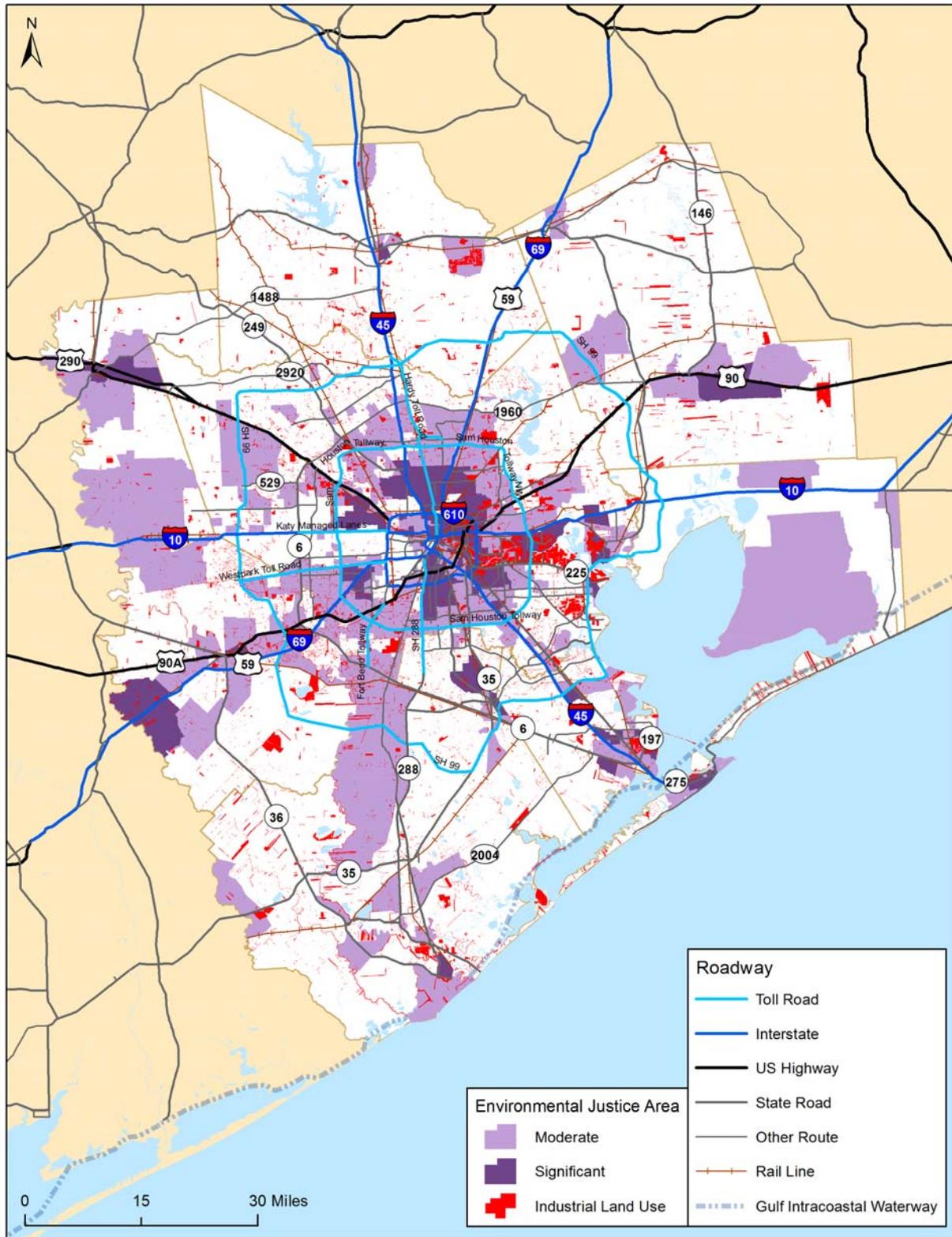
Environmental justice (EJ) areas in the H-GAC region are extensive, as shown in Figure 4.7, and several of them surround primary freight corridors like SH 288 and the outer reaches of U.S. 59, U.S. 90, and U.S. 290. Additionally, many of the significant areas coincide with important industrial zones, particularly for the petrochemical and port cluster to the east, and the consumer product distribution and other manufacturing activity focused in Harris County. As freight volumes in and around these areas grow, it will be challenging to develop and implement infrastructure, operational, and policy-related solutions that balance freight mobility needs and EJ concerns.

Figure 4.6 H-GAC Region Projected Land Use, 2040



Source: H-GAC.

Figure 4.7 Industrial Land Uses in the H-GAC Region with EJ Areas of Concern



Source: H-GAC.

Climate Change

Rising temperatures and sea levels, changing precipitation patterns (flooding or drought) and increasing storm intensities and frequencies that are likely to result from climate change present clear risks to much of the transportation infrastructure in the H-GAC region and could have very serious impacts on the Gulf of Mexico region as a whole. A study for the U.S. DOT and the U.S. Geological Survey estimated that 70 percent of the ports, 50 percent of the highway miles, and most major rail lines in the region from Freeport, Texas to Mobile, Alabama would be at risk if there were a 2- to 4-foot rise in sea level. A storm surge of 18 feet, similar to what was experienced in areas east of New Orleans during Hurricane Katrina in 2005, would affect 98 percent of the ports, 51 percent of the highway miles, and all the major rail lines in the central Gulf Coast region.⁶³ Planning for and adapting to climate change to mitigate the impacts on the movement of people and goods presents a real challenge for the H-GAC region to protect the resilience of the system.

4.4 Summary

The H-GAC region has a robust, interconnected multimodal freight network of regional, national, and international significance – moving more than 930 million tons of freight in 2007 with a combined value of approximately \$1.6 trillion. Yet the existing system is struggling to keep up with current demand, and forecasted growth will continue to strain the condition and performance of the regional freight system. At the same time, the region faces several challenges, such as overcoming regulatory bottlenecks, addressing system chokepoints with insufficient funding, coordinating system-level investment decisions across numerous planning partners and minimizing environmental and community impacts, that makes managing existing capacity and adding new capacity to the system difficult.

As the regional coordinating body through which local governments consider issues and cooperate in solving areawide problems, H-GAC is positioned to coordinate its state, regional, and local partners in addressing freight needs at a regional, systemwide level. Section 5.0 presents a list of project solutions and policy recommendations for H-GAC to consider to address these issues and challenges.

⁶³ U.S. Department of Transportation and the U.S. Geological Survey, *Potential Impacts of Climate Variability and Change on Transportation Systems and Infrastructure – Gulf Coast Study*, prepared by Cambridge Systematics, Inc., March 2008.

5. Solutions and Recommendations

The vision for the goods movement system in the H-GAC region is to be a connected, multimodal, world-class system that enhances the region's economic vitality while supporting the mobility and livability needs of its citizens. Presently, the system handles more than 465 million tons by truck, 152 million tons by rail, 312 million tons by water, 400,000 tons by air and 445 million tons by pipeline each year. However, existing chokepoints and bottlenecks throughout the region (described in Section 4.0) are symptoms of both short-term and long-term system deficiencies that, if left unaddressed, will hinder the ability of the region to attract and retain industries and absorb anticipated freight growth.

The objective of the H-GAC Regional Goods Movement Plan is to help the region realize its vision by identifying improvements and strategies that:

- Enhance the mobility, reliability and safety of the region's freight-significant corridors and facilities;
- Provide access to new growth areas;
- Promote multimodal goods movement;
- Enhance the region's economic competitiveness; and
- Mitigate community impacts related to congestion, safety, the environment and quality of life.

With these objectives in mind, this section presents project solutions and policy recommendations that are designed to address both short-term and long-term physical, operational, and institutional deficiencies. The short-term program includes recommendations to correct some existing deficiencies in the existing freight network that can be integrated into H-GAC's TIP and other planning documents for action over the next several years. The longer-term actions are those that will help the region position itself for sustained economic growth while ensuring that policies are in place to help H-GAC and its partners proactively identify and address freight issues in the coming decades.

5.1 Short-Term Program

Short-term actions, described in the following sections, include projects and policies targeted for implementation within the next five years.



Formally Define and Designate the Freight-Significant Network

Focusing investments on the most critical elements of the freight system will help maximize regional benefits; however, a critical first step is to formally designate the collection of highway corridors, intermodal facilities, and intermodal connectors in the region are deemed “freight-significant.” This official designation of a Freight Significant Network will have two important benefits. First, it will allow H-GAC to focus investments and system performance evaluations on the most critical portions of the regional freight system. Second, it will help H-GAC member governments better understand which portions of their systems are most critical to regional freight mobility and economic competitiveness and encourage them identify, propose, and implement freight-specific improvement projects where they might not have in the past.

Section 2.0 presented the freight-significant roadway network defined by stakeholders as critical for cross-regional travel and connection to the region’s chief intermodal facilities. Collectively, this network (shown in Figure 5.1) includes major seaports, cargo airports, rail transfer facilities, intermodal connectors, and key highway corridors, and provides a good starting point for the full designation of the Freight Significant Network. H-GAC should work with its partners to build upon this initial stakeholder-defined network by using more quantitative data to identify the Freight Significant Network. As a potential guide, the FHWA recently issued the planned process for designating the national primary freight network as required by MAP-21. The process will be based on measurable and objective data, including:

- Origins and destinations of freight movements;
- Total freight tonnage and value of freight moved by highways;
- Percentage of annual average daily truck traffic on principal arterials;
- Land and maritime ports of entry;
- Population centers; and
- Network connectivity, among others.⁶⁴

Although a similar quantitative process, when applied at the regional level, will likely result in a network that is generally consistent with the stakeholder designated system described in Figure 5.1, developing a quantitative process will facilitate making updates to the system in future years and will allow the region to monitor and track performance over time.

⁶⁴ Federal Register, Vol. 78, No. 25, February 6, 2013.

Work with Partners to Mitigate Short-Term Deficiencies on the Freight-Significant Network

The authority and responsibility for implementing short-term improvement projects on the region's Freight Significant Network is spread among the numerous state, city, county, and toll authority jurisdictions and agencies in the H-GAC region. However, having identified the components of the system that are significant to freight movement, H-GAC is positioned to work with these partners to identify hotspots and mitigate existing design deficiencies on the region's intermodal connectors and other components of the system.

While it is not the intention of this plan to prioritize individual freight improvement projects, Table 5.1 and Figure 5.2 provide insight into the locations and types of projects that have been identified as existing and near-term needs on priority intermodal connectors. Planning-level cost estimates are also provided. These relatively short roadways (generally less than two miles in length) provide critical connections between high-volume highway facilities and many of the region's busiest port terminals, rail yards, and other intermodal facilities. Should the implementing agencies in the H-GAC region choose to pursue any of the noted possible solutions, advanced planning would be required to more precisely define costs, benefits, and implementation strategies. This process would include further stakeholder input toward accepting the recommended improvements as well as determining the impact of the improvements on the overall transportation network.

**Table 5.1
Possible Solutions to Improve Priority Intermodal Connectors
and Freight Impacted Roads**

Possible Near-Term Solutions					
Connector	Description	Possible Solution	Cost	Notes	
1	Industrial Boulevard	Between Federal Road and the Houston Ship Channel port terminals and truck/rail facility	Wayfinding Signage, Truck Lane Striping	\$263,000	Includes signage 2 miles north and south of Industrial on Federal Road and along Industrial.
2	Jacintoport Boulevard	Between Beltway 8 to Houston Ship Channel Port Terminal	Wayfinding Signage	\$125,000	Includes signage 2 miles in advance of Jacintoport on I-10 and BW8 and along Jacintoport.
3	John F Kenney Boulevard	Connects to George Bush Intercontinental Airport	Truck Lane Striping	\$86,000	
4	Kirkpatrick Boulevard	Between the UP Settegast Rail Yard and I-610	Wayfinding Signage, Street Lighting, Paved Shoulders	\$159,000	Includes signage along Kirkpatrick only.
5	Lockwood Drive	Lockwood between I-10 and Wallisville; Wallisville between Lockwood and the Englewood Intermodal Facility	Wayfinding Signage, Truck Lane Striping	\$158,000	Includes signage 2 miles in advance of Lockwood in I-10 and along Lockwood.
6	Old Port Industrial Boulevard (Galveston)	Harborside Dr to 28th St serving the Galveston port terminals	Wayfinding Signage	\$118,394	Includes signage 1 mile in advance of Harborside on SH87 and along Harborside.
7	Penn City Road	I-10 FR to 3100 Block (Houston Ship Channel Port Terminal)	Wayfinding Signage	\$297,000	Includes signage 2 miles in advance of Penn City on I-10, BW 8, and along Penn City.
8	Pine Street (Freeport)	FM-1495 between SH 288 north to the Port Freeport terminal on Pine Street	Wayfinding Signage	\$681,000	Includes signage 2 miles in advance of Pine Street on SH 288.
9	Port Road	Between SH 146 and the Bayport container terminal	Wayfinding Signage, Truck Lane Striping	\$121,000	Includes signage 2 miles in advance of Port Road on SH 146 and along Port Road.
10	South Sheldon Road	Between I-10 and the Jacintoport cluster, truck/pipeline terminal	Add Paved Shoulders	\$1.8 mil	

Possible Near-Term Solutions

Connector	Description	Possible Solution	Cost	Notes	
11	Wallisville Road	Lockwood between I-10 and Wallisville serving the Englewood intermodal facility	Wayfinding signage, Truck Lane Striping	\$286,000	Includes signage along Wallisville Road only. Additional wayfinding signage included in Lockwood cost estimate.
12	Will Clayton Parkway	Connects to George Bush Intercontinental Airport	Truck Lane Striping	\$423,000	
13	Hardy Road	From East Louetta to Cypresswood serving the Westfield freight rail facility	Wayfinding Signage	\$120,000	Includes signage 2 miles in advance of Hardy Road along IH45 and the Hardy Toll Road.
14	Barbours Cut Boulevard	Between SH 146 and the container terminal	Wayfinding Signage	\$120,000	Includes signage 2 miles in advance of Barbours Cut along SH 146.
15	US 59 (Kendleton)	Gin to Darst Road to US 59 serving the KCS intermodal facility	Wayfinding Signage	\$120,000	Includes signage 2 miles in advance of the facility along US 59.
16	Airport Boulevard	From I-45 to Telephone Road serving Hobby airport	Wayfinding Signage, Truck Lane Striping	\$204,000	Includes signage 2 miles in advance of Airport along I-45 and along Airport.
17	SH 288 (Lake Jackson)	Nolan Ryan Expressway from BASF Chemicals to FM 1495 (288 South)	Wayfinding Signage, Truck Lane Striping	\$910,000	Includes signage along SH 288 only.
18	Clinton Drive	I-610 to Federal Road serving Houston ship channel port terminals	Wayfinding Signage, Truck Lane Striping	\$426,000	Includes signage 2 miles in advance of Clinton Drive along I-610 and along Clinton.
19	Battleground/ Independence Parkway	SH225 to Lynchburg Ferry and Houston ship channel port terminals	Wayfinding Signage, Truck Lane Striping	\$385,000	Includes signage 2 miles in advance of Battleground Road along SH 225 and along Battleground Road.



Develop a Concept of Operations for a Freight ITS Program

As discussed in Section 4.0, the H-GAC region has an established Intelligent Transportation Systems (ITS) program, including an advanced transportation and emergency management center in TranStar. TranStar generates a large amount of real-time operational data which could be useful for freight stakeholders, including congestion/traffic data, construction projects and incident information. However, the data are not collated or reported in a way that is tailored to freight system users, and are not focused on freight-intensive corridors. Moreover, connections are lacking to key freight generators that could supply freight-focused information, such as the Port of Houston, Port Freeport, trucking companies, and terminal operators.

The H-GAC and its partners should therefore lay the groundwork for developing a freight-specific ITS program, which would involve conceptualizing a system that could connect different data sources together to create a freight-focused data packet for trucking company drivers, dispatchers, and operations managers. This system would leverage both public and private sector data sources where available to develop a complete suite of freight traveler information.

The first step in developing such a system is to create a Concept of Operations (ConOps). The ConOps is an initial design document that describes what the system should do, who will be using it and how it will benefit the different users, without necessarily spelling out technical solutions. The U.S. DOT's Freight Advanced Traveler Information System (FRATIS) provides a good starting point for the development of a regional freight ITS ConOps. FRATIS is designed to:

- Integrate and augment existing regional ITS and private sector traffic data sources to improve truck routing and dispatcher decision-making and allow for real-time dynamic routing around congestion;
- Leverage information technologies already being deployed by the private sector into new applications that will directly improve intermodal freight movement efficiencies, such as reductions in turn times, reductions in terminal queues and reductions in bobtails; and
- Deliver freight-centric traveler information via multiple methods (e.g., desktop interface for dispatchers, enabled mobile devices for truck drivers), and provide public sector performance monitoring capability to track freight performance metrics for use in transportation planning.

Some regions have begun to use the FRATIS concept to develop their own regional freight ITS systems. In Southern California, for example, the Gateway Cities Council of Governments is developing a freight ITS which is broadly similar to the concept envisioned in the FRATIS ConOps. Figure 5.3 illustrates the Gateway Cities concept. It encompasses several data sources, including:

- Traffic and congestion monitoring on freight-intensive freeways and arterials;
- Queue detection and measurement at port terminal gates;
- Truck performance monitoring via GPS-enabled "trucks as probes;"

- A regional freight TMC for data collection and system performance monitoring;
- Weigh-in-motion technology for truck weight and safety enforcement; and
- A port scheduling/terminal appointment capability to better spread out truck arrivals throughout the day, reducing truck queues and emissions.

Development of a similar ConOps in the H-GAC region could help address the congestion issues identified in Section 4.0 and allow the region to more effectively absorb anticipated increases in freight traffic along its critical freight corridors.

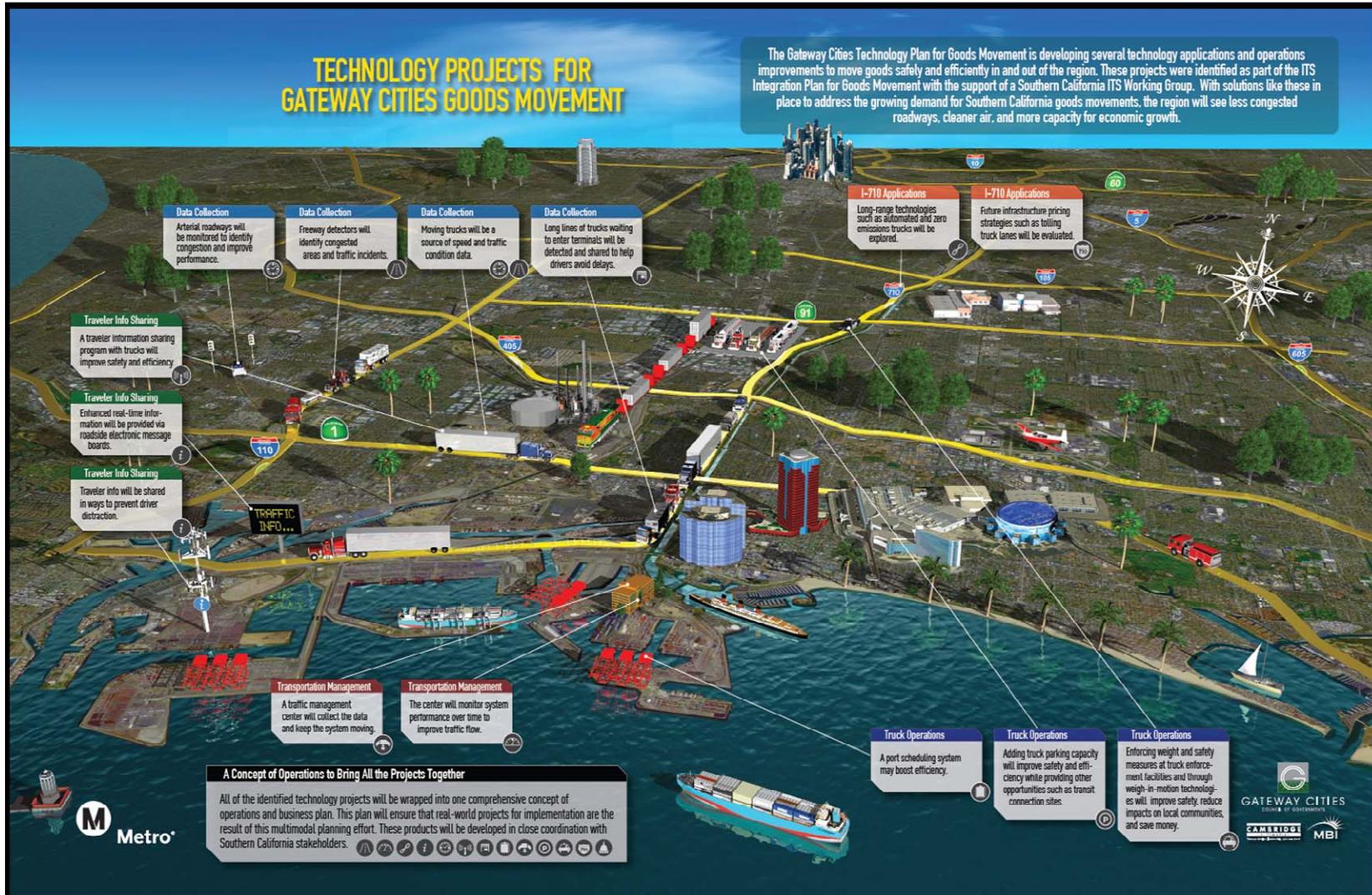
Create a Regional Goods Movement Subcommittee

Among the 38 members appointed to serve on H-GAC's Technical Advisory Committee (TAC), six seats are reserved for public and private stakeholders representing "intermodal interests" in the region. These members may include bicycle and pedestrian, airports, seaports, railroads, toll road authorities, freight shippers and carriers, or highway and transit user groups. The TAC is further supported by a series of subcommittees to advise the TAC on both technical and policy issues related to a targeted topic area. There are six existing TAC subcommittees focused on the TIP, Long-Range Regional Transportation Plan (RTP), regional transit coordination, pedestrian and bicycle considerations, operations, and transportation air quality.

H-GAC's TAC should seek approval from the Transportation Policy Council (TPC) to create a new subcommittee focused on addressing regional goods movement issues as part of the regional planning process. Establishment of such a committee would help elevate the importance of addressing freight issues within the region and provide a forum for both the TAC and the TPC to more effectively identify and address freight issues in a cooperative and continuous manner. It would also help ensure that design standards for intermodal connectors and other freight-impacted roads (e.g., ramp lengths, turn radii, lane striping) accurately reflect freight system needs. The Regional Goods Movement Study Steering Committee established to help guide this Plan provides an excellent starting point from which to create a new TAC regional goods movement subcommittee.⁶⁵

⁶⁵ A complete list of Regional Goods Movement Study Steering Committee members is included in Appendix B.

Figure 5.3 Gateway Cities Technology Plan for Goods Movement



Source: Gateway Cities Council of Governments, January 2012.

Incorporate Freight-Specific Measures into Project Evaluation Processes

H-GAC- like most of its counterparts across the country- does not use evaluation criteria that reflect potential mobility, economic and business development benefits of freight improvement projects when making transportation investment decisions. As a result, some freight projects are not considered or are ranked low compared to more traditional capacity and operational strategies. Although H-GAC’s current project evaluation criteria and methodology do describe a handful of freight-related measures in its planning factors (e.g., “connects to intermodal connectors” and “multimodal impacts”), freight-specific information is missing from the benefit-cost methodology, which accounts for 50 percent of the project score.⁶⁶

So that freight projects can be given fair consideration in the project evaluation process, H-GAC should develop project evaluation criteria that give more recognition of and emphasis to freight projects. In the short term, H-GAC should add freight-related measures to its existing planning factors and benefit cost guidance, paying particular attention to Roadway/Mobility (Non-ITS) projects. Options to consider include:

- Adding “Freight-Significant Network” to existing planning factors;
- Incorporating truck-specific delay information within benefit/cost methodologies (in addition to existing vehicle hour delay information); and
- Adding “high risk crash sites for commercial vehicles” to existing planning factors.

In the longer term, H-GAC should consider developing a more robust process to evaluate costs, benefits and trade-offs across a variety of freight and non-freight projects (both capacity and operational). This process should be capable of defining a wide range of public and private benefits and impacts of projects (both economic and non-economic), be capable of handling projects that span different modes and reflect the interest of the variety of public and private stakeholders in transportation investments, including shippers, carriers, logistics service providers, and others.

Just as important as developing criteria that reflect the potential benefits of freight-specific improvement projects is the development of guidance to assist in the application of those criteria. H-GAC should also develop concrete guidance to assist project evaluators in the assessment and ranking of projects to help eliminate bias and ensure that all potential projects are treated equally within the evaluation process.

⁶⁶ H-GAC 2013-2016 TIP Project Evaluation Criteria.



Designate and Publicize a Freight Point-of-Contact/Technical Lead

A freight point-of-contact/technical lead is a key element of successful integration of freight issues within metropolitan transportation planning processes and will be critical in helping to implement the recommendations developed as part of this effort. H-GAC should specifically identify a freight lead to serve as a liaison between the private sector freight community and the H-GAC (as the metropolitan planning organization [MPO] for the region), between H-GAC and TxDOT (including the Transportation Planning and Programming Division, the Rail Division, the Maritime Division, and the Houston and Beaumont Districts), and between the MPO and other transportation partners, including City and County agencies and leadership, the Port of Houston and Port Freeport, local Chambers of Commerce and economic development agencies, shipper/carrier organizations, and others.

Designation of a freight point of contact will help demonstrate a commitment to freight planning within H-GAC, as well as allow it to build and sustain relationships with key members of the private sector freight community. It will also help H-GAC participate in and guide future regional and statewide freight planning activities, particularly the statewide freight planning activities likely to result from the recent TxDOT Panama Canal Working Group.

Develop a Freight Performance Measures Program

The development and application of performance measures enable agencies to gauge system condition and use, evaluate transportation programs and projects and help decision-makers allocate limited resources more effectively than would otherwise be possible. In addition, development and application of freight performance measures was emphasized in MAP-21 and in FHWA's interim guidance on state freight plans and freight advisory committees.⁶⁷ H-GAC should consider applying performance measures to the freight system for the following general purposes:

- **Linking Actions to Goals.** Performance measures can help link plans and actions to H-GAC's goals and objectives;
- **Prioritizing Projects.** Performance measures can provide information needed to invest in projects and programs that provide the greatest benefits;
- **Managing Performance.** Applying performance measures can improve the management and delivery of programs, projects, and services. The right performance measures can highlight the technical, administrative, and financial issues critical to governing the fundamentals of any program or project;
- **Communicating Results.** Performance measures can help communicate the value of public investments in transportation.

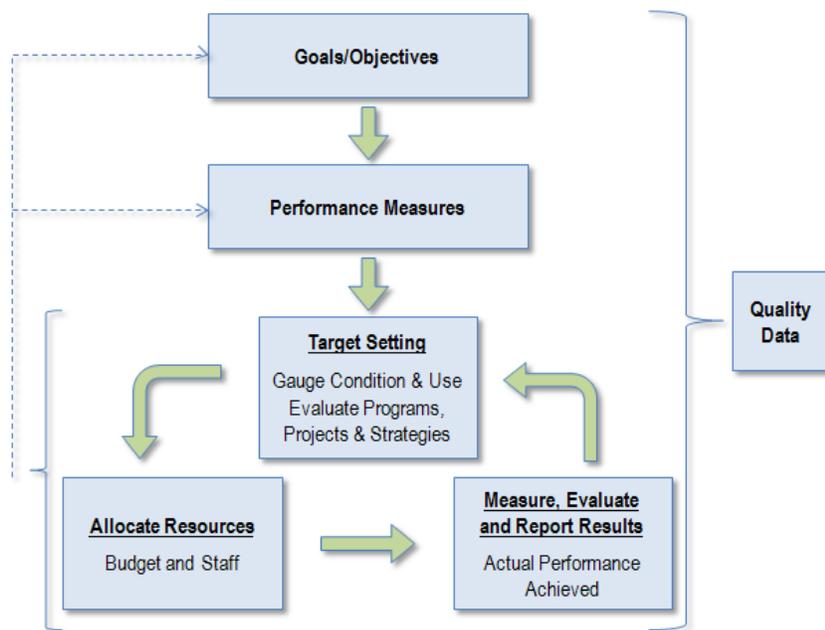
⁶⁷ Federal Register Notice 77FR62596 (<https://federalregister.gov/a/2012-25261>).

They can provide a concrete way for stakeholders to see H-GAC’s commitment to improving the transportation system and help build support for transportation investments; and

- **Strengthening Accountability.** Performance measures can promote accountability with respect to the use of taxpayer resources. They reveal whether transportation investments are providing the expected performance or demonstrate need for improvement.

In order to best accomplish one or more of these general purposes, a comprehensive performance management process, illustrated in Figure 5.4, should be implemented.

Figure 5.4
Performance-Based Planning and Programming Framework



Source: Cambridge Systematics.

National level performance measures have not yet been finalized, although discussions are on-going and US DOT will establish measures for the Interstate system in 2014.

MAP-21 has thrust performance measures into the spotlight and MPOs will be required to establish and use a performance-based approach to transportation decision making and development of transportation plans, including integration in development of the RTP and the TIP. This performance-based approach will have performance measurement as its foundation. Performance measures, to be established by U.S. DOT, will be developed to align with the seven national goals established as part of the legislation, which include:

- Safety;
- Infrastructure Condition;
- Congestion Reduction;
- System Reliability;
- Freight Movement and Economic Vitality;

- Environmental Sustainability; and
- Reduced Project Delivery Delays.

At this time, national performance measures have not been formalized, however the U.S. DOT will establish performance measures for states and MPOs to use to assess the Interstate system by April 1, 2014. As possible examples, Table 5.2 provides freight performance measures that align with the seven national goal areas. Once performance measures are set, states must establish performance targets within 1 year. MPOs are then required to establish their own performance targets no later than 180 days after the state. This means that the performance targets established by H-GAC will be need to be coordinated with TxDOT and regional planning partners to ensure consistency to the maximum extent practicable. Meeting these deadlines and developing measures in a coordinated manner is critical for H-GAC, as it is expected that implementation of a performance-based approach to planning will be a condition of MPO certification.

Table 5.2
Example Freight Performance Measures to Align
with National Transportation Goals

National Goal Area	Example Performance Measures
Safety	<ul style="list-style-type: none"> • Truck Injury and Fatal Crash Rates • Highway-Rail At-Grade Incidents
Infrastructure Condition	<ul style="list-style-type: none"> • NHS Bridge Condition • NHS Pavement Condition
Congestion Reduction	<ul style="list-style-type: none"> • Level of Service (LOS) • Duration of Congestion on Freight-Significant Highways • Recurring Delay on Freight-Significant Highways
System Reliability	<ul style="list-style-type: none"> • Interstate Highway Buffer Index • Interstate Highway Truck Speeds • Truck Travel Time on Major Corridors
Freight Movement and Economic Vitality	<ul style="list-style-type: none"> • Freight Volumes, All Modes • Logistics Cost/Gross National Product
Environmental Sustainability	<ul style="list-style-type: none"> • Emissions, All Freight Modes • Number of Hazardous Materials Incidents
Reduced Project Delivery Delays	<ul style="list-style-type: none"> • Percent of Projects Completed On Time • Percent of Projects Completed within Programmed Amount

Source: Adapted from NCFRP Report 10, *Performance Measures for Freight Transportation*, 2011.

5.2 Long-Term Actions

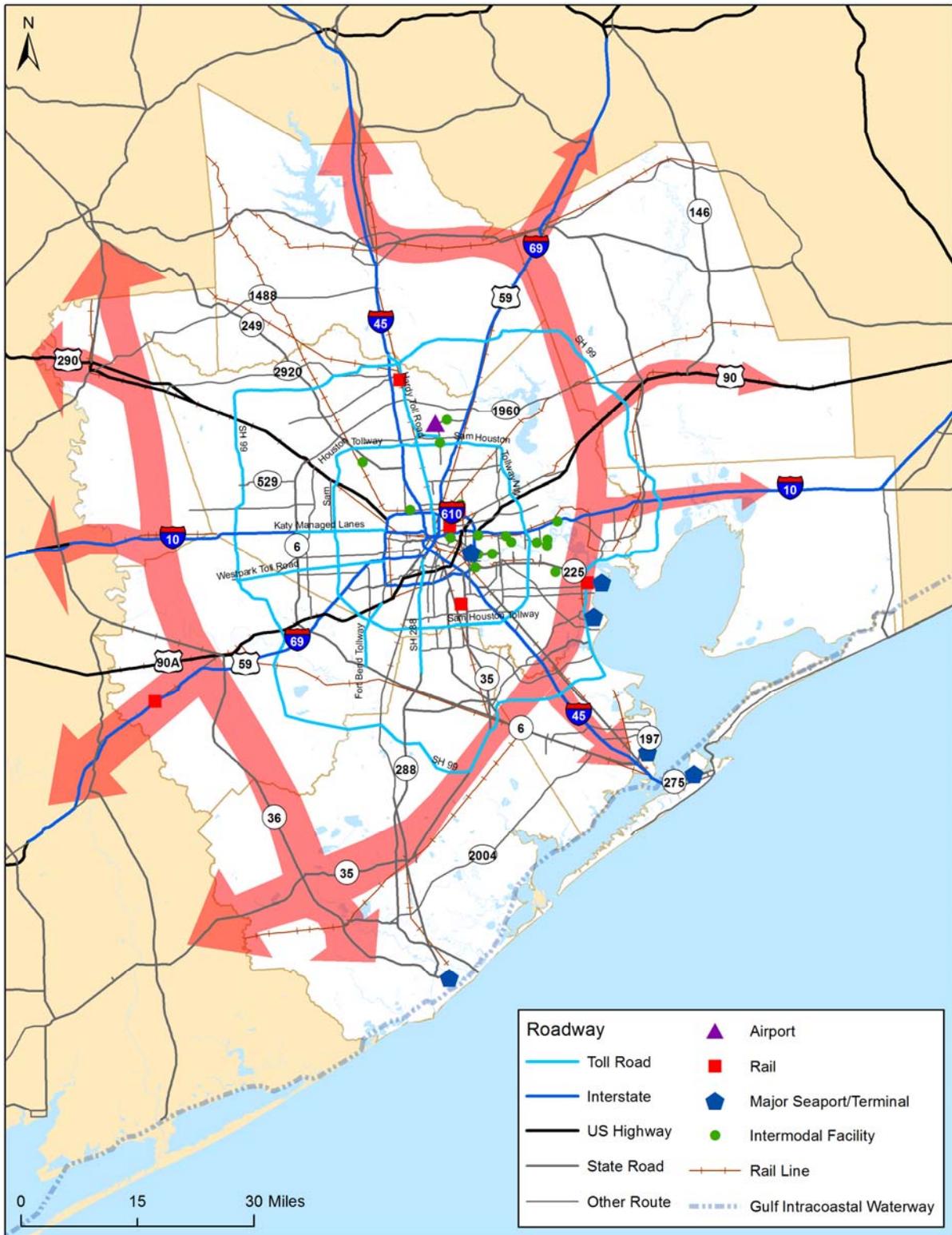
Long-term actions are defined as those that require a sustained effort and will likely require implementation over a period of five or more years. These actions, described below, are intended to position the region for future growth and economic opportunities.

Provide Access to Growing Economic Centers Outside of the Urban Core

As discussed earlier, projections for the H-GAC region indicate that the fastest growing areas will be in the outlying counties. With this growth will come the need for connecting these emerging economic centers with each other and with hinterland markets while avoiding the congestion of the urban core. The Grand Parkway is an example of a long-term, on-going investment to connect suburban growth areas to one another while providing connections to the system's radial highways. Figure 5.5 provides an illustrative example of how an enhanced and/or new corridor could connect the regional ports to outlying growth areas and hinterland markets. This is not a defined alignment, per se, but rather an illustration of how the region's future freight system might need to connect to the existing network and provide a more direct path to the region's ports.

Recognizing future growth patterns and the resulting system connectivity needs, H-GAC and its partners should begin to position the region for future growth by identifying potential freight corridors that directly connect the emerging economic centers in surrounding counties while diverting truck and rail volume away from the urban core. This may include identifying opportunities to upgrade existing highway and rail facilities or documenting need and purpose for new corridors. In either case, identifying corridor preservation or land banking opportunities will help ensure that the region can more effectively absorb anticipated growth, ensure connections to existing and emerging freight facilities and markets, and continue to attract and retain key industries and jobs.

Figure 5.5 Illustrative Port Connector/Urban Core Reliever Route



Update Freight-Significant Network with Each Long-Range Plan Update

H-GAC updates its long-range RTP every five years. In that amount of time, it is likely for regional growth patterns to shift, new supply chain patterns and strategies to emerge, and/or freight flows to adjust based on available system capacity and market demands. With each plan update, H-GAC staff should update the Freight-Significant Network to account for any changes to the system's intermodal connectors, designated hazmat routes, and other freight-significant roadway elements. This can be accomplished through updates to commodity flow analyses, interviews with stakeholders, and coordination and discussion with the TAC Regional Goods Movement Subcommittee. When incorporated as part of the planning process, an updated definition of the freight-significant roadway network will help to target freight-related RTP investments on the most critical components of the system.

Develop Climate Change Adaptation Strategies

Given the scale and strategic importance of the region's transportation infrastructure, it is critical to consider where the network is vulnerable to the impacts of climate change and to develop adaptation strategies to address them. This is particularly true in the H-GAC region- many of the region's most important freight transportation assets (including the ports, the Ship Channel, and several highway and rail corridors such as I-45, SH 146, and SH 87) are susceptible to storm surge and other impacts. Adaptation strategies may include:

- **Enhancing the resilience of the freight network.** Using a risk management approach, H-GAC should assess the potential exposure, vulnerability, and resilience of the regional goods movement system. Identifying the system elements most at risk to climate factors (sea level rise, temperature change, severe storms, and precipitation changes) and comparing them against the economic impact of interrupted service provides the basis for prioritizing strategies to increase the resilience and redundancies of the system.
- **Developing strategies to reduce transportation GHG emissions.** Several recent studies have identified a number of strategies to reduce transportation GHG emissions.^{68,69} Examples include introducing low-carbon fuels, increasing truck fuel economy, improving the efficiency and operations of the system, and adopting adaptive engineering design standards. Working with the region's freight stakeholders and planning partners, H-GAC should expand the scope of the existing air quality strategies described in Section 4.0 to more broadly include the multimodal elements of the region's freight system, including ports and terminals.

⁶⁸ U.S. Department of Transportation, *Transportation's Role in Reducing U.S. Greenhouse Gas Emissions*, April 2010.

⁶⁹ Transportation Research Board, Special Report 290, *Potential Impacts of Climate Change on U.S. Transportation*, 2008.

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- **Considering Climate Change in Transportation Planning and Land Use Controls.** One strategy recommended in the Transportation Research Board (TRB) Special Report 290 calls for transportation planners to consider climate change impacts and their effects on infrastructure investments, particularly in vulnerable locations, and when considering facilities with a development horizon of 20 to 30 years or more. One of the most effective strategies for reducing the risks of climate change is to avoid placing people and infrastructure in vulnerable locations. Just as transportation planners currently consider expected land use patterns when forecasting future travel demand and infrastructure needs, H-GAC should also assess the effects climate change might have on the provision and development of infrastructure in vulnerable locations.

A better understanding of the risks and vulnerabilities of the region's freight infrastructure – and an adaptation plan to address these challenges – will help H-GAC prioritize future transportation investments.

5.3 An Integrated Approach

By integrating infrastructure, operational, and institutional strategies, these recommendations will allow the H-GAC region to address existing deficiencies in its freight system, make improvements to improve the operational efficiency of freight movements, and more effectively engage the private sector freight community in the transportation planning, programming, and project development process. In the longer term, these recommendations will also position the region for future growth, allowing it to attract and retain key goods movement dependent industries and the jobs, tax revenues, and other economic impacts that follow.

Just as important, completion of this Plan sends an important message to H-GAC member governments and other regional stakeholders that freight is an important component of the region's transportation and economic mix and identifying and addressing freight issues is an important priority for the region. And the implementation of the recommendations described above- particularly the establishment of a regional goods movement subcommittee, the establishment of a freight point of contact, and the development of freight-friendly prioritization criteria- will allow freight issues and freight projects to more effectively compete for regional funding.

A. Intermodal Connector Screening Process

The supporting materials developed for the Regional Goods Movement Study identified physical infrastructure and operational issues on 50 intermodal connectors and freight-significant corridors within the H-GAC region. These are listed in Table A.1. The study team also identified possible near-term, interim, and long-term solutions and developed planning-level cost estimates for each. To narrow this list for the Final H-GAC Regional Goods Movement Plan, the study team developed a transparent screening process to identify the highest priority issues to address. This screening process is tied to a set of guiding principles providing strategic direction for the Plan, identifying potential investments that will:

- Enhance the mobility, reliability, and safety of existing freight roadways;
- Provide access to new growth areas;
- Promote multimodal approaches;
- Enhance the region's economic competitiveness; and
- Minimize community impacts related to congestion, safety, the environment and quality of life.

With these guiding principles in mind, this Appendix describes the screening criteria and evaluation process used to identify the most important intermodal connector issues to address. The process yielded a shortened list of suggested improvements to priority intermodal connector improvements and formed the basis for an illustrative set of short-term improvement projects included in the Regional Goods Movement Plan recommendations.

A.1 Intermodal Connector Screening Process

The intermodal connector screening process involved the following steps:

1. **Inventory Stakeholder-Identified Intermodal Connectors and Bottlenecks.** After implementing a stakeholder-driven process to identify the region's intermodal connectors and freight-significant roadways, the study team conducted an inventory of existing conditions to identify inefficiencies and other issues contributing to freight bottlenecks on these connectors. This process identified physical infrastructure and operational issues on 50 intermodal connectors and freight-significant corridors, generally categorized within the following key issues:

- Geometric design deficiencies (route alignment, turning radii, shoulders, ramp length, etc.);
- Inadequate truck capacity (truck lane striping, turn lane storage length, etc.);
- Poor pavement quality;
- Safety issues (lighting, roadside hazards, etc.);
- Inefficient access control (driveway density);
- Poor drainage;
- Grade separation;
- Driver wayfinding, such as directional signage, necessary to help drivers navigate to designated truck routes;
- Real-time traffic information, to communicate information on traffic incidents, construction, and general congestion to help dispatchers and drivers make more informed routing decisions; and
- Traffic signalization/signal timing, as traffic volumes warrant, to increase traffic throughput on intermodal connectors.

2. **Consolidate/Merge Adjacent Connector Links.** Several of the intermodal connectors identified in the inventory represent adjacent links on the same roadway. Given their proximity, the physical infrastructure and operational issues on adjacent links are the same. To streamline and simplify the list of potential projects, this step consolidated/merged adjacent links. This process reduced the list of intermodal connectors and bottlenecks from 50 to 35.

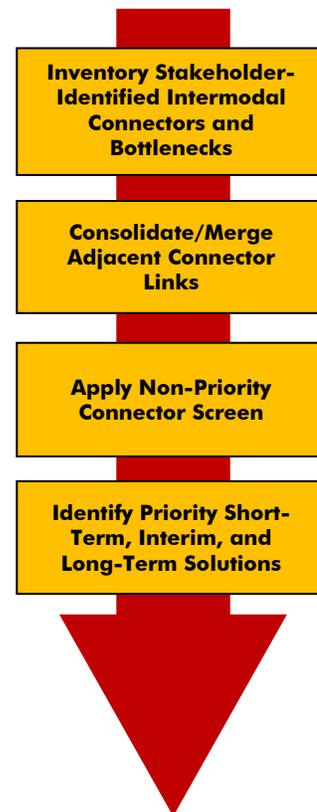


Table A.1
Intermodal Connectors and Freight Impacted Roads with Physical and/or Operational Inefficiencies

ID	Connector Name	Description	Intermodal Facility Served
1	75 th Street	75 th Street between Navigation Boulevard and the Terminal	Port of Houston
2	Center Street	Center Road (Shell Oil to SH 225)	Shell Oil facilities
3	Ferry Road	Ferry Road (SH 87) between Port Industrial Boulevard and the Terminal	Ferry terminal to Port Bolivar
4	Industrial Boulevard	Industrial Boulevard between Federal and the Terminal	Houston Ship Channel Port Terminals and Truck/Rail Facility
5	Jacintoport Boulevard	Jacintoport Boulevard Between Beltway 8 to Terminal	Houston Ship Channel Port Terminal
6	Jacintoport Boulevard	Jacintoport Boulevard Between Beltway 8 to Terminal (From Sam Houston Parkway to Sheldon)	Care Terminal, Cargill Inc., Holnam Cement, Maurice Pincoffs, Houston Ship Channel Port Terminal
7	Jefferson Road	Jefferson (Facility to SH 225)	Houston Ship Channel, Industrial Facilities
8	Jefferson Road	Jefferson (Facility to SH 225)	GATX Terminals Corp., Houston Ship Channel Truck/Pipeline Terminal
9	John F. Kennedy Boulevard	Served by an Existing NHS Route/ Will Clayton Parkway and JFK	George Bush Intercontinental Airport
10	Kirkpatrick Boulevard	Kirkpatrick Boulevard between the Terminal and IH-610	UP Settegast Rail Yard
11	Kirkpatrick Boulevard	Kirkpatrick Boulevard between the Terminal and I-610	UP Settegast Rail Yard
12	Lockwood Drive	Lockwood between I-10 and Wallisville [0.875 mi]; Wallisville between Lockwood and the Terminal [0.15 mi]	Englewood Intermodal Facility
13	Lockwood Drive	Lockwood between I-10 and Wallisville [0.875 mi]; Wallisville between Lockwood and the Terminal [0.15 mi]	S.P. Houston Intermodal Hub, Englewood Intermodal Facility
14	Manchester Street	Manchester between East Loop 610 and the Terminal	Houston Ship Channel, Industrial Facilities
15	Manchester Street	S.P. Houston Intermodal Hub, Englewood Intermodal Facility	Manchester Terminal, Houston Ship Channel
16	Mykawa Road	Mykawa Road (IH 610 to Wayside)	Commercial and industrial development
17	Navigation Boulevard	Navigation Boulevard between Engle and US90A (Wayside)	Port of Houston
18	Old Port Industrial Boulevard Galveston	Old Port Industrial Boulevard (Harborside Drive to 28 th Street)	Galveston Port Terminals

ID	Connector Name	Description	Intermodal Facility Served
19	Penn City Road	Penn City Road (IH-10 FR to 3100 Block)	Houston Ship Channel Port Terminal
20	Pine Street Freeport	FM-1495 between SH 288 Northerly to the Terminal on Pine Street	Port Freeport
21	Port Road	Port Road between SH 146 and the Terminal	Bayport Container Terminal
22	Quitman Street	Quitman between the US 59 and Stevens [0.30 mi]; Stevens between Quitman and the terminal [0.05 mi]	Industrial development
23	South Sheldon Road	South Sheldon Road between I-10 and the Terminal	Jacintoport Cluster, Truck/Pipeline Terminal
24	South Sheldon Road	South Sheldon Road between I-10 and the Terminal (I-10 to Market)	Jacintoport Cluster, Truck/Pipeline Terminal
25	Stevens Street	Quitman between the US 59 and Stevens [0.30 mi]; Stevens between Quitman and the terminal [0.05 mi]	Industrial development
26	Sweetwater Lane	W Canino (IH 45 to Sweetwater Lane) [0.1 mi]; Sweetwater Lane (Terminal gate to W. Canino) [0.1 mi]	UPS Facility
27	West Canino Road	W Canino (IH 45 to Sweetwater Lane) [0.1 mi]; Sweetwater Lane (Terminal gate to W. Canino) [0.1 mi]	UPS Facility
28	Wallisville Road (west of 610)	Lockwood between IH-10 and Wallisville [0.875 mi]; Wallisville between Lockwood and the Terminal [0.15 mi]	Englewood Intermodal Facility
29	Wallisville Road (east of 610)	Wallisville Road (IH 610 to Oates)	Trucking companies
30	Will Clayton Parkway	Served by an Existing NHS Route/ Will Clayton Parkway and JFK (from US 59 to JFK Boulevard)	George Bush Intercontinental Airport
31	Will Clayton Parkway	Served by an Existing NHS Route/ Will Clayton Parkway and JFK (from US 59 to JFK Boulevard)	Houston Intercontinental Airport (George Bush)
32	Will Clayton Parkway	Served by an Existing NHS Route/ Will Clayton Parkway and JFK (from US 59 to JFK Boulevard)	Houston Intercontinental Airport (George Bush)
33	SH 35 West Columbia	SH 35 (FM 524 to SH 36)	Old Ocean and Conoco Philips Sweeny Refinery (not a
34	SH 35 West Columbia	SH 35 (FM 524 to SH 36)	Philips Petroleum Sweeny Complex
35	Ferry Road	Ferry Road (SH 87/SH 124) between I-10 and the Terminal (High Island to Winnie)	Port Bolivar Ferry #1
36	Jacintoport Boulevard	Jacintoport Boulevard Between Beltway 8 to Terminal (From IH- 10 to BW8)	Care Terminal, Cargill Inc.,Holnam Cement, Maurice Pincoffs, Houston Ship Channel Port Terminal

ID	Connector Name	Description	Intermodal Facility Served
37	Ferry Road (SH 87)	Ferry Road (SH 87/SH 124) between I-10 and the Terminal (Bolivar Ferry to High Island)	Port Bolivar
38	Ferry Road	Ferry Road (SH 87/SH 124) between I-10 and the Terminal	Port Bolivar Ferry #1
39	Ferry Road (SH 124)	Ferry Road (SH 87/SH 124) between I-10 and the Terminal	Port Bolivar by way of SH 87
40	Ferry Road	Ferry Road (SH 87/SH 124) between I-10 and the Terminal	Port Bolivar Ferry #2
41	Hardy Road	Hardy Road to E Louetta (from East Louetta to Cypresswood)	Westfield Freight Rail Facility
42	Barbours Cut Boulevard	Barbours Cut Boulevard between SH 146 and the Terminal	Barbours Cut Container Terminal
43	US 59 Kendleton	Gin to Darst Road to US 59	Kansas City Southern Railway Company Intermodal Facility
44	Airport Boulevard (IH 45 to Telephone Road)	Airport Boulevard from IH-45 to Telephone Road	William P. Hobby Airport
45	Port Road	Port Road between SH 146 and the Terminal	Bayport Container Terminal, Port Terminal
46	Yale Street	Yale Street to I-610 North (from IH-610 to IH-10)	Freight facilities north of 610
47	SH 288 Lake Jackson	Nolan Ryan Expressway from BASF Chemicals to FM 1495 (288 South) (Freeport)	Brazosport Turning Basin, Freeport Port Terminal
48	Lockwood Drive	Lockwood Drive to I-10 (Wallisville Road to IH-o10)	S.P. Houston Intermodal Hub, Englewood Intermodal Facility
49	Clinton Drive	Clinton Drive to IH-610 (IH-610 to Federal Road)	Houston Ship Channel Port Terminals
50	Battleground/Independence Parkway	Battleground Road/Independence Parkway (SH225 to Lynchburg Ferry)	Lynchburg Ferry, Houston Ship Channel Port Terminals

Source: Cambridge Systematics.

3. Apply Non-priority Connector Screen. The study team developed a list of screening criteria to help distinguish between priority and nonpriority intermodal connectors. For this effort, a nonpriority connector was defined as one that:

- Is not designated by the Federal Highway Administration (FHWA) as an official National Highway System (NHS) Intermodal Freight Connector; AND
- Does not provide connectivity to the region’s stakeholder-defined freight significant corridor network;
- Is privately owned;
- May impose significant community or environmental impacts (such as identified land use conflicts); OR

- 
- Does not serve any of the region’s chief intermodal facilities identified in the Regional Goods Movement Profile.⁷⁰

Applying the non-priority connector screening criteria yielded 16 corridors that fell within the criteria. The remaining 19 connectors were flagged as “priority” connectors.

4. **Identify Priority Short-Term, Interim, and Long-Term Solutions.** For the 19 remaining priority intermodal connectors, Table A.2 presents possible near-term, interim, and long-term solutions to address the physical infrastructure and operational issues found on each. Prior to implementing any of the noted possible solutions, however, advanced planning would be required to further analyze the final recommended solutions. The planning process would include future stakeholder input as well as determining the effectiveness of the improvements on the overall transportation network and potential community and environmental impacts.

⁷⁰ Cambridge Systematics, et al. *Regional Goods Movement Profile*, prepared for the Houston-Galveston Area Council, February 2011.

Table A.2 Possible Solutions to Improve Priority Intermodal Connectors and Freight Impacted Roads

ID	Connector Name	Description	Primary Facility Served	Possible Solutions ^a			Notes
				Near Term	Interim Term	Long Term	
4	Industrial Boulevard	Industrial Boulevard between Federal and the Terminal	Houston Ship Channel Port Terminals and Truck/Rail Facility	Wayfinding Signage, Truck Lane Striping	Improve Federal Road curb return radii	Replace Roadway with 5-lane typical section	Near term wayfinding signage includes signage 2 miles north and south of Industrial on Federal Road and along Industrial.
5	Jacintoport Boulevard	Jacintoport Boulevard Between Beltway 8 to Terminal	Houston Ship Channel Port Terminal	Wayfinding Signage	Continue Harris County CIP project currently on hold	Replace Roadway with 5-lane typical section	Near term wayfinding signage includes signage 2 miles in advance of Jacintoport on IH-10 and BW8 and along Jacintoport.
9	John F Kennedy Boulevard	Served by an Existing NHS Route/ Will Clayton Parkway and JFK	George Bush Intercontinental Airport	Truck Lane Striping	None	None	
10	Kirkpatrick Boulevard	Kirkpatrick Boulevard between the Terminal and IH-610	UP Settegast Rail Yard	Wayfinding Signage, Street Lighting, Paved Shoulders	Increase Curb Return Radii and Signalize IH-610 intersection	Replace Roadway with 5-lane typical section	Near term wayfinding signage includes signage along Kirkpatrick only. See #11 for interim costs of intersection improvements.
12	Lockwood Drive	Lockwood between I-10 and Wallisville [0.875 mi]; Wallisville between Lockwood and the Terminal [0.15 mi]	Englewood Intermodal Facility	Wayfinding Signage, Truck Lane Striping	None	None	Near term wayfinding signage includes signage 2 miles in advance of Lockwood on IH-10 and along Lockwood.
18	Old Port Industrial Boulevard (Galveston)	Old Port Industrial Boulevard (Harborside Drive to 28 th Street)	Galveston Port Terminals	Wayfinding signage	Lighting	None	Near term wayfinding signage includes signage 1 mile in advance of Harborside on SH87 and along Harborside.
19	Penn City Road	Penn City Road (IH-10 FR to 3100 Block)	Houston Ship Channel Port Terminal	Wayfinding signage	None	Replace Roadway with 5-lane typical section	Near term wayfinding signage includes signage 2 miles in advance of Penn City on IH-10, BW 8, and along Penn City.
20	Pine Street (Freeport)	FM-1495 between SH 288 Northerly to the Terminal on Pine Street	Port Freeport	Wayfinding signage	Elevated intersection at FM 1495/SH 36 intersection	Replace Roadway with 5-lane typical section	Near term wayfinding signage includes signage 2 miles in advance of Pine Street on H 288. Interim Term Solution Cost estimate needs to be obtained from designer. Current estimate includes cost of bridge only and 15% contingency. Long-Term Solution does not include ROW acquisition.
21	Port Road	Port Road between SH 146 and the Terminal	Bayport Container Terminal	Wayfinding Signage, Truck Lane Striping	Signalize SH 146 intersection	None	Near term wayfinding signage includes signage 2 miles in advance of Port Road on SH 146 and along Port Road. Phased Port Road construction currently on-going.
23	South Sheldon Road	South Sheldon Road between I-10 and the Terminal	Jacintoport Cluster, Truck/Pipeline Terminal	Add paved shoulders	Complete Harris County CIP project	Replace Roadway with 5-lane typical section	
28	Wallisville Road	Lockwood between IH-10 and Wallisville [0.875 mi]; Wallisville between Lockwood and the Terminal [0.15 mi]	Englewood Intermodal Facility	Wayfinding signage	Complete COH CIP project	Replace Roadway with 5-lane typical section	Near term wayfinding signage includes signage along Wallisville Road only. Additional wayfinding signage included in Lockwood cost estimate.
30	Will Clayton Parkway	Served by an Existing NHS Route/ Will Clayton Parkway and JFK (from US 59 to JFK Boulevard)	George Bush Intercontinental Airport	Truck Lane Striping	None	None	
41	Hardy Road	Hardy Road to E Louetta (from East Louetta to Cypresswood)	Westfield Freight Rail Facility	Wayfinding signage	None	Replace Roadway with 5-lane typical section	Near term wayfinding signage includes signage 2 miles in advance of Hardy Road along IH45 and the Hardy Toll Road.
42	Barbours Cut Boulevard	Barbours Cut Boulevard between SH 146 and the Terminal	Barbours Cut Container Terminal	Wayfinding signage	None	None	Near term wayfinding signage includes signage 2 miles in advance of Barbours Cut along SH 146.
43	US 59 (Kendleton)	Gin to Darst Road to US 59	Kansas City Southern Railway Company Intermodal Facility	Wayfinding signage	None	Darst Road overpass at UH 59	Near term wayfinding signage includes signage 2 miles in advance of the facility along US 59. Long term overpass includes cost of bridge only and 15% contingency.
44	Airport Boulevard	Airport Boulevard from IH-45 to Telephone Road	William P. Hobby Airport	Wayfinding Signage, Truck Lane Striping	None	None	Near term wayfinding signage includes signage 2 miles in advance of Airport along IH-45 and along Airport.

ID	Connector Name	Description	Primary Facility Served	Possible Solutions ^a			Notes
				Near Term	Interim Term	Long Term	
47	SH 288 (Lake Jackson)	Nolan Ryan Expressway from BASF Chemicals to FM 1495 (288 South) (Freeport)	Brazosport Turning Basin, Freeport Port Terminal	Wayfinding Signage, Truck Lane Striping	Street Lighting	None	Near term wayfinding signage includes signage along SH 288 only.
49	Clinton Drive	Clinton Drive to IH-610 (IH-610 to Federal Road)	Houston Ship Channel Port Terminals	Wayfinding Signage, Truck Lane Striping	Complete COH CIP Project.	Replace Roadway with 5-lane typical section	Near term wayfinding signage includes signage 2 miles in advance of Clinton Drive along IH-610 and along Clinton.
50	Battleground/Independence Parkway	Battleground Road/Independence Parkway (SH225 to Lynchburg Ferry)	Lynchburg Ferry, Houston Ship Channel Port Terminals	Wayfinding Signage, Truck Lane Striping	None	Replace Roadway with 5-lane typical section	Near term wayfinding signage includes signage 2 miles in advance of Battleground Road along SH 225 and along Battleground Road.

^a Refer to the *H-GAC Intermodal Connector Technical Memorandum* for more detailed explanation of potential intermodal connector improvements.

B. Regional Goods Movement Steering Committee

B.1 Purpose of Committee

The Regional Goods Movement Steering Committee is responsible for the guidance of the Regional Goods Movement Study and for consideration of the Study outcomes and deliverables.

Regular meetings were held by H-GAC on a quarterly basis, with additional special meetings called to address specific task items, as needed.

B.2 Membership

Committee members are various stakeholders involved with goods movement issues. This includes local, county and state agency representatives and elected officials as well as representatives from private industry:

Elected Officials

1. Honorable E. Joe King, Brazoria County Judge
2. Honorable Mark Henry, Galveston County Judge
3. Honorable Owen Ralston, Waller County Judge
4. Honorable Glenn Beckendorff, Waller County Judge
5. Honorable Jimmy Sylvia, Jr., Chambers County Judge
6. Honorable Alan B. Sadler, Montgomery County Judge
7. Honorable Phil Fitzgerald, Liberty County Judge
8. Honorable Craig McNair, Liberty County Judge
9. Honorable Ed Emmett, Harris County Judge
10. Honorable Robert E. Hebert, Fort Bend County Judge
11. Honorable Annise D. Parker, City of Houston Mayor

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12. Honorable Johnny Isbell, City of Pasadena Mayor
 13. Honorable Tom Reid, City of Pearland Mayor
 14. Honorable James A. Thompson, City of Sugarland Mayor
 15. Honorable Allen Owen, Missouri City Mayor
 16. Honorable Toni Randall, League City Mayor
 17. Honorable Stephen H. DonCarlos, City of Baytown Mayor
 18. Honorable Webb K. Melder, City of Conroe Mayor
 19. Honorable Joe Jaworski, City of Galveston Mayor
 20. Honorable Lewis Rosen, City of Galveston Mayor
 21. Honorable Tommy Williams, Texas State Senator, District 4

Relative Agencies and Private Sector Stakeholders

22. Mr. Pete Reixach, Executive Director for the Port of Freeport
23. Mr. Mike Wilson, Director of Trade for the Port of Freeport
24. Mr. Alec G. Dreyer, CEO for the Port of Houston Authority
25. Mr. Leonard “Len” Waterworth, Executive Director for the Port of Houston Authority
26. Mr. Steve Cernak, Executive Director for the Port of Galveston
27. Mr. Michael Mierzwa, Port Director for the Port of Galveston
28. Mr. J.B. (Bill) Mathis, President and Executive Director for the Port of Texas City
29. Mr. Jon Boyd, Board Member for the Citizens Transportation Coalition
30. Ms. Carol Caul, Board Member for the Citizens Transportation Coalition
31. Mr. Joe Adams, Union Pacific Railroad
32. Mr. Hugh L. McCulley, BNSF Railroad
33. Mr. Delvin Dennis, District Engineer for the Texas Department of Transportation (TXDOT)
34. Mr. Michael W. Alford, P.E., District Engineer for the Texas Department of Transportation (TxDOT) Ms. Jennifer Moczygemba, Rail System Section Director for TXDOT

35. Ms. Maureen Crocker, Executive Director for the Gulf Coast Rail District
36. Mr. Peter Key, Executive Director for the Harris County Toll Authority
37. Mr. Jeffery (Jeff) McCaig, Chairman and CEO for Trimac
38. Mr. John Oren, President of Pinch Flatbed
39. Mr. John Talhelm, Senior Vice President for Jones Lang LaSalle Americas, Inc.
40. Mr. B. Kelley Parker, III, Executive Vice President for Cushman & Wakefield of Texas, Inc.
41. R.A. “Mickey” Deison, Chair, Conroe Industrial Development Corporation

Alternates

42. *For Judge King* Honorable Matt Sebesta, Brazoria County Commissioner, Pct.2
43. *For Judge Sylvia* Robert L. Hall, Jr., Chambers County Engineer
44. *For Judge Hebert* Honorable Richard Morrison, Fort Bend Commissioner, Pct. 1
45. *For Judge Emmett* Honorable Richard Zientek, Director of Transportation Issues, Harris County
46. *For Peter Key* Charles Dean, Harris County Public Infrastructure
47. *For Jennifer Moczygemba* Mark Werner, TxDOT Rail Division