



Houston-Galveston
Area Council

Regional Industry Cluster Analysis

for the Thirteen County Houston-Galveston Region

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Executive Summary

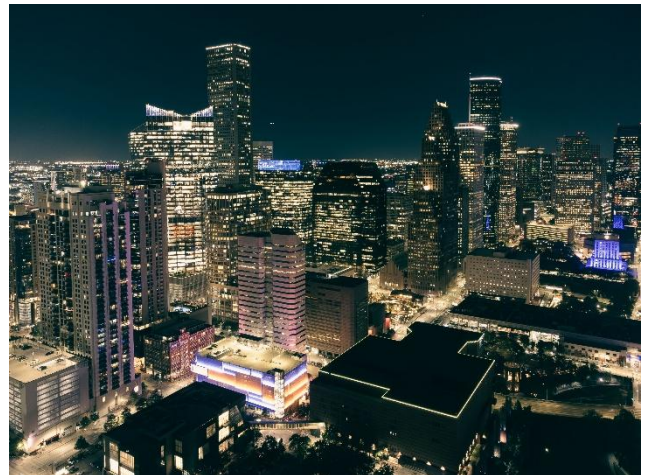
Economic development is a process through which economic activity is continuously organized and reorganized across space. Firms, workers, capital, and knowledge are not distributed evenly across regions. Instead, they tend to concentrate in places with advantages in natural resources, transportation access, infrastructure, institutions, market scale, and technological capabilities. These spatial concentrations generate agglomeration economies through knowledge spillovers, labor-market pooling, supplier networks, and economies of scale, thereby shaping long-term regional competitiveness. At the same time, agglomeration is not static. Throughout history, technological revolutions, infrastructure development, institutional change, and energy transitions have continuously changed the comparative advantages of different regions and driven the ongoing restructuring of economic geography.

This report examines the formation, evolution, and spatial organization of industry clusters in the Houston-Galveston Area Council (HGAC) 13 counties. The report focuses on how historically formed locational advantages produced long-existing industrial specialization, how these clusters have evolved over time, and how the region may develop new forms of functional specialization as technology, energy systems, and global value chains continue to change.

The analysis combines employment data, Gross Domestic Product (GDP) data, location quotients (LQ), shift-share decomposition, subcluster analysis, and spatial visualization based on business establishment locations. Employment-based cluster analysis primarily covers 1990–2025. Regional economic structure analysis using Bureau of Economic Analysis (BEA)-based GDP, population, and income indicators primarily covers 2001–2024. Data Axle establishment points are used to identify the most recent spatial organization and functional geography.

Key Findings:

- **HGAC region experienced strong long-term growth.** Between 2001 and 2024, regional population increased from approximately 5.0 million to 7.9 million residents, while real GDP increased from roughly \$308.4 billion to \$594.9 billion. GDP growth exceeded population growth, indicating that regional expansion was supported by both demographic growth and increases in output. However, GDP per capita growth was more modest than the Texas and national benchmarks, suggesting that rapid population growth has been a major driver of aggregate expansion.
- **The region maintained a group of long-term specialized clusters.** Using an LQ threshold of 1.25, five clusters consistently maintained specialization relative to both Texas and the United States during the 1990-2024 study period: **Oil and Gas**



Production and Transportation, Upstream Chemical Products, Construction Products and Services, Water Transportation, and Local Industrial Products and Services.

These clusters form the strong industrial foundation of the Houston regional economy.



- **Several emerging clusters** indicate the region's evolving functional specialization. **Transportation and Logistics** has become increasingly important as Houston develops a multimodal logistics system integrating ports, airports, highways, rail, warehousing, and intermodal facilities. **Metalworking Technology** reflects the region's energy-linked advanced manufacturing base. **Electric Power Generation and Transmission** shows signs of renewed specialization associated with renewable energy, grid integration, electrification, industrial power demand, and data center-related load growth.
- **The region has developed a clear spatial division of functions.** Harris County remains the management, innovation, engineering, finance, and business-service core. The Houston Ship Channel and Gulf Coast industrial corridor concentrate on

petrochemical manufacturing, refineries, pipelines, storage terminals, and export facilities. Brazoria County provides a major petrochemical manufacturing base. Galveston County contributes port, coastal infrastructure, and maritime functions. Montgomery and Fort Bend Counties reflect corporate expansion, suburban growth, and construction demand. Chambers County represents industrial corridor expansion.

- **The region's healthcare employment base remains underdeveloped relative to its size and population.** Despite being home to the Texas Medical Center, one of the world's largest and most prominent medical complexes, the HGAC region does not exhibit a high employment concentration in the Local Health Services cluster. The cluster employed 336,276 workers in 2025, making it one of the region's largest sources of employment, yet its location quotient was only 0.86. This indicates that healthcare services represent a smaller share of regional employment than the national average and suggests that, despite the presence of the Texas Medical Center, the broader region may not be fully self-sufficient in meeting its healthcare service needs. The contrast between a globally significant medical center and a comparatively under-concentrated regional healthcare workforce represents an important structural challenge as the region's population continues to grow.

This report concludes that technological change will not eliminate historically formed industrial agglomerations. Instead, it will redistribute functions within industrial value chains based on the accumulated capabilities of different regions. The Houston-Galveston Area Council (HGAC) region, particularly the metropolitan economic system centered on Houston, provides a representative case for understanding this process. Over the long term, energy, petrochemicals, advanced manufacturing, port logistics, and engineering services have constituted the region's most important sources of competitive advantage, forming one of the largest and most closely integrated industrial agglomeration systems in the United States. These accumulated industrial foundations have not only shaped the region's current economic structure but will also continue to influence its development trajectory under future technological transformations.

This issue is particularly important in the era of artificial intelligence. As a general-purpose technology capable of reshaping the entire production system, AI will not assign the same role to every region within the AI value chain. Metropolitan areas with strong concentrations of software innovation, venture capital, and internet platform firms may be more likely to specialize in model development and platform creation, whereas regions with strengths in energy, engineering, manufacturing, infrastructure, and logistics are more likely to undertake

applied industrial functions. Therefore, in the era of artificial intelligence and digitalization, Houston is more likely to develop new functional specializations in industrial artificial intelligence, energy-supported computing infrastructure, data centers, digital engineering, smart manufacturing and logistics.

These functional specializations will also generate new agglomeration externalities. As they become increasingly concentrated within the region, knowledge spillovers, supply chain coordination, and productivity gains may continue to strengthen regional competitiveness. At the same time, however, negative externalities such as rising electricity demand, competition for industrial land, traffic congestion, housing pressure, water consumption, and insufficient infrastructure capacity are likely to become more visible and may gradually turn into structural constraints on the region's long-term development.

Introduction and Methodology

1.1 Research Background

Economic activity is unevenly distributed across space. Over time, firms and workers have concentrated in places with favorable resources, transportation networks, infrastructure, institutional capacity, market scale, and specialized knowledge. These initial locational advantages provide the basis for industrial agglomeration, allowing economic activity to benefit from spatial proximity and increasing productivity(Fujita et al., 1999; Krugman, 1991).

Once an initial concentration forms, cumulative mechanisms reinforce it. Labor market pooling, supplier linkages, input-output relationships, and knowledge spillovers attract additional firms and workers(Duranton & Puga, 2004; Rosenthal & Strange, 2001). Over time, this process creates path dependence, meaning that earlier investments, infrastructure decisions, and institutional arrangements continue to shape regional industrial structure even after the original sources of advantage have changed(Martin & Sunley, 2006).

Agglomeration economies can be divided into localization economies and urbanization economies. Localization economies arise from the spatial concentration of firms within the same industry, improving productivity through specialized labor markets, suppliers, and industry-specific knowledge spillovers. Urbanization economies, on the other hand, derive from city size and industrial diversity, as shared infrastructure, universities and research institutions, public services, and broader market conditions jointly support the development of multiple industries(Glaeser et al., 1992; Moomaw, 1988). Together, these two mechanisms help explain why a small number of metropolitan areas can maintain high levels of innovation capacity and economic competitiveness over the long term.

Industry cluster theory further emphasizes that regional competitiveness is produced by networks of related firms, suppliers, institutions, infrastructure, and labor markets rather than by isolated industries(Porter, 1998). Strong clusters support productivity, employment growth, innovation, and

entrepreneurship. New industries also tend to emerge more easily in regions that already possess related capabilities(Neffke et al., 2011).

At the same time, agglomeration is not static. Transportation technologies, port infrastructure, highways, pipelines, containerization, digital networks, trade policy, energy transitions, and artificial intelligence all reshape where economic activities locate, and which functions different regions perform(Glaeser & Kohlhase, 2004; Puga, 1999). Therefore, the main question is not only where industrial clusters are concentrated, but also how existing agglomerations are reorganized across value chains as technological, infrastructural, and market conditions change. This report examines that question through the case of the HGAC region.

1.2 Research Questions

This report is organized around four research questions:

- *Which industries have formed long-term specialization in the HGAC region since 1990?*
- *How have these clusters changed in employment scale, location quotients, subcluster composition, and shift-share effects changed over time?*
- *How are industrial functions distributed across counties and business locations within the region?*
- *What risks, constraints, and strategic opportunities emerge as the region moves toward energy transition, digitalization, and AI-enabled industrial systems?*

1.3 Study Area

The study area is the HGAC 13 counties: Austin, Brazoria, Chambers, Colorado, Fort Bend, Galveston, Harris, Liberty, Matagorda, Montgomery, Walker, Waller, and Wharton Counties. The report analyzes the region at both the aggregate regional

scale and the county scale, comparing performance against Texas and the United States where appropriate.

1.4 Data Sources and Cluster Definitions

1.4.1 Employment Data

The primary employment dataset used in this report is [the Quarterly Census of Employment and Wages](#) (QCEW), published by the U.S. Bureau of Labor Statistics (BLS). QCEW provides employment and establishment data by detailed NAICS industry classification and geographic unit. Covering approximately 95 percent of U.S. employment, it is one of the most comprehensive and consistent sources for measuring long-term employment trends in the United States. Therefore, this report uses QCEW as the primary data source for measuring industry size, industrial structure, regional specialization, and long-term cluster evolution.

[County Business Patterns](#) (CBP), published by the U.S. Census Bureau, is used as a complementary dataset. CBP supports historical cross-checking, establishment-based analysis, and selected time-series comparisons where appropriate.

Employment and establishment data are used for the following analyses:

- *Employment analysis*
- *Establishment analysis*
- *Location quotient (LQ) calculation*
- *Shift-share analysis*
- *Industry cluster and subcluster evolution analysis*

1.4.2 Gross Domestic Product Data

Regional economic output is measured using GDP by industry data published by [the U.S. Bureau of Economic Analysis](#) (BEA). GDP data are used to evaluate the economic scale and industrial structure of the region and its counties.

Specifically, GDP data are used to analyze:

- *Total regional GDP*
- *County-level GDP*

- *Industrial GDP composition*
- *GDP growth trends*

1.4.3 Population and Income Data

Population and income data are primarily drawn from [the BEA Regional Economic Accounts](#) and population estimates from [the U.S. Census Bureau](#). These indicators are used to evaluate regional development from multiple dimensions, including demographic growth, income growth, productivity, and prosperity.

These data are used to measure:

- *Population growth*
- *Personal income growth*
- *GDP per capita*
- *Income per capita*
- *Productivity change*

1.4.4 Establishment-Level Business Data

To overcome the spatial limitations of county-level statistics, this report incorporates establishment-level business data from Data Axle. Data Axle provides business location data at the establishment level, allowing the report to examine the spatial organization of economic activity in greater detail.

These data are used for:

- *Establishment spatial distribution analysis*
- *Identification of industrial agglomerations*
- *Industrial corridor analysis*
- *Identification of emerging industrial centers*

1.4.5 Geographic Data

Spatial analysis in this report uses geographic data including county boundary shapefiles, transportation network data, and GIS reference layers. These datasets provide the spatial foundation for mapping industry clusters, establishment distributions, county specialization, and industrial corridors.

The geographic data are used to display:

- *Employment spatial distribution*
- *Industry cluster distribution*
- *County-level specialization patterns*

- *Spatial distribution of emerging and declining industries*
- *Industrial corridors and economic centers*

1.5 Industry Cluster Definitions

Industry clusters are defined using [the U.S. Cluster Mapping Project](#) framework developed by the Institute for Strategy and Competitiveness at Harvard Business School in collaboration with the U.S. Economic Development Administration. This framework groups detailed NAICS industries into economically related clusters based on production linkages, occupational similarity, technological relatedness, supply chain relationships, and patterns of spatial co-location.

The framework distinguishes between two broad types of clusters:

- *Traded clusters*
- *Local clusters*

The framework further classifies industries into:

- *Cluster*
- *Subcluster*

Local clusters primarily serve internal regional demand and are therefore present in nearly all regions. Traded clusters, by contrast, serve markets beyond the local region and are more closely associated with exports, innovation, productivity growth, and regional competitiveness.

To maintain consistency, industries not covered by the Cluster Mapping framework are excluded from the cluster analysis. These excluded industries include:

- *Crop and Animal Production, NAICS 111–112*
- *Postal Services, NAICS 491110*
- *Public Administration, NAICS 92*
- *Selected funds and trust-related industries, NAICS 525110, 525120, 525190, and 525920*
- *Private Households, NAICS 814110*

After excluding these industries, the cluster framework still covers approximately 93 percent of total QCEW employment during the study period.

1.6 Analytical Methods

Method	Questions	Main Output
Regional economic structure analysis	How has population, GDP, productivity, and income changed?	Regional growth quality and county typology
Location quotient analysis	Which industries are specialized relative to Texas and the U.S.?	Long-term, emerging, and declining specialization
Spatial analysis	Where are firms and cluster activities located?	Business nodes, industrial corridors, county functions
Subcluster analysis	How has each cluster's internal structure changed?	Functional composition within the cluster
Shift-share analysis	Did employment change come from national growth, industry mix, or regional competitiveness?	National Growth, Industry Mix, Regional Shift
Functional specialization analysis	Which parts of the value chain are performed in different places?	Headquarters, engineering, manufacturing, logistics, digital infrastructure roles

Overall, agglomeration is identified through high employment concentration, elevated LQ values, and dense establishment locations. Path dependence is observed through long-term LQ stability, sustained employment scale, and continuity in subcluster composition. Regional competitiveness is measured through the Regional Shift component of shift-share analysis. Functional specialization is inferred from subcluster structure, county employment distribution, and business establishment geography.

1.7 Limitations

- QCEW data are subject to confidentiality-related disclosure restrictions at detailed county-industry levels. When publication could reveal identifiable information about an individual employer, the Bureau of Labor Statistics suppresses employment, wage, and related measures. Because disclosure status may change across years, detailed county- or subcluster-level data may show temporary increases or decreases that partly reflect changes in suppression status. Annual movements may also result from establishment openings or closures, business expansion or contraction, relocation, industry reclassification, or changes in how multi-establishment firms report their worksites. The analysis therefore avoids drawing conclusions from isolated annual changes. Overall trends are assessed using multiple

years of disclosed observations, establishment counts where available, and broader county or regional aggregates.

Suppressed employment values are identified as undisclosed, are not treated as actual employment values, and are not imputed in this analysis. CBP, QCEW, and Data Axle differ in coverage, timing, establishment definitions, and employment estimation methods; they are used only for complementary purposes.

- NAICS code is revised on a five-year cycle, with particularly significant classification changes in 2017 and 2022. To ensure comparability over time, industry codes are harmonized using NAICS crosswalks before applying cluster definitions.
- Data Axle is most useful for spatial pattern recognition; official employment totals should continue to rely primarily on QCEW.
- GDP by industry (2-digit NAICS code) is a value-added measure and does not map perfectly to cluster-level employment definitions (based on 6-digit NAICS code).

Regional Economic Structure

2.1 Analytical Framework

Economic development can be evaluated through multiple dimensions. Relying on a single indicator often provides only a partial understanding of regional performance. Population growth may indicate attractiveness and market expansion, while GDP growth reflects economic output. GDP per capita captures changes in productivity and economic efficiency, whereas personal income reflects the extent to which economic growth translates into improved living standards.

To provide a comprehensive assessment of regional development, this study adopts a four-dimensional evaluation framework consisting of population, GDP, GDP per capita, and personal income. Together, these indicators capture the scale, productivity, and prosperity of local economies and allow counties to be classified according to different development paths.

It should be noted that personal income data published by the Bureau of Economic Analysis (BEA) are reported in current dollars and are not adjusted for inflation. Therefore, income growth should be interpreted primarily as an indicator of changes in income levels and relative prosperity rather than changes in real purchasing power.

2.2 Regional Growth Performance

Using the four-dimensional framework described above, this section evaluates the long-term performance of the HGAC region relative to Texas and the United States. Examining changes in population, economic output, productivity, and income provides insight into whether regional growth has been driven primarily by demographic expansion, improvements in economic efficiency, or a combination of both. Comparing HGAC with state and national benchmarks also helps place

regional performance within a broader economic context.

Compared with both Texas and the United States, the HGAC region experienced strong population growth and sustained economic expansion between 2001 and 2024 (**Table 1**). Regional population increased from approximately 5.0 million residents to 7.9 million residents, representing growth of 59 percent. This exceeded both the Texas average of 47 percent and the national average of 19 percent.

During the same period, real GDP increased from \$308.4 billion to \$594.9 billion, representing growth of approximately 93 percent (**Table 2**). Although this growth rate was lower than the statewide increase of 118 percent, it substantially exceeded the national growth rate of 64 percent. As the economic center of Southeast Texas, the HGAC region remained one of the state's most significant contributors to economic output and employment growth.

Regional GDP growth substantially exceeded population growth, indicating that economic expansion was driven not only by demographic growth but also by improvements in productivity, business investment, and industrial development. Real GDP per capita increased from approximately \$61,800 in 2001 to \$75,000 in 2024, representing growth of 21 percent (**Table 3**). However, this increase lagged behind both Texas (48 percent) and the United States (38 percent).

Per capita personal income increased from \$34,086 in 2001 to \$76,376 in 2024, representing growth of 124 percent (**Table 4**). Although part of this increase reflects inflation, the overall trend indicates substantial improvements in income levels and regional prosperity. Throughout the study period, HGAC maintained higher income levels than both Texas and the United States. In 2024, regional per capita personal income exceeded the Texas average by approximately \$6,500 and remained above the national average, reflecting the concentration of relatively high-paying industries within the region.

Table 1. Population and Growth Rate: HGAC Region, Texas, and United States, 2001–2024

	2001	2010	2024	Growth Rate (2001-2024)
HGAC	4,989,758	6,114,278	7,931,741	59.0%
Texas	21,319,622	25,238,386	31,290,831	46.8%
US	284,968,955	309,378,227	340,110,988	19.4%

Source: the U.S. Bureau of Economic Analysis and the U.S. Census Bureau.

Table 2. Real GDP and Growth Rate: HGAC Region, Texas, and United States, 2001–2024 (in Thousands of Dollars)

	2001	2010	2024	Growth Rate (2001-2024)
HGAC	\$308,361,215	\$404,106,330	\$594,947,447	92.9%
Texas	\$1,020,517,032	\$1,323,059,067	\$2,221,943,292	117.7%
US	\$14,230,726,000	\$16,789,750,000	\$23,358,435,000	64.1%

Source: the U.S. Bureau of Economic Analysis

Table 3. Real GDP per Capita and Growth Rate: HGAC Region, Texas, and United States, 2001–2024

	2001	2010	2024	Growth Rate (2001-2024)
HGAC	\$61,799	\$66,092	\$75,008	21.4%
Texas	\$47,868	\$52,422	\$71,009	48.3%
US	\$49,938	\$54,269	\$68,679	37.5%

Table 4. Per Capita Personal Income and Growth Rate: HGAC Region, Texas, and United States, 2001–2024

	2001	2010	2024	Growth Rate (2001-2024)
HGAC	\$34,086	\$45,186	\$76,376	124.1%
Texas	\$29,601	\$38,911	\$69,823	135.9%
US	\$31,548	\$40,557	\$73,204	132.0%

Source: the U.S. Bureau of Economic Analysis

Overall, the HGAC region demonstrated strong long-term growth characterized by simultaneous increases in population, economic output, productivity, and income. Relative to Texas and the nation, the region’s most significant strength is its ability to attract population and maintain above-average income levels. These trends provide an important foundation for understanding the county-level development patterns and industrial dynamics discussed in subsequent sections.

2.3 County-Level Development Patterns

Despite strong regional growth, development outcomes varied significantly across counties. The four-dimensional framework reveals substantial differences in population growth, economic output, GDP per capita, and income levels. To further explain these differences, this section also examines real GDP growth by county and industry between 2001 and 2024. This industry-level comparison helps identify whether county growth was driven primarily by population expansion, capital-intensive industrial activity, high-value-added services, logistics and manufacturing growth, or local-serving demand.

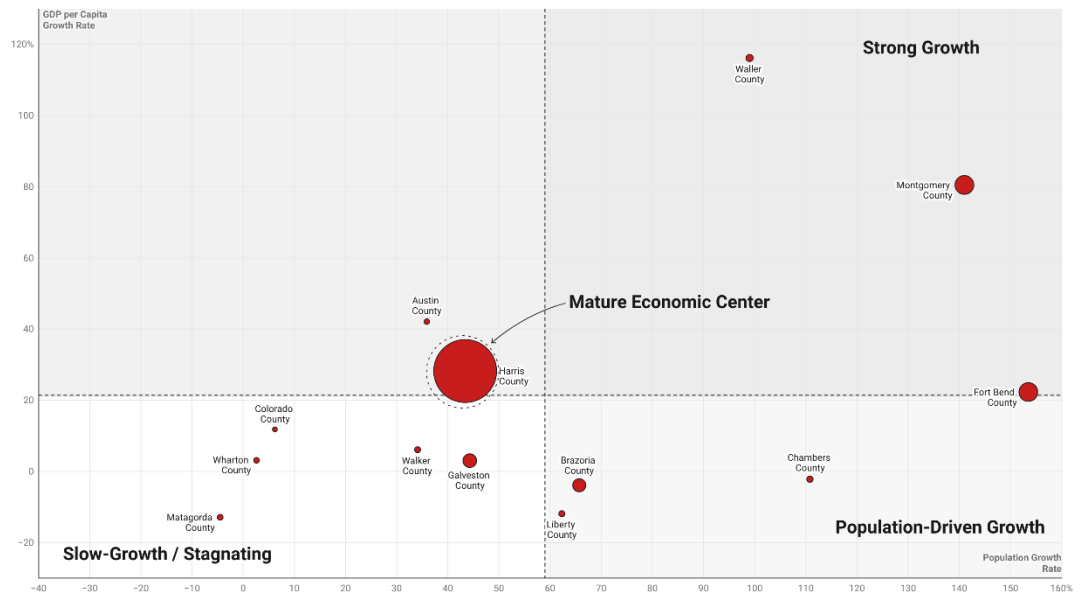
Strong Growth Counties

Montgomery County and Waller County emerged as the region's strongest growth performers.

Montgomery County recorded real GDP growth of 335 percent, accompanied by population growth of 141 percent and GDP per capita growth of 81 percent. Similarly, Waller County experienced GDP growth of 330 percent, population growth of 99 percent, and GDP per capita growth of 116 percent. In both counties, economic output expanded substantially faster than population growth, suggesting that growth was not driven by demographic expansion alone but was also associated with business investment, industrial development, and rising output intensity.

Population-Driven Growth Counties

Fort Bend County experienced the most significant population growth in the region, increasing by more



than 150 percent between 2001 and 2024. During the same period, GDP increased by 210 percent, while GDP per capita increased by only 22 percent. This pattern suggests that economic growth was closely associated with rapid suburban population expansion and residential development. Although economic performance remained strong, output growth relative to population growth was more modest than in Montgomery and Waller Counties. Brazoria County, Chambers County, and Liberty County exhibit similar characteristics, with population growth exceeding GDP growth and declining GDP per capita over the study period.

Mature and Stable Economic Centers

Harris County remains the dominant economic center of the HGAC region. In 2024, Harris County generated approximately \$459 billion in real GDP, accounting for more than three-quarters of total regional output. The county also recorded the highest GDP per capita level in the region, reaching approximately \$91,800. Its economic strength is supported by a diverse industrial base, including energy, logistics, advanced manufacturing, healthcare, and professional services.

Austin County, Galveston County, and Walker County are relatively stable. All counties maintain relatively high-income levels and economic bases but exhibit slower growth than rapidly expanding suburban counties.

Slow-Growth and Stagnating Counties

Several counties experienced relatively limited economic expansion. Colorado County and Wharton County recorded GDP growth rates below 20 percent and population growth rates below 10 percent. *Matagorda County represents the clearest case of economic stagnation.* Between 2001 and 2024, both population and GDP declined. Real GDP fell by approximately 17 percent, while population decreased by nearly 5 percent. Although personal income continued to increase, declining GDP and productivity indicators suggest weakening economic activity and reduced competitiveness.

Industrial Sources of Growth

Industry-level GDP growth provides further evidence

for the county development patterns (*Figure 1*).

Austin County's GDP increased from approximately \$869 million to \$1.85 billion, representing growth of about 113 percent. Growth was mainly driven by retail trade, manufacturing, real estate, professional services, and wholesale trade.

Brazoria County's GDP increased from approximately \$11.4 billion to \$18.4 billion, representing growth of about 60 percent. Manufacturing remained one of its largest sectors, increasing from about \$4.58 billion to \$5.16 billion. However, the fastest and largest gains came from real estate, health care, retail trade, manufacturing, and professional services. This indicates that Brazoria County remains a mature industrial county, but its recent growth has become more diversified and is no longer driven solely by traditional industrial production.

Chambers County's GDP increased from approximately \$1.28 billion in 2001 to \$2.69 billion in 2024, representing growth of about 110 percent. Growth was driven mainly by real estate, transportation, manufacturing, construction, and public administration. The rapid rise of transportation-related GDP suggests that logistics,

Figure 1. HGAC Real GDP Growth by County and Industry, 2001–2024 (in Thousands of Dollars)

	Austin	Brazoria	Chambers	Colorado	Fort Bend	Galveston	Harris	Liberty	Matagorda	Montgomery	Walker	Waller	Wharton
Agriculture	12K	14.2K	42.7K	-3.5K	-29.8K	-7.9K	-7.4K	-4.4K	-16.3K	-2.4K	-15.2K	31.1K	-18.9K
Mining	-48.2K	96.5K	-60.8K	-85.9K	618.5K	-125.3K	11M	-137.4K	-363.8K	1.5M	17.7K	-10K	-468.9K
Utilities	826	51.3K	-49.3K	3.1K	-40.9K	-230.1K	251.4K	7.6K	-145.5K	387.6K	1.1K	3K	478.2K
Construction	11.4K	379.5K	185.6K	21.8K	406.9K	165.1K	-1.7M	79.9K	11.4K	1.1M	48K	120.7K	-12.3K
Wholesale	96K	143.5K	-40.2K	-18.2K	1.8M	162.7K	33.3M	38.3K	2.4K	1.6M	11.3K	300.8K	42.5K
Information	88K	221.9K	-550	-3.3K	1.7M	148.7K	7.7M	55.9K	12.7K	786.9K	8.4K	6.1K	6.1K
Finance	1.7K	-54.5K	8.3K	-4.2K	352.3K	196.1K	3M	-6.4K	-17.2K	956.8K	6K	16K	-10.8K
Real Estate	140.8K	1.3M	364.9K	104.2K	6M	1.9M	28.4M	452.8K	-150.9K	4.4M	209.8K	195.6K	72.8K
Professional	99.4K	441.6K	68K	21.4K	1.3M	462.3K	26.1M	-32.6K	-13.1K	2.1M	49.4K	-24.7K	-25.2K
Management	38.8K	115.9K	0	0	223.7K	3.1K	9.6M	0	1.1K	1.3M	0	0	0
Administrative	29.8K	194.1K	44.5K	-4.8K	920.1K	360K	9.9M	31.1K	40.8K	803.5K	0	76.6K	19.5K
Education	21.2K	36.7K	-2	0	153.5K	30.1K	2.2M	0	2.4K	141.4K	7.7K	5.3K	7.6K
Health Care	56.2K	666.6K	-12.9K	0	2M	333.3K	13.6M	0	67.1K	1.9M	34.4K	47.4K	157.6K
Art	8.1K	76.8K	874	-3.6K	135.1K	54.8K	2.3M	-849	1.5K	141.8K	2.9K	23.7K	865
Accommodation	7.4K	160.9K	40.4K	-23.6K	566.4K	142.8K	2.5M	-41.2K	1.1K	633.9K	-5.7K	19.8K	2.4K
Other Services	-2.7K	19.3K	111.9K	-25.4K	339.2K	84.5K	767.2K	2.9K	-28.7K	423K	988	23.3K	-15.2K
Public Administration	-1.4K	320.7K	139.7K	244	2.1M	874K	8.5M	176.5K	-23K	1.6M	72.5K	153.9K	-30K
Manufacturing	173.6K	260.3K	219.1K	75.4K	4.8M	1.6M	36.7M	-70.6K	18.2K	8.4M	102.8K	2M	-7K
Retail	192.6K	643.1K	48K	31.2K	2.4M	785.7K	10.8M	107.2K	21.9K	1.7M	154.9K	161.6K	104.9K
Transportation	56.1K	68.2K	296.5K	17K	390.1K	157K	4.6M	76K	0	815.4K	852	166.4K	5K

port-related activity, and industrial corridor functions have become more important. Chambers County therefore reflects the outward expansion of the region's industrial corridor.

Colorado County's GDP increased from approximately \$648 million to \$750 million, growth of only about 16 percent. Growth was concentrated in real estate, manufacturing, retail trade, construction, and professional services, while mining declined significantly.

Fort Bend County's GDP increased from approximately \$13.4 billion in 2001 to \$39.4 billion in 2024, representing growth of about 195 percent. The largest absolute gains came from real estate, manufacturing, retail trade, public administration, and health care. Real estate increased by nearly \$6.0 billion, manufacturing by approximately \$4.8 billion, retail trade by about \$2.4 billion, and health care by about \$2.0 billion. These results show that Fort Bend County combines population-driven growth with emerging higher-output activities, including manufacturing, health care, and selected business functions.

Galveston County's GDP increased from approximately \$13.0 billion to \$20.1 billion, representing growth of about 54 percent. Growth was driven primarily by real estate, manufacturing, public administration, retail trade, and professional services. Manufacturing increased by about \$1.6 billion, while real estate increased by about \$1.9 billion. At the same time, utilities, mining, and agriculture declined. Overall, Galveston County can be understood as a mature coastal economy, where port, maritime, coastal infrastructure, manufacturing, public-sector, and real estate functions remain important.

Although **Harris County's** percentage growth was lower than rapidly expanding suburban counties because of its much larger initial base, its absolute GDP gains were by far the largest in the region. GDP increased from approximately \$254.2 billion in 2001 to \$463.6 billion in 2024, representing growth of about 82 percent. The largest absolute gains came from manufacturing, wholesale trade, real estate, professional services, health care, and mining. Manufacturing increased by approximately \$36.7 billion, wholesale trade by \$33.3 billion, real estate by \$28.4 billion, professional services by \$26.1 billion, and health care by \$13.6 billion. These results confirm Harris County's role as the

region's diversified management, engineering, finance, logistics, manufacturing, and business-service core.

Liberty County's GDP increased by only about 46 percent between 2001 and 2024. Growth was mainly associated with real estate, public administration, retail trade, construction, and transportation, while mining and manufacturing declined. This suggests that Liberty County's growth was more closely linked to population spillover, local services, public-sector activity, and peripheral development rather than broad-based high-output industrial expansion.

Matagorda County's GDP declined from approximately \$2.48 billion to \$1.90 billion, a decrease of about 23 percent. The main declines came from mining, real estate, and utilities. Although health care, administrative services, retail trade, manufacturing, and information recorded some growth, these gains were not large enough to offset the contraction in traditional sectors. This suggests weakening economic activity, reduced competitiveness, and limited industrial diversification.

Montgomery County's GDP increased from approximately \$9.3 billion in 2001 to \$39.9 billion in 2024, representing growth of about 328 percent. The largest absolute gains came from manufacturing, real estate, professional services, health care, and retail trade. Manufacturing alone increased by approximately \$8.4 billion, while real estate increased by about \$4.4 billion. Professional services, health care, and retail trade also recorded substantial gains. This pattern indicates that Montgomery County's growth was not simply a result of suburban residential expansion; it also reflected the expansion of manufacturing, business services, medical services, real estate development, and corporate functions.

Walker County experienced moderate but limited growth. Its GDP increased from approximately \$1.71 billion to \$2.41 billion, representing growth of about 42 percent. Growth was driven mainly by real estate, retail trade, manufacturing, public administration, and professional services. Public administration remained a large part of the county economy, suggesting that government, education, correctional, and public institutional functions continue to play an important role. Walker County therefore represents a stable local service and

public-sector economy rather than a major industrial growth center.

Waller County shows an even more striking industrial expansion pattern. Its GDP increased from approximately \$977 million in 2001 to \$4.29 billion in 2024, representing growth of about 339 percent, the highest among the counties examined. The largest gains came from manufacturing, wholesale trade, real estate, transportation, and retail trade. Manufacturing increased by nearly \$2.0 billion, while transportation and wholesale trade also grew rapidly. This suggests that Waller County's growth was closely related to industrial corridor expansion, logistics activity, manufacturing growth, and the outward movement of economic activity from the Houston metropolitan core.

Wharton County's GDP increased from approximately \$1.78 billion to \$2.09 billion, representing growth of about 17 percent. Growth was mainly associated with utilities, health care, retail trade, real estate, and wholesale trade, while mining and public administration declined. The results suggest that Wharton County did not experience broad-based industrial expansion during the study period.

2.4 Summary

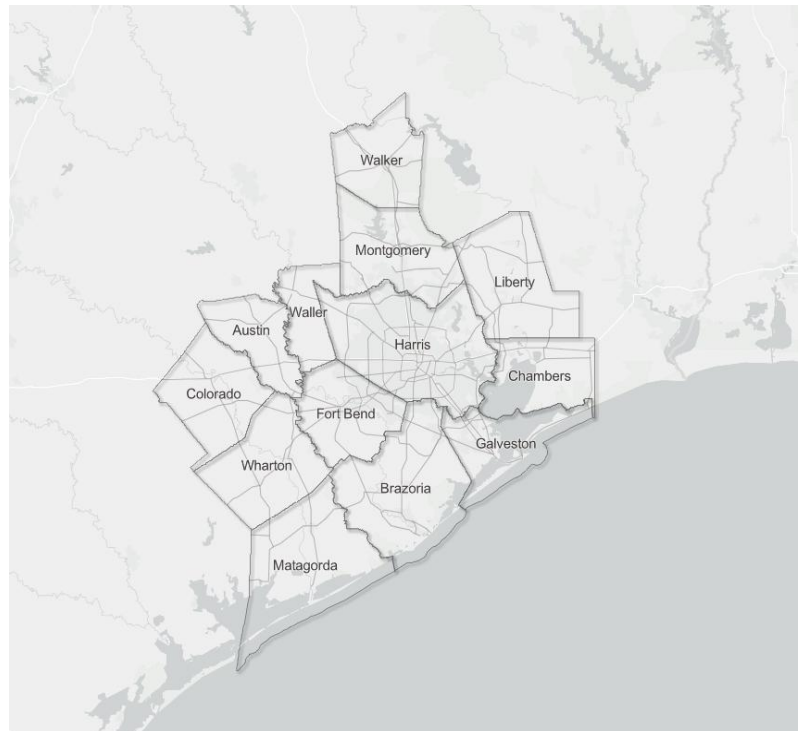
Spatial Differentiation and Polycentric Regional Growth

Overall, the county-level results show that growth in the HGAC region has not been spatially uniform. Instead, the region has developed a differentiated pattern of metropolitan expansion, industrial corridor growth, and peripheral stagnation.

The strongest examples of fast growth are concentrated northwest of Harris County, particularly in Montgomery County and Waller County. In both counties, population and GDP grew rapidly, and GDP growth exceeded population growth. This suggests that these counties are not simply absorbing suburban population spillovers but are also gaining industrial investment, logistics activity, manufacturing growth, business functions, and higher-output economic activities.

A second pattern is visible in the *suburban expansion belt surrounding Harris County*. Fort Bend County, Brazoria County, Chambers County,

and Liberty County all experienced substantial growth, but their growth patterns were more closely associated with suburbanization, population spillover, residential development, local-serving demand, and selected industrial or logistics functions. In these counties, population growth often exceeded or closely matched GDP growth, resulting in more modest gains or declines in GDP per capita. Fort Bend County represents the clearest case of population-driven suburban expansion, while Chambers County reflects a stronger industrial corridor and logistics component. Brazoria County retains an important petrochemical and industrial base, but its recent growth also reflects broader suburban and regional expansion dynamics.



Austin County and Galveston County show a more stable development pattern. Both counties experienced moderate population and GDP growth, suggesting steady economic development. Galveston County remains a mature coastal economy with port, maritime, manufacturing, public-sector, and real estate functions, while Austin County reflects a more stable peripheral economy supported by local-market activity, manufacturing, and real estate development.

The outer peripheral counties, including Colorado County, Wharton County, Matagorda County, and

Walker County, experienced much weaker growth.

Matagorda County represents the clearest case of stagnation, with both population and GDP declining during the study period. These results indicate that regional growth has not spread evenly across the thirteen-county area. Instead, growth has been concentrated along specific suburban corridors, industrial corridors, and metropolitan expansion zones, while more distant peripheral counties have experienced slower or more uneven development.

Taken together, these findings suggest that the HGAC region is evolving from a predominantly Harris-centered metropolitan economy toward a more polycentric regional structure. However, this transition is uneven. Some counties are gaining higher-output industrial and business functions, some are expanding primarily through suburban population growth and local-serving demand, and others remain more dependent on slower-growing legacy or peripheral economic activities. This spatial differentiation provides an important foundation for understanding the organization of industry clusters and county-level functional specialization in later chapters.

Long-Term Specialized Clusters

3.1 Long-Term Specialized Clusters

Location Quotient (LQ) analysis indicates that the Houston-Galveston Area Council (HGAC) region has developed a highly specialized industrial structure that has remained remarkably stable over the past three decades. Using an LQ threshold of 1.25, five clusters consistently maintained specialization relative to both Texas and the United States throughout the 1990–2025 study period: Oil and Gas Production and Transportation, Upstream Chemical Products, Construction Products and Services, Water Transportation, and Local Industrial Products and Services. The long-term persistence of these clusters demonstrates that Houston's regional competitiveness is supported by a mature and diversified industrial base rather than temporary economic cycles or short-term market fluctuations.

Although all five clusters remained specialized throughout the study period, substantial differences exist in the degree of specialization. Four clusters—*Oil and Gas Production and Transportation*, *Upstream Chemical Products*, *Construction Products and Services*, and *Water Transportation*—exhibit particularly strong and persistent competitive advantages, whereas *Local Industrial Products and Services* maintains a comparatively moderate but highly stable level of specialization. Together, these clusters form the foundation of Houston's long-term industrial competitiveness.

3.2 Oil and Gas Production and Transportation

3.2.1 Cluster Overview

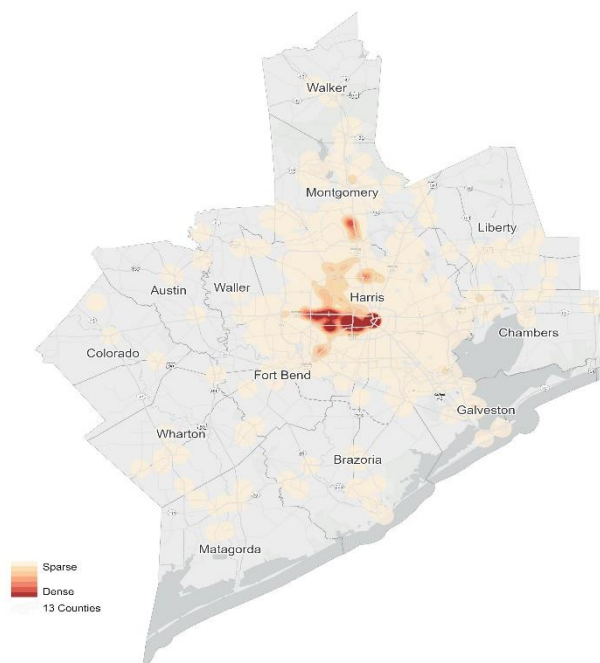
Among all clusters, Oil and Gas Production and Transportation exhibits by far the strongest specialization. Relative to the United States, its LQ increased from 7.07 in 1990 to 9.32 in 2025 and remained above 7.0 throughout the study period, reaching a peak of 12.97 in 2005. Even when benchmarked against Texas—the nation's leading energy-producing state—the cluster consistently maintained an LQ between approximately 1.3 and

2.2, indicating that Houston's concentration of energy-related activities substantially exceeds both the national and state averages. This exceptional specialization reflects Houston's role as the nation's leading center for energy company headquarters, engineering services, oilfield services, commodity trading, finance, and integrated energy management.

3.2.2 Spatial Organization

The spatial distribution of business establishments (**Figure 2**) provides important insights into how Houston's Oil and Gas Production and Transportation cluster is geographically organized. According to the map, establishments exhibit a highly concentrated metropolitan spatial pattern centered in Harris County. *The overwhelming majority of firms are located within Houston's metropolitan business core, particularly in Downtown Houston, the Galleria area, and the Energy Corridor, where they form a continuous concentration of corporate headquarters, engineering companies, oilfield service firms, and*

Figure 2. 2025 Oil and Gas Production and Transportation Establishment Density



specialized business services. This pronounced monocentric agglomeration reflects decades of cumulative localization economies, specialized labor markets, knowledge spillovers, and dense inter-firm networks. The spatial concentration of firms indicates that Houston functions as the organizational center of the regional energy economy.

Outside the metropolitan core, establishments gradually expand toward several secondary business nodes. To the north, firms extend into southern Montgomery County, particularly around The Woodlands, where the continued growth of corporate offices, engineering firms, and oilfield service companies has created an important extension of Houston's metropolitan energy economy. Westward expansion toward Fort Bend County similarly reflects the decentralization of selected business and professional service activities while maintaining close functional integration with the metropolitan core.

Overall, the spatial organization of the Oil and Gas Production and Transportation cluster demonstrates that Houston's competitive advantage is fundamentally derived from the concentration of knowledge-intensive business activities rather than the location of natural resources alone. The metropolitan business core serves as the command center of a much broader regional and national energy production network, coordinating exploration, engineering, finance, logistics, and

operational activities across multiple producing regions.

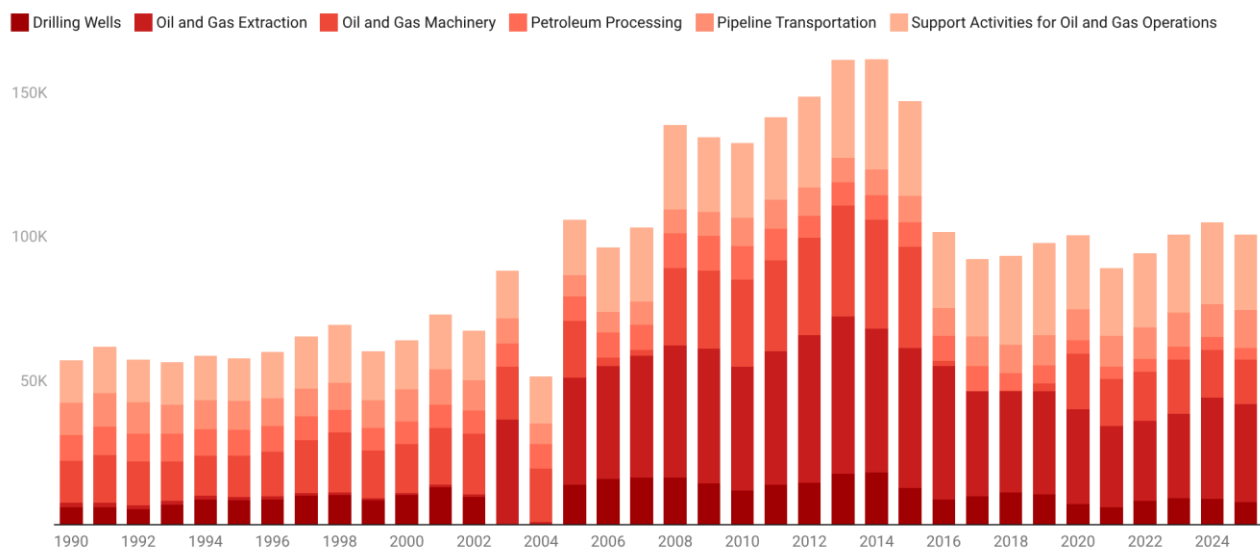
3.2.3 Subcluster Evolution and Regional Functional Division

The internal composition of the Oil and Gas Production and Transportation cluster (**Figure 3**) illustrates how Houston's energy economy has evolved in response to technological innovation, commodity price cycles, and structural changes in the global energy industry. Rather than responding uniformly to external shocks, different subclusters exhibit distinct long-term development patterns that reflect their respective positions within the energy value chain and collectively demonstrate the resilience of Houston's integrated energy economy.

By 2025, Oil and Gas Extraction had become the largest subcluster, accounting for 33.9 percent of total cluster employment (34,128 employees), followed by Support Activities for Oil and Gas Operations (26 percent; 26,207 employees), Oil and Gas Machinery (15.4 percent; 15,495 employees), Pipeline Transportation (13.1 percent; 13,150 employees), Drilling Wells (7.7 percent; 7,749 employees), and Petroleum Processing (4 percent; 4,000 employees).

Compared with 1990, the internal composition changed substantially. Oil and Gas Extraction

Figure 3. Oil and Gas Production and Transportation Cluster Composition, 1990-2025



expanded from only 2.6 percent of total employment to become the dominant activity, while Support Activities for Oil and Gas Operations maintained a consistently large employment base throughout the study period. Together, these two subclusters accounted for around 60 percent of total cluster employment by 2025. In contrast, Oil and Gas Machinery and Petroleum Processing gradually declined in relative importance, whereas Pipeline Transportation maintained a comparatively stable employment base.

These structural changes closely correspond to several major developments in the U.S. energy industry. During the 1990s, relatively low oil prices constrained upstream investment, making equipment manufacturing, refining, engineering services, and pipeline transportation the primary sources of employment. Beginning in the early 2000s, advances in horizontal drilling and hydraulic fracturing technologies triggered the shale revolution, dramatically expanding domestic oil and gas production. Although major producing regions such as the Permian Basin and Eagle Ford are located outside Houston, the metropolitan area benefited disproportionately because it functions as the headquarters location for major energy companies and the national center for engineering, finance, oilfield services, and project management. Consequently, employment in Oil and Gas Extraction and Support Activities expanded rapidly. Employment dynamics also reveal substantial differences in cyclical sensitivity across the energy

value chain. Drilling Wells exhibited the strongest cyclical fluctuations, closely tracking oil prices and capital investment. Oil and Gas Machinery experienced the most pronounced structural decline following the 2014–2016 oil price collapse, reflecting the capital-intensive nature of oilfield equipment manufacturing. In contrast, Pipeline Transportation remained comparatively stable because pipeline infrastructure operates under long-term transportation contracts, while Petroleum Processing experienced a gradual decline primarily associated with automation and productivity improvements.

The regional distribution of subclusters further demonstrates that the HGAC energy cluster is characterized by functional specialization rather than homogeneous development across counties (**Table 5**). Harris County overwhelmingly dominates regional employment, consistently accounting for approximately ninety percent of total cluster employment throughout the study period. Unlike surrounding counties, Harris County contains every major segment of the energy value chain, including corporate headquarters, exploration management, oilfield services, engineering, equipment manufacturing, pipeline transportation, and petroleum processing. This diversified industrial structure reinforces Houston's position as the nation's integrated energy management and innovation center.

Table 5. 2025 Oil and Gas Production and Transportation Cluster Establishments and Employment Composition by county

	Drilling Wells	Oil and Gas Extraction	Oil and Gas Machinery	Petroleum Processing	Pipeline Transportation	Support Activities
Austin	1 (0)*	1 (0)*	2 (0)*		2 (0)*	6 (0)*
Brazoria	2 (0)*	7 (0)*	12 (124)	1 (0)*	17 (0)*	28 (0)*
Chambers		8 (0)*	2 (0)*		20 (511)	12 (0)*
Colorado	2 (0)*	2 (0)*	1 (0)*			4 (0)*
Fort Bend	7 (209)	26 (84)	21 (0)*	5 (0)*	5 (0)*	82 (2,349)
Galveston	3 (0)*	10 (0)*	1 (0)*	8 (0)*	2 (0)*	32 (311)
Harris	96	423	256	49	144	739

	(7,540)	(33,021)	(15,044)	(4,000)	(10,935)	(20,482)
Liberty	2	3	3		8	18
	(0)*	(0)*	(0)*		(0)*	(0)*
Matagorda	1	2			11	4
	(0)*	(0)*			(0)*	(0)*
Montgomery	26	41	28	3	12	126
	(0)*	(1,023)	(0)*	(0)*	(1,637)	(3,055)
Walker	3	3	6		3	10
	(0)*	(0)*	(327)		(0)*	(10)
Waller	1	1	7		1	13
	(0)*	(0)*	(0)*		(0)*	(0)*
Wharton	2	10	3		8	36
	(0)*	(0)*	(0)*		(67)	(0)*

Notes: the number above represents the number of establishments, while the number in parentheses below represents employment. * indicates that employment data is undisclosed or suppressed for confidentiality purposes.

Outside Harris County, surrounding counties perform complementary functions. Montgomery County has experienced rapid growth in Support Activities for Oil and Gas Operations and Oil and Gas Extraction, reflecting the continued expansion of corporate offices, engineering firms, and oilfield service providers around The Woodlands. Fort Bend County similarly maintains a concentration of oilfield services and professional business activities that support the metropolitan energy economy. For the rest of the counties, they often exhibit relatively high location quotients because of their small employment bases. This specialization, therefore, reflects the structure of the local economy more than the regional scale of the energy industry. Taken together, the evolution of the subcluster composition demonstrates that Houston's competitive advantage extends well beyond resource extraction alone. The region has developed a highly integrated energy ecosystem in which Harris County serves as the metropolitan core of management, innovation, engineering, and corporate services, while surrounding counties provide complementary production, logistics, processing, and operational functions. This functional division of labor strengthens regional

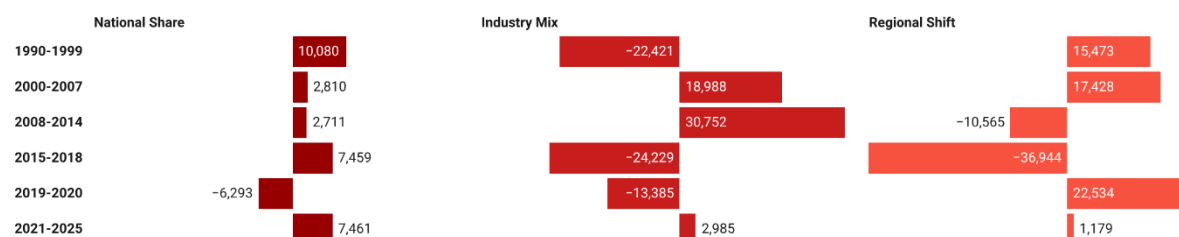
resilience by allowing different segments of the energy value chain to respond differently to external shocks.

3.2.4 Shift-Share Analysis

While the location quotient analysis demonstrates Houston's long-standing specialization in the Oil and Gas Production and Transportation cluster, and the subcluster analysis illustrates how the industry's internal structure has evolved, shift-share analysis complements the previous analyses by decomposing employment change into national growth, industry mix, and regional shift effects, thereby identifying the extent to which employment growth was driven by national economic conditions, industry-wide cycles, or Houston's own regional competitiveness.

The results (*Figure 4*) indicate that the development of Houston's energy cluster has been shaped by alternating periods of strong industry expansion and contraction, while the region's competitive position remained relatively strong over most of the study period.

Figure 4. Shift-Share Analysis of Oil and Gas Production and Transportation Cluster, 1990-2025



During 1990–1999, national economic growth contributed positively to employment, whereas the national oil and gas industry expanded more slowly than the overall U.S. economy, resulting in a negative industry mix effect. Despite unfavorable national industry conditions, Houston recorded a substantial positive regional shift (+15,473 jobs), indicating that the region outperformed the national energy industry and continued to strengthen its position as the country's leading energy center.

Between 2000 and 2007, both the industry mix effect (+18,988 jobs) and regional shift (+17,428 jobs) were strongly positive. Rising global energy demand, increasing oil prices, and expanding investment in upstream exploration created favorable industry conditions nationwide. Houston not only benefited from these industry-wide trends but also exceeded national performance, reflecting the region's ability to attract investment, corporate headquarters, engineering activities, and energy-related business services.

The period from 2008 to 2014 presents a different pattern. Although the industry mix effect reached its highest positive value (+30,752 jobs), reflecting the rapid expansion of the U.S. shale industry, the regional shift became negative (-10,565 jobs). This suggests that employment growth in Houston lagged behind the national industry average during this period. Rather than indicating declining specialization, the results reflect the rapid emergence of new production regions such as the Permian Basin, Eagle Ford, and Bakken, where drilling and extraction employment expanded more rapidly than in the Houston metropolitan area. As the national headquarters and service center of the energy industry, Houston continued to benefit from the shale revolution, but a growing share of production employment occurred outside the region.

The 2015–2018 period represents the weakest phase of the study period. Following the collapse of global oil prices beginning in late 2014, the national oil and gas industry experienced substantial employment losses, producing a large negative industry mix effect (-24,229 jobs). Houston also recorded the largest negative regional shift (-36,944 jobs), indicating that employment declined more rapidly than national industry trends.

Conditions improved during 2019–2020 despite the disruptions caused by the COVID-19 pandemic.

Although both national growth and industry mix remained negative because of the nationwide economic recession and the collapse in energy demand, Houston recorded a strong positive regional shift (+22,534 jobs). This indicates that the region performed considerably better than the national oil and gas industry, suggesting that its diversified energy ecosystem provided greater resilience than many production-oriented regions.

During the post-pandemic recovery between 2021 and 2025, all three shift-share components became positive. National economic recovery, improving industry conditions, and renewed regional competitiveness jointly contributed to employment growth. Although the regional shift was more modest than during previous expansion periods, the positive value indicates that Houston continued to strengthen its competitive position within the national energy economy.

3.2.5 Summary

Overall, the spatial organization, subcluster evolution, and shift-share analysis collectively demonstrate that Houston's long-term competitive advantage is derived from the integration of its regional energy ecosystem. The highly concentrated metropolitan spatial structure, the complementary functional specialization across counties, and the persistent positive regional competitive effects together indicate that Houston has developed an energy cluster whose strength extends well beyond resource extraction alone.

Also, counties within the HGAC region perform complementary roles across the energy value chain. Harris County serves as the metropolitan core for corporate headquarters, engineering, finance, technology, and integrated energy management, while surrounding counties contribute specialized functions in production support, transportation, refining, logistics, and field operations. This regional division of labor enables the cluster to benefit simultaneously from agglomeration economies within the metropolitan core and operational specialization across the broader region.

The shift-share results further demonstrate that although Houston's energy economy remains closely linked to global commodity cycles, its long-

term competitiveness is supported by localized capabilities that cannot be easily replicated elsewhere. Strong inter-firm networks, specialized labor markets, advanced business services, transportation infrastructure, and decades of accumulated industrial knowledge have enabled Houston to maintain its position as one of the world's leading integrated energy centers despite repeated technological, economic, and market disruptions.

3.3 Upstream Chemical Products

3.3.1 Cluster Overview

Upstream Chemical Products represents the second major source of Houston's long-term competitive advantage. Its LQ remained consistently between 5.26 and 6.80 relative to the United States and approximately 2.0 to 2.6 relative to Texas. The cluster benefits from abundant hydrocarbon feedstocks supplied by the regional energy industry, large-scale refining capacity, integrated petrochemical complexes, and extensive downstream manufacturing activities, making Houston one of the world's most competitive petrochemical production centers.

3.3.2 Spatial Organization

The spatial organization of the Upstream Chemical Products cluster (**Figure 5**) differs substantially from that of the Oil and Gas Production and Transportation cluster. Oil and gas firms are highly concentrated within Houston's central business districts, whereas chemical manufacturing establishments are distributed across multiple industrial production centers closely connected by transportation and utility infrastructure.

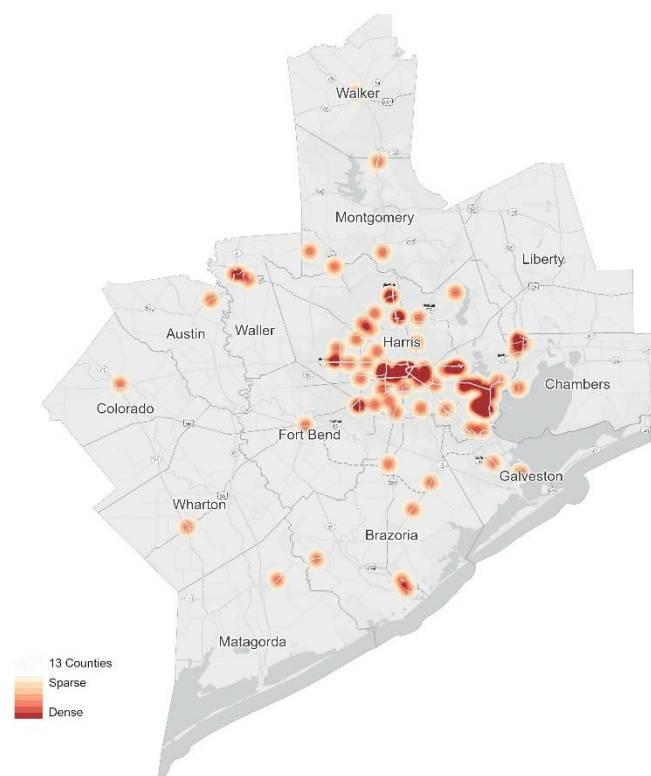
The largest concentration of establishments is located along the Houston Ship Channel, extending through Pasadena, Deer Park, La Porte, and Baytown. This corridor contains one of the world's largest concentrations of refineries, petrochemical complexes, storage terminals, pipeline networks, and export facilities. These facilities are highly interconnected through pipelines, ports, and utility systems, allowing basic feedstocks, intermediate chemicals, and downstream products to move

efficiently across different stages of the industrial value chain.

In addition to the Ship Channel, concentrations are also observed in southern Brazoria County around the Freeport petrochemical complex, while smaller manufacturing nodes are distributed across western Harris County, Fort Bend County, Montgomery County, and several surrounding counties. These dispersed industrial nodes indicate that chemical manufacturing depends not only on proximity to corporate headquarters but also on access to feedstock supply, industrial land, transportation infrastructure, utility systems, and large-scale production facilities.

The contrasting spatial patterns illustrate the different economic roles of the two industries. Oil and Gas Production and Transportation is primarily organized around corporate management, engineering, finance, and professional services, producing a highly concentrated metropolitan office cluster. In contrast, Upstream Chemical Products is fundamentally a manufacturing industry whose production facilities require extensive industrial infrastructure and large production sites.

Figure 5. 2025 Upstream Chemical Products Cluster Establishments Density



Consequently, the industry forms a distributed manufacturing network anchored by several major industrial complexes.

Overall, the spatial distribution demonstrates that Houston's chemical industry is supported by an integrated production network extending across the Gulf Coast industrial region. The close proximity among refineries, petrochemical plants, pipelines, marine terminals, and export facilities reduces transportation costs, facilitates material flows between successive production stages, and strengthens the competitiveness of one of the world's largest petrochemical manufacturing clusters.

3.3.3 Subcluster Evolution and Regional Functional Division

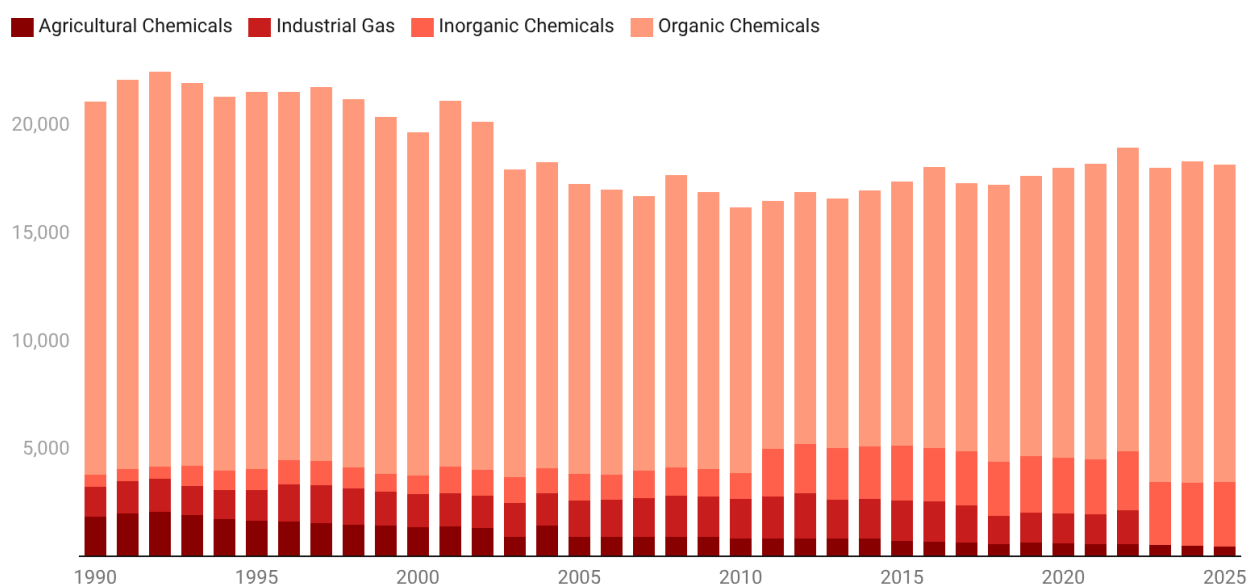
Compared with the Oil and Gas Production and Transportation cluster, the internal composition of Upstream Chemical Products exhibits considerably greater stability (*Figure 6*), reflecting Houston's long-established specialization in petrochemical manufacturing. Unlike upstream energy activities, which are strongly influenced by commodity price cycles and exploration investment, petrochemical manufacturing is supported by long-term industrial demand, integrated production facilities, and extensive downstream supply chains.

By 2025, Organic Chemicals remained the dominant subcluster, employing 14,686 workers and accounting for 80.9 percent of total cluster employment. Inorganic Chemicals employed 3,010 workers (16.5 percent), while Agricultural Chemicals accounted for only 448 employees (2.4 percent). Industrial Gas also maintained a relatively stable employment base of approximately 1,500 to 2,000 workers annually through 2022. Beginning in 2023, employment data for this subcluster were undisclosed because of confidentiality restrictions, although the number of establishments remained relatively stable, indicating the continued presence of Industrial Gas activity in the region.

The overall industrial structure changed only modestly during the study period. Organic Chemicals consistently accounted for approximately 70 to 82 percent of total employment, maintaining its dominant position throughout 1990–2025. Meanwhile, Inorganic Chemicals expanded steadily from 2.6 percent to 16.0 percent, becoming the second-largest subcluster, whereas Agricultural Chemicals gradually declined from 8.6 percent to 2.6 percent. These trends indicate that Houston's petrochemical industry has become increasingly concentrated in higher-value basic chemical intermediates while the relative importance of agricultural chemical production has diminished.

The county-level distribution of subclusters (*Table 6*) demonstrates an exceptionally high degree of

Figure 6. Upstream Chemical Products Cluster Composition, 1990-2025



manufacturing concentration. Harris County has consistently served as the dominant production center, accounting for virtually all employment in Agricultural Chemicals, Industrial Gas, and Inorganic Chemicals throughout most of the study period. In addition to its large refining capacity and petrochemical complexes along the Houston Ship Channel, Harris County also accommodates engineering services, research activities, pipeline infrastructure, and export facilities, forming the technological and operational core of the regional petrochemical industry.

Also, Brazoria County is heavily concentrated in Organic Chemicals. Throughout the study period, approximately 6,000 organic chemical

manufacturing jobs were consistently located in Brazoria County, reflecting the continued importance of the Freeport petrochemical complex. Therefore, Brazoria complements the regional manufacturing system by concentrating on large-scale production of ethylene, polyethylene, and other bulk chemical intermediates supplied to downstream manufacturers.

Outside these two counties, petrochemical manufacturing remains limited. Several surrounding counties contain only small numbers of specialized manufacturing establishments.

Table 6.2025 Upstream Chemical Products Cluster Establishments and Employment Composition by county

	Agricultural Chemicals	Industrial Gas	Inorganic Chemicals	Organic Chemicals
Austin		1 (0)*	2 (0)*	
Brazoria		6 (0)*	4 (100)	21 (6,282)
Chambers			1 (0)*	4 (0)*
Fort Bend		2 (0)*	3 (22)	4 (0)*
Galveston		5 (0)*	3 (0)*	7 (383)
Harris	9 (448)	45 (0)*	39 (2,888)	94 (7,303)
Liberty		1 (0)*		1 (0)*
Matagorda				3 (0)*
Montgomery		5 (0)*	1 (0)*	12 (718)
Walker			1 (0)*	
Waller	1 (0)*			1 (0)*
Wharton			1 (0)*	

Notes: the number above represents the number of establishments, while the number in parentheses below represents employment. * indicates that employment data is undisclosed or suppressed for confidentiality purposes.

3.3.4 Shift-Share Analysis

The shift-share results (Figure 7) show that the Upstream Chemical Products cluster experienced alternating periods of regional strength and structural pressure between 1990 and 2025. Across most periods, the industry mix effect was negative, indicating that the national upstream chemical industry grew more slowly than the overall economy or faced broader structural headwinds. This pattern suggests that the cluster's employment trajectory was shaped not only by local conditions, but also by national industry cycles, technological change, capital intensity, and productivity improvements that reduced the need for proportional employment growth.

During the 1990s, the cluster benefited from a positive national growth effect and a strong positive regional shift. Although the industry mix effect was substantially negative, the positive regional shift suggests that the HGAC region outperformed the national upstream chemical industry during this period.

From 2000 to 2014, the cluster continued to show positive regional shift effects, although the magnitude weakened over time. The positive regional shift in 2000–2007 and 2008–2014 indicates that the region retained competitive advantages relative to the national industry. However, the persistently negative industry mix effect shows that the broader upstream chemical sector faced slower employment growth at the national level. In this sense, the HGAC region's performance was relatively strong, but it was operating within an industry environment that was not broadly employment expansive.

The 2015–2018 period marked a change in the cluster's competitive position. While the national

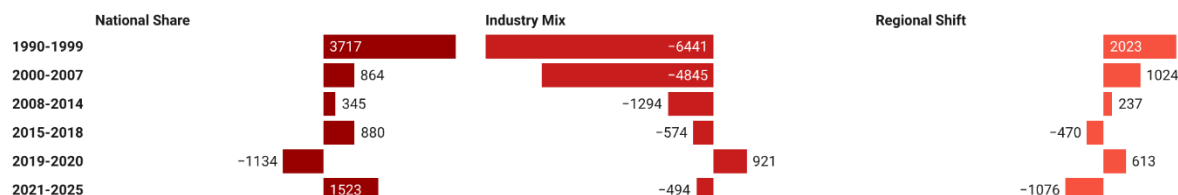
share remained positive and the industry mix effect became less negative, the regional shift turned negative. This indicates that local employment growth in the cluster underperformed what would have been expected based on national and industry trends. The result suggests a weakening of the region's employment-based competitive effect, even though the region remained a major center of petrochemical production.

During 2019–2020, the pattern shifted again. The national share effect was negative, reflecting the broader economic downturn during this short period, while both the industry mix and regional shift effects were positive. This suggests that the upstream chemical sector was relatively more resilient than the overall economy, and that the HGAC region performed better than expected relative to national trends.

In the most recent period, 2021–2025, the cluster benefited from a positive national share effect, but the regional shift became strongly negative. This indicates that although the broader economy recovered, the HGAC region's upstream chemical employment did not keep pace with national expectations for the cluster. This should not be interpreted as a loss of industrial competitiveness. Rather, it may suggest that the region's upstream chemical cluster has become increasingly capital-intensive and productivity driven.

Overall, the shift-share results indicate that the HGAC region historically held a strong competitive position in Upstream Chemical Products, particularly before 2015. However, the more recent negative regional shift suggests that employment growth in the cluster has become more constrained. The cluster remains a core part of the region's industrial base, but its future competitiveness is likely to depend less on large-scale job growth and more on productivity, infrastructure efficiency, feedstock access, technological upgrading, and integration with energy, logistics, and advanced manufacturing systems.

Figure 7. Shift-Share Analysis of Upstream Chemical Products Cluster, 1990-2025



3.3.5 Summary

Taken together, the location quotient, spatial organization, subcluster evolution, and shift-share analyses reveal that Houston's competitive advantage in Upstream Chemical Products is fundamentally rooted in its highly integrated manufacturing ecosystem. The region has maintained one of the nation's highest levels of industrial specialization while preserving a remarkably stable production structure centered on organic chemicals. Spatially, petrochemical manufacturing is organized around two complementary production hubs, Harris County and Brazoria County. They are connected through pipelines, port facilities, utility systems, and shared feedstock networks. Although national industry conditions have fluctuated over time, Houston has consistently sustained a strong manufacturing base through economies of scale, vertical integration, export-oriented production, and close linkages with the Gulf Coast energy industry. Together, these characteristics have enabled Houston to evolve beyond a traditional refining center into one of the world's largest and most competitive petrochemical manufacturing regions, reinforcing its strategic position within both the U.S. and global chemical supply chains.

3.4 Construction Products and Services

3.4.1 Cluster Overview

Construction Products and Services also maintained significant specialization over the entire study period. Although its LQ gradually declined from 4.98 in 1990 to 3.28 in 2025 relative to the United States, it consistently remained well above the specialization threshold. The sustained competitiveness of this cluster reflects continuous metropolitan expansion, rapid population growth, large-scale industrial investment, and persistent demand for residential, commercial, transportation, and energy-related infrastructure construction.

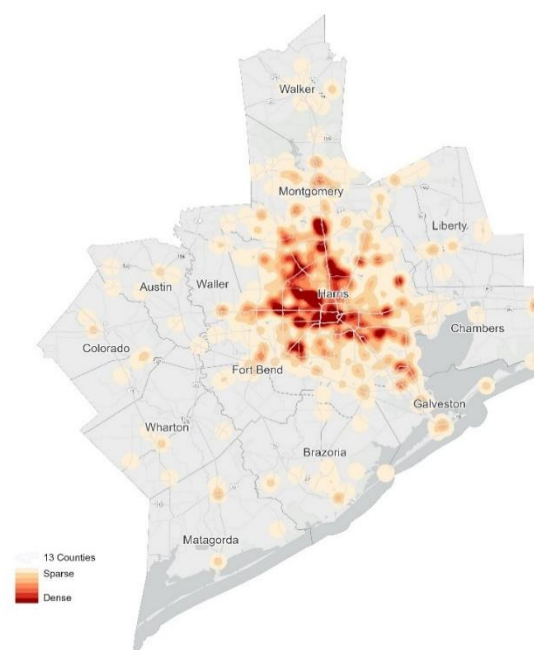
3.4.2 Spatial Organization

The spatial distribution of business establishments illustrates the market-oriented nature of the Construction Products and Services cluster (**Figure 8**). Based on the map, construction-related establishments are distributed throughout the expanding metropolitan area in close proximity to residential, commercial, industrial, and infrastructure development.

Although Harris County remains the largest concentration of establishments, the overall spatial pattern is considerably more dispersed than that of the energy and chemical industries. Construction firms are distributed across the entire Houston metropolitan area, forming a broad urban network. High concentrations extend continuously from central Houston into western Harris County, Fort Bend County, Montgomery County, and northern Brazoria County, closely corresponding to areas experiencing rapid population growth and suburban expansion.

A notable characteristic of the cluster is its strong relationship with the metropolitan transportation network. Construction establishments are widely

Figure 8. 2025 Construction Cluster Establishments Density



distributed along major highway corridors, including Interstate 10, Interstate 45, Interstate 69, Beltway 8, and the Grand Parkway. These transportation corridors connect rapidly growing residential communities, industrial parks, logistics centers, and commercial developments, allowing construction firms to efficiently serve projects across the metropolitan region. Rather than clustering around a single industrial facility, firms locate close to construction markets where demand is continuously generated.

Compared with the Oil and Gas Production and Transportation and Upstream Chemical Products clusters, the Construction Products and Services cluster exhibits substantially greater spatial coverage across suburban counties. Significant concentrations are observed in Montgomery County, Fort Bend County, Brazoria County, Galveston County, and portions of Liberty County, reflecting the rapid outward expansion of the Houston metropolitan area over recent decades. These counties have experienced sustained residential development, industrial investment, and infrastructure construction, creating strong and geographically dispersed demand for construction contractors, building products, utility installation, and engineering services.

The spatial pattern also demonstrates that construction activity closely follows urban development activities. Peripheral counties contain numerous local concentrations of establishments associated with new housing developments,

commercial centers, transportation projects, and public infrastructure improvements. Unlike export-oriented industries, most construction firms primarily serve local and regional markets, making proximity to customers a key determinant of business location.

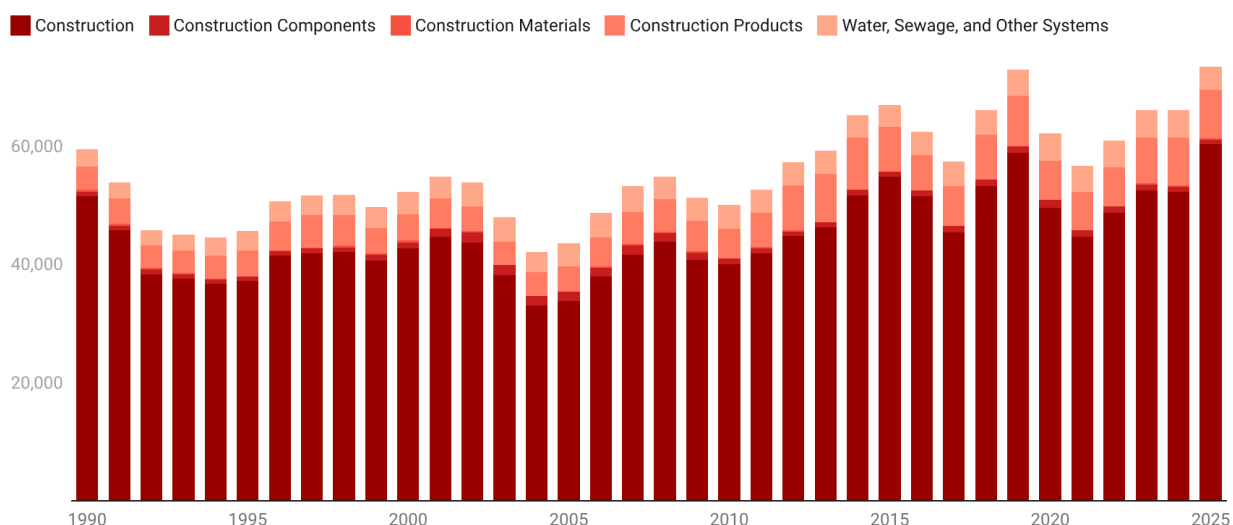
Overall, the spatial organization of the Construction Products and Services cluster reflects Houston's long-term metropolitan expansion. Continuous population growth, suburbanization, industrial investment, and infrastructure development have created a highly distributed construction market extending across the thirteen-county region. This broad geographic coverage strengthens the resilience of the construction industry by diversifying demand across multiple local markets while supporting the continued physical growth of the metropolitan economy.

3.4.3 Subcluster Evolution and Regional Functional Division

The internal composition of the Construction Products and Services cluster (*Figure 9*) has remained highly stable throughout the study period, indicating that Houston's competitive advantage is primarily concentrated in construction activities.

Construction consistently accounted for approximately 77–87% of total cluster employment, remaining the dominant subcluster throughout 1990–2025. In 2025, Construction represented

Figure 9. Construction Products and Services Cluster Composition, 1990-2025



82.1% of total employment (60,260 jobs), followed by Construction Products (11.2%, 8,261 jobs), Water, Sewage, and Other Systems (5.3%, 3,891 jobs), Construction Components (0.9%, 731 jobs), and Construction Materials (0.3%, 243 jobs).

Compared with 1990, the overall employment composition changed only modestly. Construction declined from 86.7% to 79.1%, while Construction Products expanded from 6.5% to 12.2%, becoming the second-largest subcluster. Water, Sewage, and Other Systems remained relatively stable, increasing slightly from 4.9% to 7.0%. Construction Components maintained a small but stable share, whereas Construction Materials remained negligible throughout the study period.

These trends suggest that Houston's construction cluster is driven primarily by downstream construction activities. Continuous population growth, metropolitan expansion, energy investment, industrial development, and large-scale infrastructure projects have generated sustained demand for residential, commercial, industrial, and utility construction. The gradual increase in Construction Products also reflects the growing importance of prefabricated building products and specialized construction equipment accompanying rapid metropolitan growth.

Table 7. 2025 Construction Products and Services Cluster Establishments and Employment Composition by county

	Construction	Construction Components	Construction Materials	Construction Products	Water, Sewage, and Other Systems
Austin	9 (9)*			1 (0)*	2 (0)*
Brazoria	66 (9,489)*	1 (0)*	1 (0)*	10 (152)*	16 (148)
Chambers	18 (0)*	1 (0)*		3 (0)*	2 (0)*
Colorado	2 (0)*	2 (0)*			5 (0)*
Fort Bend	43 (467)*	8 (0)*		8 (130)	16 (0)*
Galveston	46 (2,552)	5 (0)*		8 (0)*	19 (307)*
Harris	592 (41,373)	68 (731)	13 (243)	138 (7,615)	96 (3,352)
Liberty	21 (594)*	3 (0)*		5 (0)*	10 (28)
Matagorda	8 (0)*			2 (0)*	6 (0)*
Montgomery	90 (5,623)	13 (0)*		11 (364)	32 (0)*
Walker	7 (0)*				7 (40)
Waller	10 (62)	5 (0)*		2 (0)*	3 (16)
Wharton	8 (91)		1 (0)*		3 (0)*

Notes: the number above represents the number of establishments, while the number in parentheses below represents employment. * indicates that employment data is undisclosed or suppressed for confidentiality purposes.

Although Construction is the dominant subcluster throughout the HGAC region, county-level employment patterns (*Table 7*) reveal differences in the location and scale of the regional construction industry. These patterns reflect the distribution of construction firms and workers, as well as the influence of urban redevelopment, suburban expansion, industrial investment, port infrastructure, and public facility development. Because firms may undertake projects outside the county where they are located, construction employment should not be interpreted as a direct measure of local construction activity or demand.

Harris County has consistently remained the regional center of construction activity throughout the study period. Construction employment remained above 27,000 workers during every year of the analysis and reached 41,373 employees in 2025, accounting for approximately 72 percent of total regional Construction employment. The county’s large and diversified economy generates continuous demand for commercial office buildings, industrial facilities, healthcare institutions, educational campuses, public infrastructure, transportation projects, and urban redevelopment. However, the location of construction firms and employment does not necessarily correspond to the location of physical construction projects. Many firms based in Harris County also undertake housing, commercial, and infrastructure projects in surrounding counties, where construction activity follows the geographic distribution of new development across the region.

Brazoria County has emerged as the second-largest construction market within the region. Construction employment increased from 4,177 workers in 1990 to a peak of nearly 12,000 workers in 2019 before stabilizing at around 9,400 workers in 2025. Unlike Harris County, where construction demand is driven by a broad metropolitan economy and regional management functions, Brazoria County’s

construction growth reflects a dual set of drivers. On the one hand, the county’s petrochemical manufacturing base, energy facilities, LNG-related projects, manufacturing expansions, Port Freeport infrastructure, and supporting industrial facilities generate substantial industrial construction demand. On the other hand, Brazoria County has also been influenced by population growth and suburban expansion on the southern and southwestern edges of the Houston metropolitan area, which have increased demand for housing, roads, schools, healthcare facilities, and local-serving infrastructure. As a result, Brazoria County’s construction employment growth reflects both industrial investment and suburban development pressures.

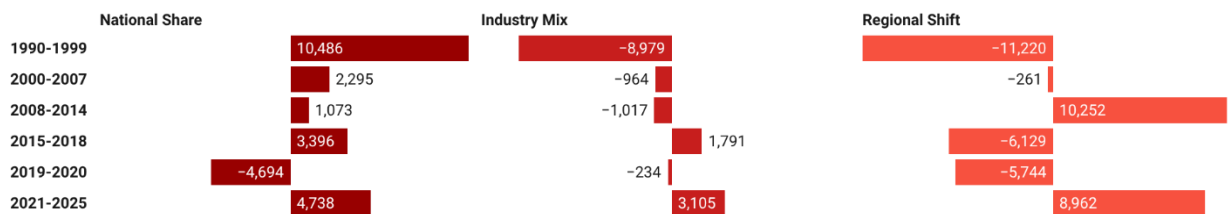
Montgomery County represents a different pattern of growth. Construction employment expanded from fewer than 400 workers in 1990 to more than 5,600 workers by 2025, reflecting the continued northward expansion of the Houston metropolitan area. Rapid development in The Woodlands, Conroe, and surrounding suburban communities increased demand for residential housing, corporate campuses, schools, healthcare facilities, and transportation infrastructure.

Galveston County has maintained relatively stable construction employment throughout the study period. Employment generally fluctuated between approximately 1,000 and 2,500 workers, supported by a combination of port-related infrastructure, tourism development, healthcare expansion, coastal redevelopment, and public infrastructure investment.

3.4.4 Shift-Share Analysis

From 1990 to 1999, the cluster underperformed despite positive national growth (*Figure 10*). The national share effect was positive, but both the

Figure 10. Shift-Share Analysis of Construction Products and Services Cluster, 1990-2025



industry mix effect and regional shift effect were negative. This suggests that construction-related employment in the HGAC region grew more slowly than expected during the 1990s, even though the region already had a strong construction specialization.

From 2000 to 2007, the cluster showed modest improvement. The positive national share effect supported employment growth, while the industry mix and regional shift effects remained slightly negative. This indicates that the cluster benefited from broader economic expansion, but regional construction employment growth was still relatively moderate.

The strongest regional performance occurred during 2008–2014. The regional shift reached 10,252 jobs, indicating that construction employment in the HGAC region grew much faster than national and industry trends would have predicted. The result was closely associated with the rapid expansion of the Houston metropolitan economy, particularly from 2010 onward, when population growth, employment expansion, residential and commercial development, energy-sector investment, and infrastructure construction generated substantial demand for construction labor. The positive regional shift therefore reflects the strong connection between construction employment and the broader regional growth cycle.

From 2015 to 2018, the cluster weakened temporarily. Although national and industry conditions were favorable, the regional shift turned negative at -6,129 jobs. This suggests that local construction employment growth slowed relative to national expectations, likely reflecting adjustment after the energy downturn and slower industrial construction activity.

The 2019–2020 period was the sharpest contraction. All three components were negative, reflecting the combined effects of macroeconomic disruption, short-term industry weakness, and regional employment decline during the COVID-19 period.

The cluster rebounded strongly during 2021–2025. The national share effect and industry mix effect were both positive, and the regional shift reached 8,962 jobs. This indicates that the cluster benefited from national recovery, favorable construction-related industry conditions, and renewed regional

demand. The positive regional shift shows that HGAC construction employment again grew faster than national expectations.

3.4.5 Summary

The Construction Products and Services cluster reflects Houston's role as one of the fastest-growing metropolitan economies in the United States. Its development is primarily supported by sustained regional demand generated through population growth, urban expansion, industrial investment, and large-scale infrastructure development. Spatial analysis shows that construction establishments are organized around the metropolitan core while extending outward along major transportation corridors into surrounding counties, closely following patterns of residential development, commercial growth, and industrial expansion. This geographic distribution demonstrates the close relationship between construction activity and the region's evolving urban structure.

The cluster's internal composition has remained remarkably stable over the past three decades. Construction activities consistently account for the overwhelming majority of employment, while construction products, utility infrastructure, and related manufacturing provide complementary support. County-level specialization further illustrates a functional division of labor, with Harris County serving as the regional construction center, Brazoria and Montgomery supporting rapid suburban and industrial growth, and Galveston contributing through coastal infrastructure and reconstruction activities.

Shift-share analysis indicates that although the global financial crisis and energy-sector adjustments created temporary shocks to construction employment, the region's competitive advantage recovered quickly during the economic recovery period.

Overall, the Construction Products and Services cluster functions as a foundational industry supporting Houston's long-term economic development. Continuous urbanization, diversified investment, and sustained regional growth have created a stable construction ecosystem that

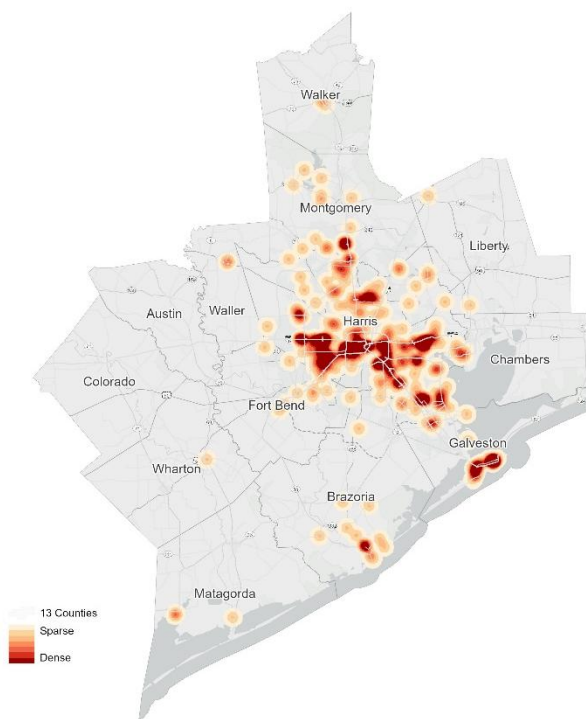
provides the physical infrastructure necessary for the expansion of every major industry within the region.

3.5 Water Transportation

3.5.1 Cluster Overview

Compared with the previous three clusters, Water Transportation exhibits a lower but highly stable degree of specialization. Its LQ remained between 1.62 and 2.21 relative to the United States and between approximately 2.2 and 2.9 relative to Texas throughout the study period. The consistently higher LQ relative to Texas further demonstrates Houston's dominant position within the state's maritime economy. Centered on the Port of Houston, this cluster supports international trade in crude oil, refined petroleum products, petrochemicals, industrial machinery, and other manufactured goods, reinforcing Houston's role as one of the nation's most important logistics gateways.

Figure 11. 2025 Water Transportation Cluster Establishments Density



3.5.2 Spatial Distribution

The spatial distribution of establishments reveals the geographic organization of Houston's Water Transportation cluster (*Figure 11*). Water transportation activities exhibit a distinct port-oriented spatial structure shaped by maritime infrastructure, navigable waterways, industrial waterfronts, and international trade networks.

The largest concentration of establishments is located along the Houston Ship Channel, extending from Downtown Houston through the eastern industrial corridor toward Pasadena, Deer Park, Baytown, and the Port Houston complex. Firms are organized along the navigation channel, where port terminals, logistics facilities, warehouses, freight forwarders, shipping companies, and marine service providers are concentrated. This spatial pattern reflects the industry's dependence on deep-water port infrastructure, maritime accessibility, and direct connections with industrial production and trade flows.

Beyond the Houston Ship Channel, the cluster extends southeast toward Galveston County and southward toward Brazoria County, forming a broader Gulf Coast maritime corridor. Galveston County contains an important concentration around the Port of Galveston, supporting cruise operations, cargo handling, offshore service vessels, ship repair, and maritime logistics. Brazoria County forms another important coastal-industrial node around Freeport and Port Freeport, where water transportation activities are closely tied to petrochemical manufacturing, LNG-related activity, bulk cargo movement, port infrastructure, and industrial logistics. These coastal nodes complement Port Houston and expand the region's maritime functions beyond the metropolitan core.

The corridor connecting Harris County, Galveston County, and Brazoria County represents the dominant development axis of the Water Transportation cluster. Firms are concentrated along the Houston Ship Channel, Galveston Bay, and the Freeport industrial-port area, illustrating the close integration between water transportation, petrochemical manufacturing, energy infrastructure, international trade, and multimodal logistics. The spatial overlap with the Oil and Gas Production and Transportation cluster and the Upstream

Chemical Products cluster further demonstrates the strong industrial linkages among these sectors.

Overall, the spatial organization of the Water Transportation cluster demonstrates that Houston's competitive advantage is derived from an integrated regional port system. The combination of Port Houston, the Houston Ship Channel, the Port of Galveston, Port Freeport, extensive inland transportation infrastructure, and close connections with petrochemical, energy, and logistics industries has created one of the most comprehensive maritime transportation ecosystems in North America.

3.5.3 Subcluster Evolution and Regional Functional Division

Water Transportation exhibits the highest degree of internal concentration among all four specialized clusters. Marine Transportation Services consistently accounted for more than 90% of total cluster employment throughout the study period (Figure 12).

In 2025, Marine Transportation Services employed 15,471 workers, representing 99.9% of total cluster employment. Employment data for Boat Building and Repairing were suppressed in several years, resulting in apparent fluctuations and limiting direct comparisons over time. However, the number of establishments remained relatively stable at several

dozen, indicating the continued presence of boat building and repair activities in the region. Water Passenger Transportation remained a very small component of the cluster throughout the study period.

This employment structure demonstrates that Houston's competitive advantage lies in maritime logistics and global trade connectivity. The Port of Houston serves as the principal export gateway for crude oil, refined petroleum products, petrochemicals, liquefied gases, heavy industrial equipment, and bulk commodities, connecting the region's energy and manufacturing clusters to domestic and international markets.

The county distribution shows that the Water Transportation cluster (Table 8) is primarily concentrated in three counties: Harris, Galveston, and Brazoria, although related establishments are also present in several inland counties. Harris County functions as the dominant metropolitan-port core, Galveston County serves as an important coastal maritime node, and Brazoria County provides an industrial-port node linked to Freeport and Gulf Coast petrochemical logistics. Smaller concentrations are distributed across Fort Bend, Chambers, Montgomery, Matagorda, and other counties. This pattern reinforces the conclusion that the region's Water Transportation cluster is organized around port infrastructure, navigable waterways, and industrial trade flows.

Figure 12. Water Transportation Cluster Composition, 1990-2025



Table 8. 2025 Water Transportation Cluster Establishments and Employment Composition by county

	Boat Building and Repairing	Marine Transportation Services	Water Passenger Transportation
Brazoria	1 (0)*	16 (788)*	1 (0)*
Chambers		5 (0)*	
Fort Bend	1 (0)*	14 (7)*	1 (0)*
Galveston	9 (0)*	36 (1,855)*	2 (0)*
Harris	28 (0)*	187 (12,821)	9 (19)
Liberty		1 (0)*	
Matagorda	5 (0)*	2 (0)*	
Montgomery	4 (0)*	8 (0)*	
Walker		1 (0)*	
Wharton	1 (0)*		

Notes: the number above represents the number of establishments, while the number in parentheses below represents employment. * indicates that employment data is undisclosed or suppressed for confidentiality purposes.

3.5.4 Shift-Share Analysis

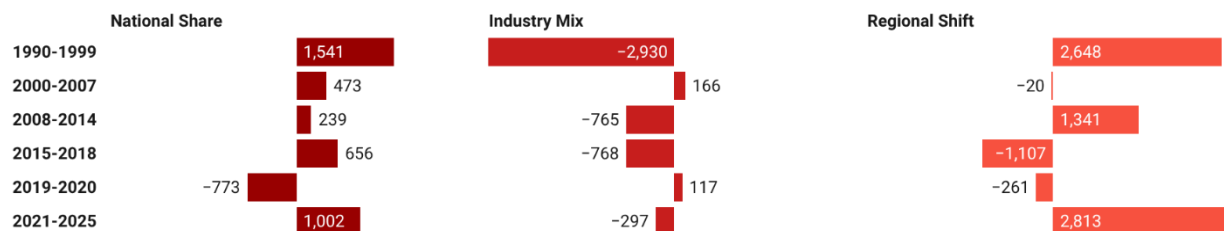
The shift-share results (Figure 13) show that the Water Transportation cluster maintained a generally strong regional position between 1990 and 2025, although its performance varied across trade cycles, energy-market conditions, and broader economic disruptions.

During 1990–1999, the cluster recorded a positive national share effect of 1,541 jobs and a strong positive regional shift of 2,648 jobs, while the industry mix effect was negative at -2,930 jobs. This indicates that although the national water

transportation industry faced structural weakness, the HGAC region outperformed national industry trends. The positive regional shift reflects the strength of the Houston Ship Channel, Port Houston, petrochemical logistics, and Gulf Coast maritime trade.

During 2000–2007, all components were relatively small. The national share effect was positive at 473 jobs, the industry mix effect was also positive at 166 jobs, and the regional shift was slightly negative at -20 jobs. This suggests that the cluster grew modestly during the pre-recession expansion, mainly supported by national economic and industry conditions, while the regional competitive effect remained stable.

Figure 13. Shift-Share Analysis of Water Transportation Cluster, 1990-2025



During 2008–2014, the regional shift became strongly positive again, reaching 1,341 jobs. This offset the negative industry mix effect of -765 jobs and produced a positive overall result. The pattern suggests that the HGAC region's water transportation activities performed well during the post-recession recovery period, supported by port activity, energy exports, petrochemical shipments, and regional logistics demand.

During 2015–2018, the cluster weakened. Although the national share effect was positive at 656 jobs, both the industry mix and regional shift effects were negative, at -768 and -1,107 jobs respectively. This suggests that local employment growth fell below expected levels during this period. The decline may reflect global oil price crash, slower industrial shipment growth, or a temporary weakening in regional maritime demand.

During 2019–2020, the cluster experienced another contraction. The national share effect was negative at -773 jobs, reflecting the broader economic disruption of the COVID-19 period. Although the industry mix effect was slightly positive, the regional shift was negative at -261 jobs. This indicates that the cluster was affected by both national economic contraction and regional weakness in maritime-related employment.

The strongest recent performance occurred during 2021–2025. The national share effect was positive at 1,002 jobs, and the regional shift reached 2,813 jobs, more than offsetting the negative industry mix effect of -297 jobs. This indicates that the HGAC region's Water Transportation cluster recovered strongly and grew faster than national industry trends. The result is consistent with renewed port activity, energy and petrochemical trade, supply chain recovery, and the continued importance of Port Houston, the Houston Ship Channel, the Port of Galveston, and Port Freeport.

3.5.5 Summary

Overall, the location quotient, spatial organization, subcluster evolution, and shift-share analyses show that Houston's competitive advantage in the Water Transportation cluster is fundamentally derived from its integrated maritime logistics ecosystem. The cluster is organized around Port Houston, the

Houston Ship Channel, the Port of Galveston, and Port Freeport, forming a highly connected transportation corridor that integrates international shipping, petrochemical exports, energy logistics, rail freight, highways, and warehousing. Although national industry performance has fluctuated considerably over time, Houston has consistently maintained a strong regional competitive advantage, with only a temporary decline during the COVID-19 pandemic. These findings indicate that Houston's leadership in water transportation is supported by long-term structural advantages, including world-class port infrastructure, multimodal connectivity, and deep integration with the region's energy and petrochemical industries, reinforcing its position as one of North America's leading maritime logistics hubs.

3.6 Local Industrial Products and Services

Compared with the four core traded clusters, Local Industrial Products and Services exhibits a more moderate level of specialization, with LQ values generally ranging from 1.29 to 1.65 relative to the United States and 1.26 to 1.46 relative to Texas. Although its specialization is less pronounced, its persistence over more than three decades indicates that Houston possesses a broad and diversified industrial manufacturing base. Rather than representing a globally distinctive export industry, this cluster primarily provides machinery, fabricated products, industrial services, and intermediate inputs that support the operation and expansion of the region's energy, petrochemical, construction, and logistics sectors.

3.7 Chapter Summary

The analyses presented in this chapter demonstrate that Houston's long-standing industry clusters form a highly integrated economic system built upon decades of industrial specialization, infrastructure investment, and cumulative agglomeration economies. Although each cluster performs distinct economic functions, together they constitute the foundation of the region's industrial competitiveness and reinforce one another through extensive

supply-chain linkages, shared infrastructure, and complementary production activities.

The Oil and Gas Production and Transportation cluster remains the strategic core of Houston's economy. For the past decades, Houston has evolved into the national center for energy headquarters, engineering, finance, oilfield services, technology development, and project management. Closely linked to this cluster, Upstream Chemical Products has developed into one of the largest petrochemical manufacturing systems in North America by leveraging abundant Gulf Coast hydrocarbon feedstocks, large-scale refining capacity, and integrated chemical production networks. Construction Products and Services represents another pillar of regional competitiveness, supported by sustained metropolitan expansion, industrial investment, and infrastructure development. Meanwhile, Water Transportation provides the logistical backbone that connects regional production with domestic and international markets through Port Houston, the Houston Ship Channel, the Port of Galveston, and Port Freeport.

Beyond their industrial relationships, these four clusters exhibit distinctly different spatial organizations that reflect their functional roles within Houston's regional economy. Oil and Gas Production and Transportation displays the strongest metropolitan concentration, with firms clustering in Harris County and surrounding business districts where corporate headquarters, engineering firms, financial institutions, and specialized business services are concentrated. Upstream Chemical Products follows the Houston Ship Channel and Gulf Coast industrial corridor, where refineries, petrochemical complexes, pipelines, storage terminals, and export facilities are co-located to maximize production efficiency. Water Transportation is similarly concentrated along the port corridor, relying on deep-water navigation channels and multimodal freight infrastructure to support global trade. In contrast, Construction Products and Services is distributed broadly across the metropolitan area, closely following patterns of population growth, suburban expansion, and infrastructure investment.

These contrasting spatial patterns illustrate a clear regional division of economic functions.

Knowledge-intensive activities—including corporate headquarters, engineering, finance, research and development, and professional services—are concentrated within the metropolitan core. Capital-intensive manufacturing is organized along the petrochemical corridor where production facilities benefit from shared infrastructure and feedstock availability. Logistics activities are anchored by the regional port system, while construction activities expand alongside urban development and primarily serve regional demand. Rather than competing for the same locations, the four clusters occupy complementary geographic niches within an integrated metropolitan production system. From the perspective of global value chains, Houston's competitive advantage extends far beyond natural resource production. Unlike many energy-producing regions that specialize primarily in extraction, Houston performs multiple high-value functions across the entire industrial value chain, including corporate management, engineering design, technology development, petrochemical manufacturing, advanced industrial production, international logistics, commodity trading, and global business services. This functional diversity enables the region to connect upstream resource production with downstream manufacturing and international markets while maintaining strong resilience during commodity price cycles and broader economic fluctuations.

Taken together, the location quotient, spatial organization, subcluster evolution, and shift-share analyses consistently demonstrate *that Houston's long-term competitiveness is not derived from any single industry or natural resource advantage. Instead, it is built upon a diversified and highly integrated industrial ecosystem in which energy production, petrochemical manufacturing, maritime transportation, urban development, and specialized business services mutually reinforce one another.*

This mature economic structure has sustained Houston's position as one of the world's leading energy and industrial hubs while providing the foundation for the continued development of emerging industries.

Changing Specialization and Emerging Clusters

While several clusters maintained stable specialization throughout the study period, other industries experienced significant changes in relative specialization, reflecting the long-term evolution of Houston's industrial structure.

4.1 Emerging Specialized Clusters

Several industries experienced increasing specialization during the study period, reflecting Houston's adaptation to evolving technologies, changing energy systems, and global supply chain restructuring.

4.2 Transportation and Logistics

4.2.1 Cluster Overview

Transportation and Logistics represents one of the most notable emerging specialized clusters in the HGAC region. The cluster first exceeded an LQ of 1.0 in 2008, experienced temporary fluctuations during the mid-2010s, and became consistently specialized after 2018, reaching an LQ of 1.53 in 2025. During the same period, total cluster employment increased from 14,047 workers in 1990 to 58,557 in 2025, more than quadrupling over the study period. The simultaneous growth in both employment and LQ indicates that Transportation and Logistics expanded substantially faster than the national average, gradually becoming a new source of regional competitive advantage.

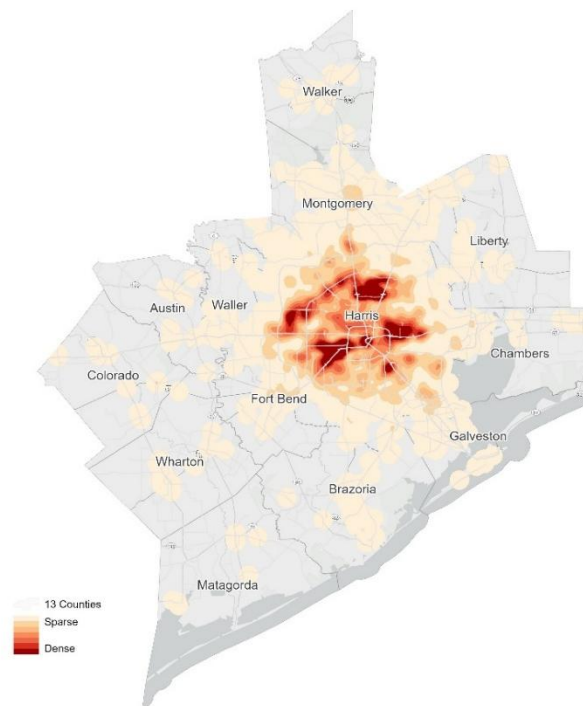
4.2.2 Spatial Organization

The spatial distribution of establishments (*Figure 14*) shows that the Transportation and Logistics cluster is concentrated primarily within Harris County, but its pattern is not limited to the downtown core. Instead, establishments are widely distributed across suburban Harris County and extend outward along

major transportation corridors. This reflects the land-intensive nature of logistics activities, which often require access to highways, warehousing sites, industrial land, airports, rail facilities, and distribution centers.

The spatial distribution also highlights the close relationship between logistics activities and Houston's multimodal transportation infrastructure. Dense concentrations of establishments are located near George Bush Intercontinental Airport, William P. Hobby Airport, the Port of Houston, major rail terminals, intermodal freight facilities, and highway interchanges. These infrastructure assets enable efficient movement of goods among ports, airports, railroads, trucking networks, and distribution centers, reinforcing Houston's role as one of North America's leading multimodal logistics hubs.

Figure 14. 2025 Transportation and Logistics Cluster Establishments Density



4.2.3 Subcluster Evolution and Regional Functional Division

The subcluster structure changed significantly over time (Figure 15). In 1990, Trucking accounted for 51.5 percent of total cluster employment and was the largest component of the cluster. Ground Transportation Support Activities accounted for 36.3 percent, while Air Transportation accounted for only 6.6 percent. By 2025, Air Transportation had become the largest subcluster, accounting for 44.4 percent of total cluster employment. The shares of Trucking and Ground Transportation Support Activities declined to 25.7 percent and 26.2 percent, respectively.

This shift reflects differences in growth rates across subindustries, not a decline in traditional transportation activities. Between 1990 and 2025, Trucking employment increased from 7,240 to 14,703 workers, while Ground Transportation Support Activities grew from 5,103 to 16,282 workers. Both subclusters maintained steady employment growth. The fastest-growing component was Air Transportation, whose employment increased sharply from 925 workers in 1990 to 25,318 workers in 2025. By 2025, it

accounted for nearly half of total cluster employment and became the core driver of the continued rise in the Transportation and Logistics cluster’s specialization. This indicates that air cargo and related logistics activities have become the fastest-growing component of Houston’s transportation system.

The evolution of the cluster reflects Houston’s functional upgrading within global supply chains. In the earlier period, Houston’s transportation sector was primarily supported by a road freight system associated with the energy industry and regional goods movement. Over the past two decades, the continued expansion of Port Houston, the 2016 expansion of the Panama Canal, growth in petrochemical exports, deeper U.S.–Mexico supply-chain integration, and rapidly rising demand for international air cargo have contributed to the formation of an integrated transportation network that combines maritime shipping, air transportation, trucking, rail, warehousing, and intermodal logistics. This transformation shows that Houston is evolving from a traditional regional transportation center into an international integrated transportation hub connecting global trade, energy exports, and North American supply chains.

Figure 15. Transportation and Logistics Cluster Composition, 1990-2025

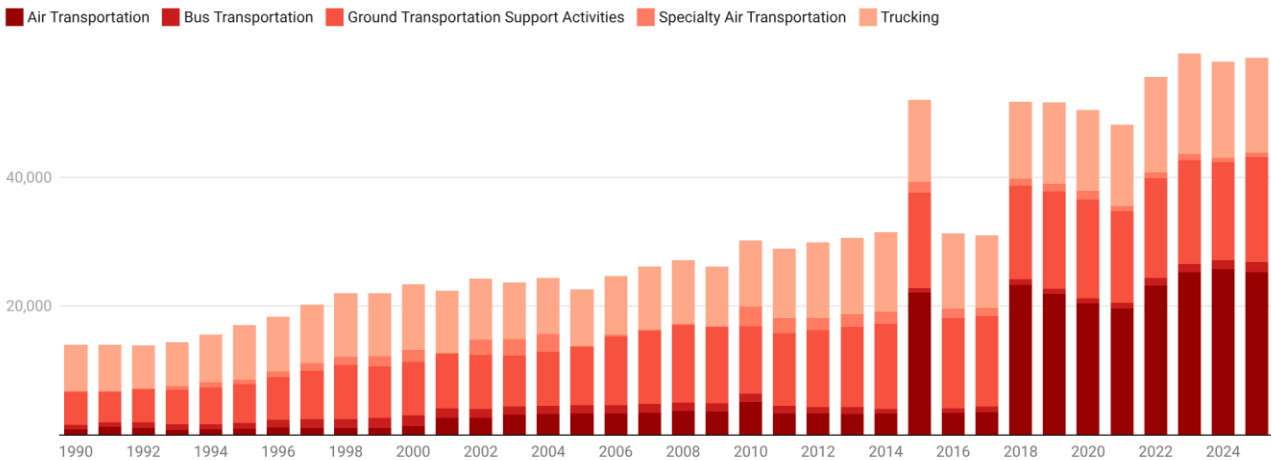


Table 9. 2025 Transportation and Logistics Cluster Establishments and Employment Composition by county

	Air Transportation	Bus Transportation	Ground Transportation	Specialty Air Transportation	Trucking
Austin	3 (0)*		3 (0)*		14 (0)*

Brazoria	8 (0)*		35 (461)	2 (0)*	82 (375)
Chambers	2 (0)*		16 (28)		15 (0)*
Colorado		1 (0)*	1 (0)*	1 (0)*	12 (78)
Fort Bend	18 (0)*	1 (0)*	79 (495)	5 (0)*	142 (363)
Galveston	5 (0)*	2 (0)*	21 (96)	3 (0)*	34 (0)*
Harris	179 (25,318)	24 (1,573)	764 (14,143)	46 (651)	1118 (13,010)
Liberty	1 (0)*		5 (215)		16 (102)
Matagorda	1 (0)*		1 (0)*		4 (0)*
Montgomery	12 (0)*		66 (829)	8 (30)	117 (758)
Walker	1 (0)*		4 (15)		6 (8)
Waller	4 (0)*		3 (0)*	1 (0)*	11 (0)*
Wharton	1 (0)*		2 (0)*	1 (0)*	16 (9)*

Notes: the number above represents the number of establishments, while the number in parentheses below represents employment. * indicates that employment data is undisclosed or suppressed for confidentiality purposes.

The 2025 county-level employment data (**Table 9**) show that the Transportation and Logistics cluster is highly concentrated in Harris County. Harris County accounted for nearly all Air Transportation employment, with 25,318 workers, as well as the largest employment concentrations in Ground Transportation Support Activities, Trucking, Bus Transportation, and Specialty Air Transportation. This confirms Harris County's role as the dominant transportation and logistics core of the HGAC region.

Air Transportation is the most geographically concentrated subcluster. In the available data, all major Air Transportation employment is located in Harris County. This pattern is closely associated with George Bush Intercontinental Airport and William P. Hobby Airport, which support air cargo, passenger-related transportation services, freight coordination, and time-sensitive logistics activities. The concentration of air transportation employment

in Harris County helps explain why the county remains the central node of the region's logistics system.

Ground Transportation Support Activities and Trucking show a more dispersed pattern. Harris County remains the largest center, with 14,143 workers in Ground Transportation Support Activities and 13,010 workers in Trucking. However, these activities also extend into Montgomery, Brazoria, Fort Bend, and Liberty counties. Montgomery County recorded 829 workers in Ground Transportation Support Activities and 758 workers in Trucking, while Brazoria and Fort Bend also recorded several hundred workers in each category. This suggests that ground logistics and trucking functions are spreading outward along suburban and industrial corridors.

Other counties contain limited employment concentrations and do not form major employment centers within this cluster.

Overall, the county-level subcluster structure shows a clear division of functions. Harris County dominates high-volume and higher-order logistics activities, especially Air Transportation, transportation management, ground support services, trucking, and airport-related logistics. Surrounding counties mainly support ground-based logistics, trucking, warehousing, and corridor-based freight movement. This pattern reinforces the interpretation that the Transportation and Logistics cluster is organized around a Harris County core, with secondary logistics functions extending outward along major highway, industrial, airport, and port corridors.

4.2.4 Shift-Share Analysis

The shift-share analysis (*Figure 16*) indicates that Houston's Transportation and Logistics cluster maintained a positive regional shift throughout nearly the entire study period, demonstrating that the region consistently outperformed national industry trends. This sustained regional competitiveness suggests that Houston's favorable business environment—including continuous investment in highways, freight corridors, intermodal facilities, airports, ports, and supporting logistics infrastructure—has created conditions that support the long-term expansion of transportation and distribution activities. Rapid metropolitan growth, increasing freight demand, and Houston's strategic location within national and international transportation networks have further reinforced the cluster's competitive position.

The only exception occurred during the 2015–2018 period, when the regional shift became

temporarily negative. This short-term decline coincided with a broader slowdown affecting transportation-related industries within the region. Similar patterns were observed in the Water Transportation cluster, suggesting that regional transportation activities were influenced by common external factors rather than structural weaknesses within the Transportation and Logistics cluster itself. The underlying drivers of this temporary decline are discussed further in the chapter on risks and policy implications.

4.2.5 Summary

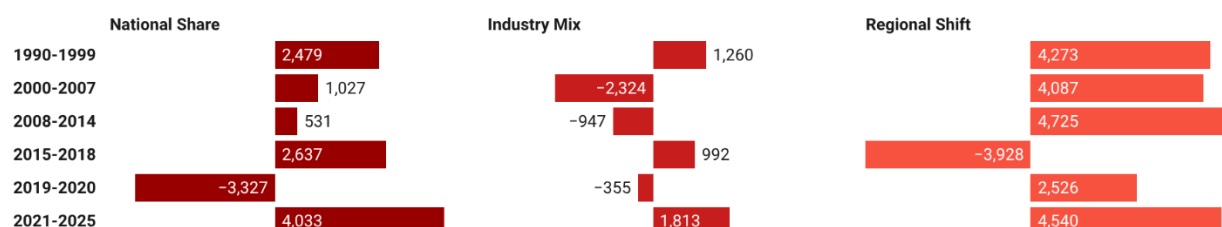
In summary, the Transportation and Logistics cluster is evolving into one of the region's most strategically important support systems for trade, manufacturing, energy, petrochemicals, and consumer markets. Its future growth will depend on continued investment in highway capacity, airport logistics, port connections, rail and intermodal facilities, warehouse space, and efficient regional freight movement.

4.3 Metalworking Technology

4.3.1 Cluster Overview

Metalworking Technology presents another distinctive development trajectory. The cluster began to develop a clear specialization advantage around 2004, with its location quotient rising from approximately 1.09 and reaching a peak of about 1.58 during 2012–2015. After that peak, the LQ gradually declined to 1.22 in 2025. As horizontal drilling and hydraulic fracturing technologies expanded rapidly in the early twenty-first century,

Figure 16. Shift-Share Analysis of Transportation and Logistics Cluster, 1990-2025



demand increased for precision machining, fabricated metal products, drilling equipment, valves, pumps, and various components used in oilfield equipment. In response, Houston's energy equipment manufacturing and metalworking supply chains strengthened significantly. The growth of this cluster therefore reflected the broader expansion of energy-related manufacturing and supplier networks around the region's oil and gas economy. After the collapse of international oil prices during 2014–2016, capital expenditures in the upstream oil and gas sector contracted sharply. Demand for drilling equipment, heavy machinery, and related metalworking products declined, leading to a gradual weakening of the cluster's specialization level. However, the cluster has continued to maintain an LQ above 1.0 through 2024. When benchmarked against Texas as a whole, its LQ has remained above 1.3 for most of the period, indicating that Houston still retains one of the strongest regional specializations in metalworking and energy equipment manufacturing within the state.

4.3.2 Spatial Organization

The greatest concentration of establishments is still located within Harris County, where firms form several dense manufacturing districts extending across central Houston, the western industrial areas, and the eastern manufacturing corridor (*Figure 17*). Outside the metropolitan core, firms expand along major transportation and industrial corridors into Montgomery, Fort Bend, Galveston, Brazoria, Waller, and Chambers Counties. Rather than forming continuous urban concentrations, these establishments are distributed among industrial parks, manufacturing zones, and logistics areas that provide convenient access to highways, rail facilities, petrochemical complexes, and industrial customers. The resulting spatial pattern illustrates the importance of transportation accessibility and proximity to downstream manufacturing activities. Several secondary concentrations are particularly evident around the Houston Ship Channel and the petrochemical corridor extending through eastern Harris County into Chambers County. These locations support extensive fabrication, precision machining, industrial maintenance, valve manufacturing, pump production, and equipment repair activities serving refineries, chemical plants, offshore energy facilities, and pipeline infrastructure.

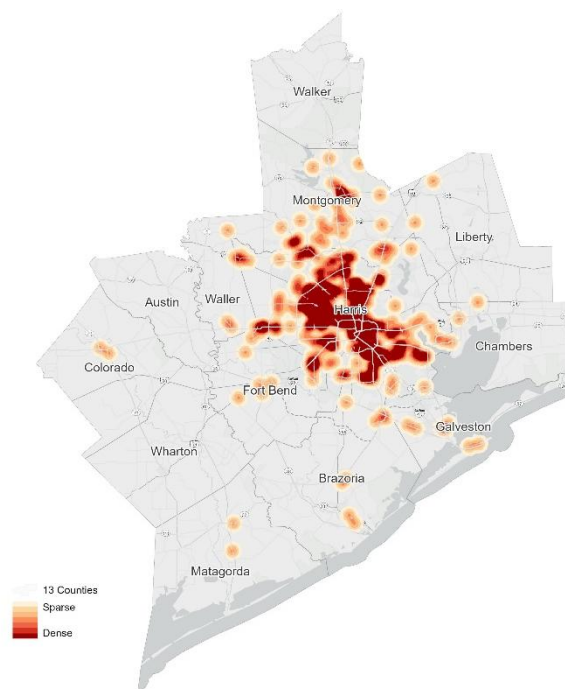
Additional concentrations surrounding The Woodlands and western Harris County reflect the expansion of engineering firms and advanced manufacturing suppliers supporting Houston's energy and industrial sectors.

Compared with Houston's transportation-related clusters, Metalworking Technology exhibits a more manufacturing-oriented spatial organization. While transportation firms primarily concentrate around freight terminals and logistics facilities, metalworking firms locate near industrial customers and production facilities where continuous demand exists for fabricated metal products, machinery components, industrial equipment, and maintenance services.

4.3.3 Subcluster Evolution and Regional Functional Division

The internal composition of the Metalworking Technology cluster (*Figure 18*) demonstrates that Houston's competitive advantage has consistently been concentrated in metal processing and industrial fabrication. Throughout the study period,

Figure 17. 2025 Metal Working Technology Cluster Establishments Density



Metal Processing remained the dominant subcluster, reflecting the region's role as the primary manufacturing base supporting the Gulf Coast energy industry.

By 2025, Metal Processing employed 8,012 workers, accounting for approximately 77 percent of total cluster employment. Fasteners ranked second with 1,510 employees (14.5 percent), followed by Machine Tools and Accessories (470 employees, 4.5 percent) and Metalworking Machinery (384 employees, 3.7 percent). Hand Tools represented only a negligible share of total employment.

Compared with 1990, the overall structure of the cluster remained remarkably stable. Metal Processing consistently accounted for roughly three-quarters to nearly ninety percent of total employment throughout the study period, indicating that Houston's competitive advantage has long been centered on industrial fabrication, welding, machining, precision metal processing, and fabricated components.

Although Metal Processing maintained its dominant position, the smaller subclusters exhibited noticeably different development trajectories. Machine Tools and Accessories expanded rapidly during the mid-2000s, with employment increasing from fewer than 500 workers in the early 2000s to more than 1,100 by 2008–2014. This period coincided closely with the rapid expansion of the U.S. shale industry, during which demand for precision machining, drilling equipment, valves, pumps, and specialized production components

increased substantially. Following the collapse of global oil prices after 2014, employment gradually declined as energy companies reduced capital expenditures and postponed investment in new drilling projects.

Fasteners emerged as an increasingly important component of the cluster after the mid-2000s. Employment expanded steadily from approximately 850 workers to nearly 1,500 by 2024, reflecting sustained demand for standardized industrial components used across energy infrastructure, petrochemical facilities, heavy equipment, and construction projects. Unlike Machine Tools, the Fasteners subcluster exhibited relatively stable long-term growth, suggesting that demand was supported by a broader range of downstream manufacturing activities.

For county-level employment pattern, Harris County alone accounted for approximately 94 percent of Metal Processing employment in 2025, demonstrating the exceptional geographic concentration of this manufacturing activity within the metropolitan core.

4.3.4 Shift Share Analysis

The shift-share results (*Figure 19*) show that the Metalworking Technology cluster experienced strong regional outperformance during the shale boom period, followed by a clear downturn after the 2014–2016 oil price collapse and a partial recovery after 2021. Across most periods, the

Figure 18. Metalworking Technology Cluster Composition, 1990-2025

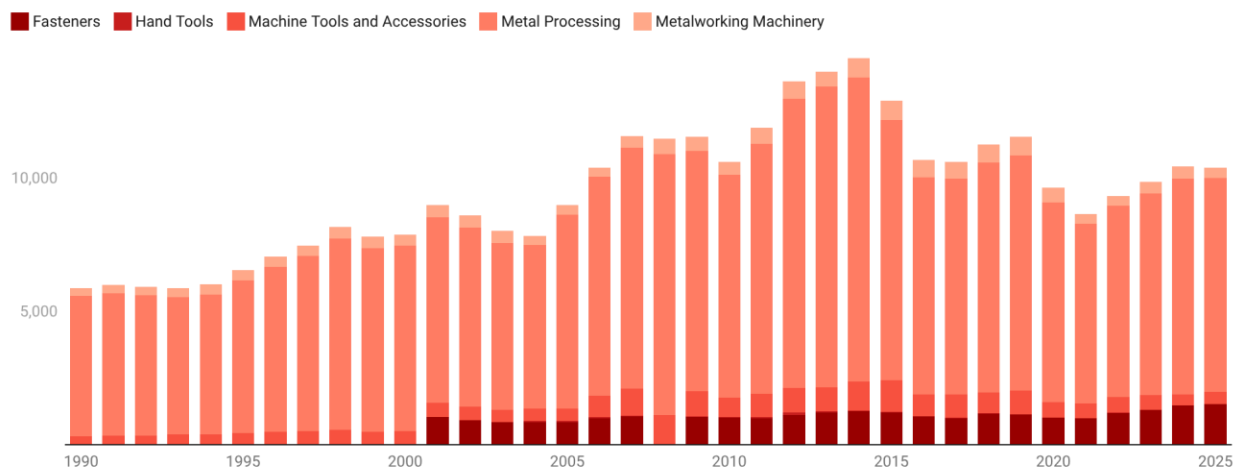
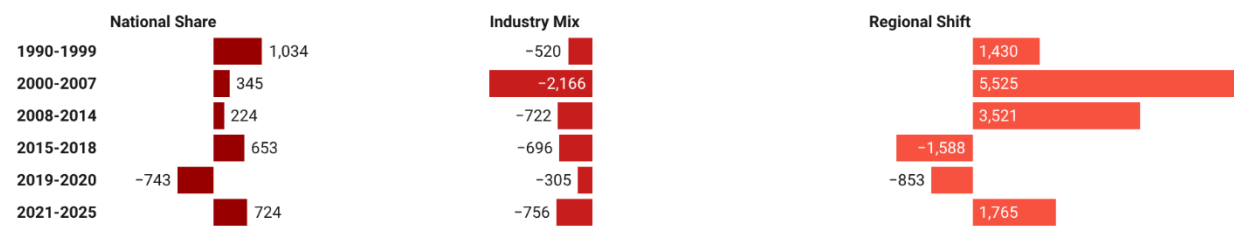


Figure 19. Shift-Share Analysis of Metalworking Technology Cluster, 1990-2025



industry mix effect was negative, indicating that metalworking-related industries faced slower national employment growth or broader structural pressure. Against this national industry background, the HGAC region’s positive regional shifts before 2015 and after 2021 are especially important.

4.3.5 Summary

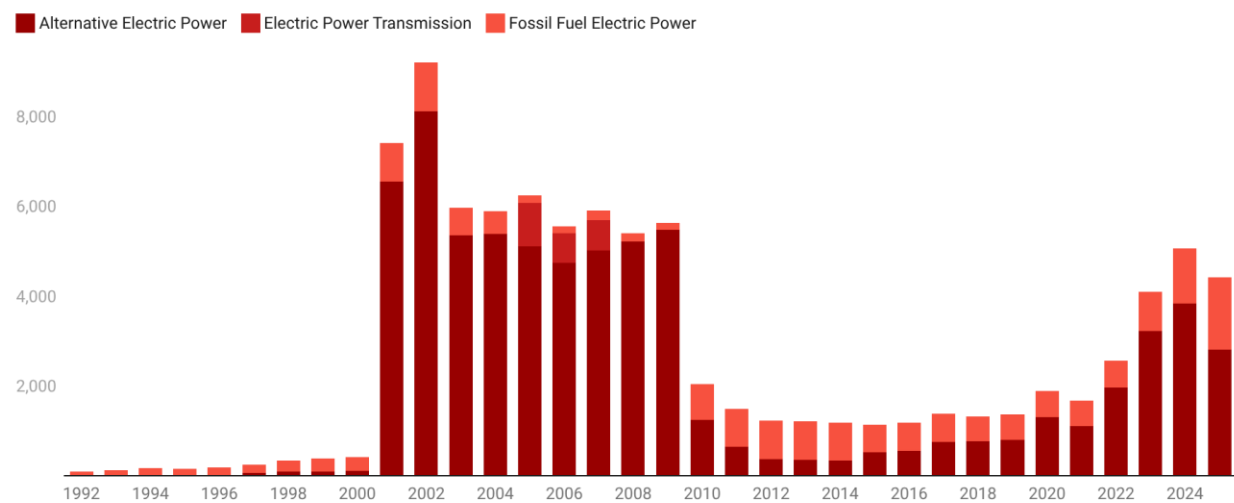
Overall, Houston's Metalworking Technology cluster functions primarily as an industrial support industry embedded within the regional manufacturing ecosystem. The cluster supplies fabricated metal products, precision components, industrial equipment, and engineering-related manufacturing services for energy production, petrochemicals, infrastructure, and advanced manufacturing. This close integration with Houston's broader industrial base explains both the cluster's rapid expansion during periods of energy investment and its subsequent adjustment following the decline in upstream capital expenditures.

4.4 Electric Power Generation and Transmission

Electric Power Generation and Transmission exhibits the most distinctive evolutionary pattern among all emerging clusters (Figure 20). Unlike the gradual development observed in other industries, Houston experienced two separate periods of specialization.

The first occurred during the early 2000s, when the cluster's LQ rose rapidly, peaking at approximately 1.66 in 2001 before declining sharply after 2008 and eventually falling below the specialization threshold. Six-digit NAICS employment data attribute much of this early concentration to Hydroelectric Power Generation in Harris County, with smaller contributions from fossil-fuel generation and electric power transmission (Figure 21). However, this pattern should not be interpreted

Figure 20. Electric Power Generation and Transmission Cluster Composition, 1990-2025



as evidence that a large number of hydroelectric facilities were physically located in Harris County. The reported establishments and employment likely included headquarters, administrative offices, legal entities, or reporting units associated with Houston-based energy companies that owned or managed generation assets located outside the county. By 2010, both establishment counts and employment classified under Hydroelectric Power Generation declined sharply. This discontinuity likely reflects a combination of corporate restructuring, asset divestitures, consolidation of reporting units, and industry reclassification among large multi-establishment energy firms. Cluster employment consequently fell from approximately 5,000–6,000 workers to fewer than 2,000, contributing to the decline in the cluster's location quotient.

A second phase of specialization has emerged since 2020. By 2025, the cluster's LQ had recovered to approximately 1.17, while employment increased to more than 5,000 workers. Unlike the earlier period, recent growth has been driven primarily by Solar Electric Power Generation and Wind Electric Power Generation located in Harris County, whereas traditional Fossil Fuel Electric Power has remained relatively stable. This transition reflects broader structural changes within the Texas electricity market. Rapid expansion of renewable energy, increasing electricity demand associated with industrial development, electrification, and large-scale data centers,

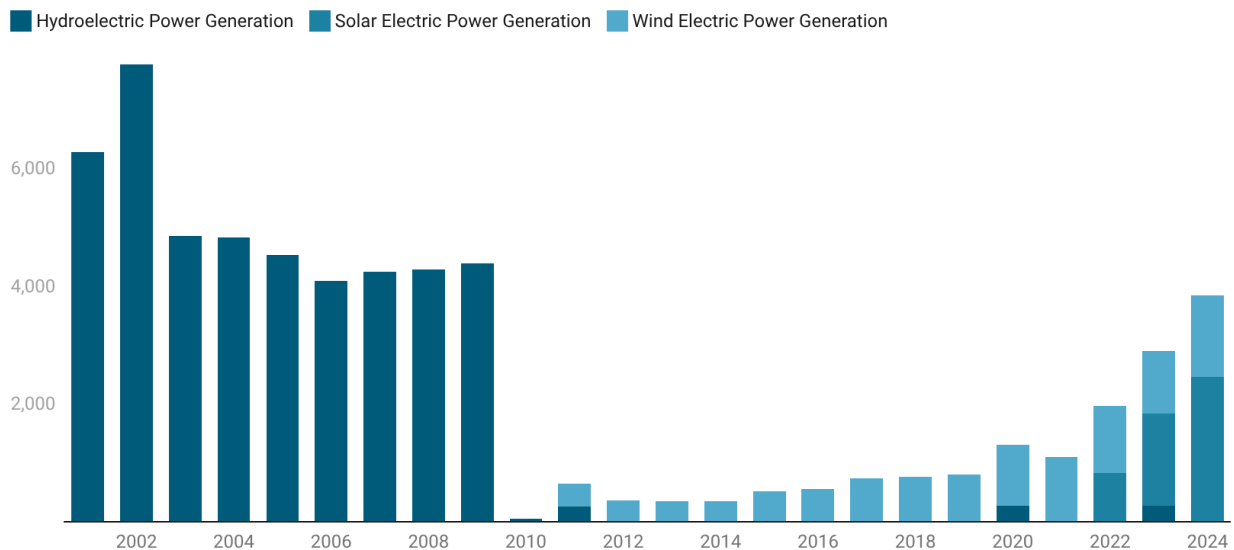
together with Texas' leading position in renewable power generation, have created new opportunities for Houston to develop expertise in renewable energy engineering, grid integration, energy management, and power infrastructure. The re-emergence of this cluster therefore represents a structural transition toward a more diversified electricity industry.

4.5 Declining Relative Specialization

Several clusters exhibited a gradual decline in Location Quotient over the past three decades. Importantly, these trends do not necessarily indicate employment losses or industrial decline. Instead, they suggest that employment in these industries expanded more rapidly in other metropolitan regions than in Houston, reducing Houston's relative specialization.

Business Services is the most representative case of declining relative specialization despite continued employment growth. Its location quotient relative to the United States declined steadily from 1.31 in 1990 to 1.05 in 2025. Relative to Texas, its LQ also fell from 1.63 in 1990 to 0.99 in 2025. Over the same period, employment increased substantially from 68,944 workers to 215,613 workers.

Figure 21. Alternative Electric Power Composition in 6-digit NAICS Code, 2001-2024



This pattern indicates that Houston's Business Services sector continued to expand and remained an important support system for the region's energy economy. However, its relative specialization weakened as other metropolitan areas, including Dallas, Austin, Seattle, Atlanta, and San Francisco, experienced faster growth in finance, technology, consulting, corporate headquarters, and other advanced business service functions. As a result, Houston's Business Services cluster became larger in absolute employment terms, but its relative concentration gradually declined compared with both the United States and Texas.

A similar trend can be observed in Distribution and Electronic Commerce.

The cluster's LQ declined from 1.32 in 1990 to 1.10 in 2025 compared with national level. Also, compared with Texas, the LQ dropped from 1.2 in 1990 to 1.0 in 2025.

Although Houston remains one of the nation's largest freight and logistics centers, the rapid expansion of national distribution networks, e-commerce fulfillment centers, and inland logistics hubs—including Dallas-Fort Worth, Inland Empire, Memphis, Louisville, and Kansas City—has reduced Houston's relative concentration within this industry.

4.6 Health Care and Biopharmaceuticals: Large Scale without High LQ



Despite being home to one of the world's largest medical complexes, the Houston region does not exhibit a particularly high employment concentration in

the Local Health Services cluster. In 2025, the cluster employed 336,276 workers, making it one of the region's largest employers. However, its location quotient remained at only 0.86, indicating that healthcare services account for a smaller share of total regional employment than the national average.

This seemingly counterintuitive result reflects the exceptional scale and diversity of Houston's broader economy. The region supports a highly specialized workforce across multiple export-oriented industries, particularly Energy, Advanced Manufacturing, Transportation and Logistics, and Business Services. As these sectors generate substantial employment, the relative share of healthcare employment is diluted despite its large absolute size. In other words, Houston possesses an exceptionally large healthcare system because it serves a rapidly growing metropolitan population of nearly eight million residents and functions as a national and international medical destination, rather than because its economy is disproportionately specialized in healthcare services.

The presence of the Texas Medical Center therefore represents a concentration of world-class hospitals, medical schools, physicians, and clinical care providers. Much of its economic significance lies in research, education, highly specialized medical treatment, and the attraction of patients from outside the region, impacts that are only partially reflected by employment-based location quotients.

The Biopharmaceuticals cluster presents an even more distinctive pattern. Although Houston possesses globally recognized biomedical research institutions and a rapidly expanding innovation ecosystem, the cluster has historically remained underrepresented, with its location quotient rising from approximately 0.11 in 1990 to 0.5 in 2025.

This relatively low concentration reflects the historical evolution of Houston's life sciences sector. The region has traditionally specialized in healthcare delivery, clinical medicine, and biomedical research. Many employments may be associated with institutions such as the Texas Medical Center, MD Anderson Cancer Center, and Baylor College of Medicine falls within healthcare services, higher education, or scientific research.

Nevertheless, the steady increase in the location quotient over the past three decades suggests the gradual emergence of a broader life sciences ecosystem. Recent investments in biotechnology commercialization, medical innovation, startup incubation, and translational research have strengthened the region's capabilities beyond clinical care. Although Houston has not yet developed the vertically integrated pharmaceutical manufacturing and commercialization network found in established life sciences hubs such as

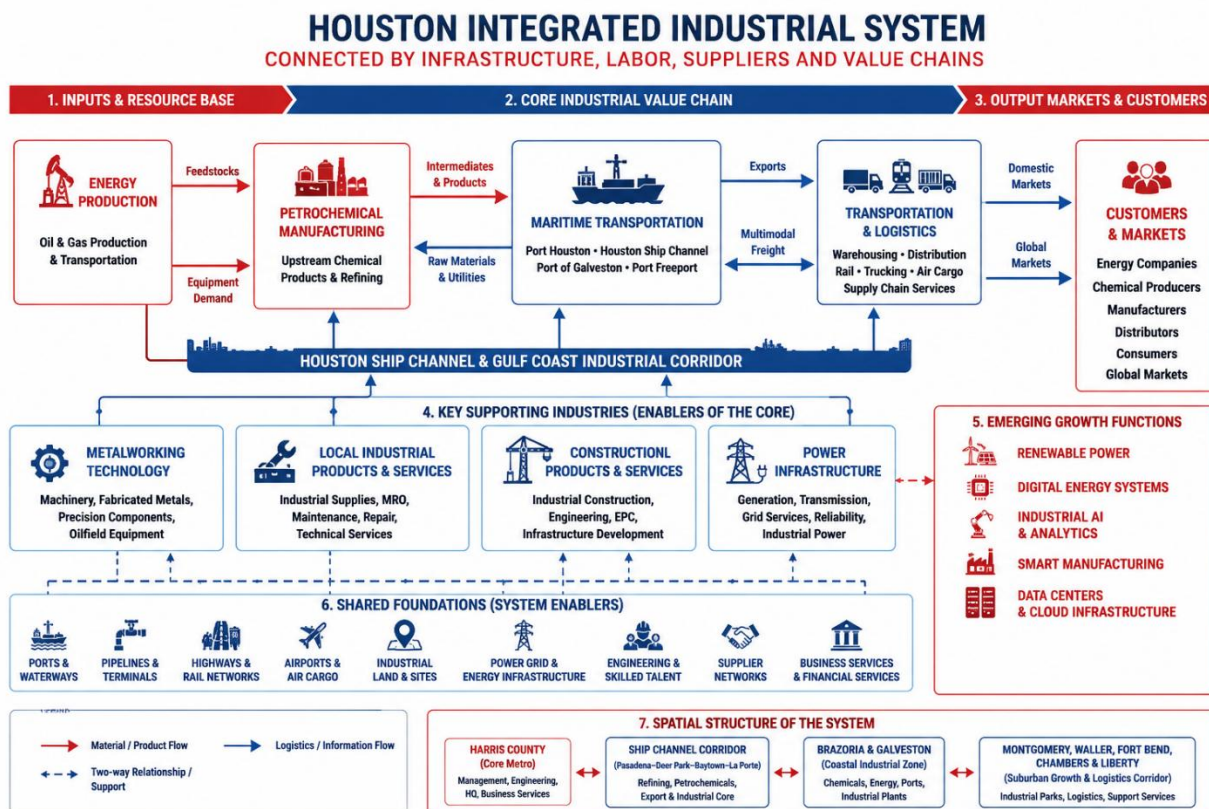
Boston or the San Francisco Bay Area, the upward trend indicates increasing diversification and future

growth potential within the cluster.

Integrated Industrial System

The preceding cluster analyses indicate that the Houston region should be understood as an integrated production system. Energy production, petrochemical manufacturing, water transportation, logistics, construction, metalworking, local industrial products, and emerging power infrastructure interact through shared infrastructure, labor markets, supplier networks, and value-chain functions. This combination reflects the coexistence of localization economies and urbanization economies. Localization economies continue to support innovation and productivity within specialized industries, whereas urbanization economies arise from the diversity of industries, occupations, institutions, and infrastructure found within a large metropolitan region. The interaction

between these two forms of agglomeration enables Houston to retain deep industrial specialization while simultaneously increasing its capacity to adapt to technological change, evolving global markets, and structural transformation. *Therefore, Houston's long-run advantage lies in combining localization economies in specialized energy and industrial clusters with urbanization economies generated by a large, diversified metropolitan economy.* This combination suggests that Houston is more likely to develop new growth functions in industrial AI, energy-supported computing infrastructure, data centers, digital engineering, smart manufacturing, power infrastructure, and smart logistics. while maintaining its highly specialized industrial base.



Resilience, Risks, and Long-Term Industrial Transformation

6.1 Commodity Price Volatility and Energy Dependence



Although Houston's economy has become increasingly diversified in recent years, the regional economy remains highly connected to global energy markets. Historical subcluster data

shows that international oil price fluctuations first affect capital-intensive industries such as drilling, resource development, oilfield services, and energy equipment manufacturing, and then spread to related sectors such as port transportation and integrated logistics.

During the 2014–2016 collapse in international oil prices, nearly all existing industry clusters in Houston experienced a negative regional shift. This indicates that reduced energy investment affected not only the energy sector itself, but also transmitted through supply chains to engineering services, equipment manufacturing, transportation and logistics, port operations, and other related industries. This pattern demonstrates the continued importance of energy cycles in shaping the broader regional economy.

6.2 Climate and Geophysical Risks

Houston's location along the Gulf Coast exposes the region to hurricanes, flooding, storm surges, and other severe weather events. These hazards present significant risks to refineries, petrochemical complexes, pipelines, ports, and transportation infrastructure.

Past events such as Hurricane Harvey, Hurricane Laura, and Winter Storm Uri demonstrated that

disruptions to one component of the industrial system can rapidly affect production, transportation, exports, and downstream manufacturing. Because many petrochemical facilities operate within tightly integrated production chains, interruptions at a limited number of facilities may significantly reduce regional output.

Continued investment in resilient infrastructure, flood protection, power reliability, and transportation redundancy will therefore remain critical for maintaining long-term industrial competitiveness.



6.3 Global Supply Chain, Trade and Cybersecurity Risks

Houston's economy is deeply integrated into global supply chains. This integration creates opportunities for international trade while simultaneously increasing exposure to geopolitical uncertainty, trade disputes, cybersecurity threats, and supply chain disruptions.

The chemical industry is particularly vulnerable because production processes are highly interconnected. Temporary shortages of feedstocks can interrupt downstream chemical production, while congestion at ports or trade restrictions may significantly reduce exports. Trade disputes between the United States and China during 2018 illustrated how tariffs on chemicals and plastics can directly affect production and international market access.



Increasing digitalization also creates new cybersecurity challenges. The Colonial Pipeline ransomware attack demonstrated that disruptions to critical infrastructure can rapidly affect fuel distribution, logistics, and industrial production across multiple regions.

6.4 Technological Transformation and Potential Future Functional Roles

Technological transformation and the global energy transition will continue to reshape Houston's industrial system. Historical evidence from the shale revolution shows that new technologies do not only change methods of energy production; they also reorganize demand for engineering services, specialized labor, equipment manufacturing, metalworking, logistics, and project management. Similar changes are already emerging in Houston's current industrial applications. The [HyVelocity Gulf Coast Hydrogen Hub](#) has been selected by the U.S. Department of Energy as a regional clean hydrogen hub covering the Gulf Coast, including Houston, with up to \$1.2 billion in federal cost share. The Houston Energy Transition Initiative and the University of Houston Center for Carbon Management have also examined the infrastructure requirements for scaling carbon capture and storage in greater Houston, including power, water, pipelines, and storage capacity.

At the same time, artificial intelligence and data-center demand are turning electricity, land, and infrastructure capacity into new conditions for industrial competitiveness. [HARC's research on data centers](#) and the future of the Texas grid notes that rapid data-center growth could reshape electricity demand, water use, and land development across the state. Recent developments also show Houston-based energy firms entering the data-center power infrastructure market. For example, Cloverleaf Infrastructure, founded by Houston energy-sector leaders, has received \$300 million in investment commitments to help data centers secure clean-energy power supplies. These examples indicate that hydrogen, CCUS, renewable power integration, digital energy systems, industrial artificial intelligence, and data-center-related

infrastructure are no longer only long-term concepts. They are beginning to connect with Houston's existing energy, power, engineering, land, and infrastructure systems.



For this reason, Houston's future functional roles are more likely to be industrial and applied in nature. The region's stronger opportunity lies not in becoming primarily a software platform or consumer technology center, but in applying new technologies to energy systems, industrial production, infrastructure management, logistics networks, and advanced manufacturing.

6.5 Negative Externalities and Policy Response

The emergence of new industrial functions will also generate new negative externalities. As hydrogen production, carbon capture and storage, renewable power integration, data centers, digital energy systems, industrial artificial intelligence, and advanced manufacturing become more closely connected with Houston's existing industrial base, they may **increase pressure on electricity supply, water resources, industrial land, transportation infrastructure, housing markets, and environmental systems.**

Electricity demand is likely to become one of the most important constraints. Data centers, electrified industrial processes, hydrogen production, carbon management systems, and advanced manufacturing all require large and reliable power supplies. If grid capacity, transmission infrastructure, and backup power systems do not expand at a comparable pace, energy-intensive growth may create congestion, reliability risks, and higher electricity costs for both firms and residents. Land-use conflicts may also become more visible. New industrial facilities, logistics centers,

transmission corridors, data centers, and energy infrastructure require large sites with access to power, water, roads, pipelines, and labor. In a rapidly growing metropolitan region, competition for land may intensify among industrial development, housing, environmental protection, flood mitigation, and community needs. Water demand and environmental impacts also require attention. Hydrogen production, petrochemical processing, advanced manufacturing, cooling systems, and some data-center operations can place additional pressure on water resources. If these activities concentrate in areas already exposed to flooding, storm surge, or industrial pollution, they may increase environmental risks for nearby communities and ecosystems.

Transportation and logistics externalities may also intensify. The expansion of industrial production, port activity, warehousing, and data-center construction can increase truck traffic, freight congestion, road maintenance costs, and emissions along major corridors. These impacts may be

especially significant near the Houston Ship Channel, airport areas, suburban logistics corridors, and rapidly industrializing counties.

Labor and housing pressures may also emerge. New technology-intensive industrial functions require engineers, construction workers, technicians, logistics workers, electricians, data-center operators, and specialized industrial labor. If workforce development, housing supply, and transportation access do not keep pace with job growth, the region may face skill shortages, longer commutes, and rising housing affordability pressures. These negative externalities indicate that future growth must be managed through coordinated infrastructure planning, land-use regulation, workforce development, environmental monitoring, and regional governance. In particular, electricity planning, water-resource management, flood resilience, industrial land preservation, freight corridor investment, and community impact mitigation should be integrated into the region's economic development strategy.

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Appendices

Appendix A. Cluster Definition and NAICS Codes

Table A-1. Oil and Gas Production and Transportation Cluster

NAICS Code	Label	Subcluster Name
324110	Petroleum Refineries	Petroleum Processing
324199	All Other Petroleum and Coal Products Manufacturing	Petroleum Processing
213112	Support Activities for Oil and Gas Operations	Support Activities for Oil and Gas Operations
541360	Geophysical Surveying and Mapping Services	Support Activities for Oil and Gas Operations
213111	Drilling Oil and Gas Wells	Drilling Wells
211111	Crude Petroleum and Natural Gas Extraction	Oil and Gas Extraction
211112	Natural Gas Liquid Extraction	Oil and Gas Extraction
333132	Oil and Gas Field Machinery and Equipment Manufacturing	Oil and Gas Machinery
486110	Pipeline Transportation of Crude Oil	Pipeline Transportation
486210	Pipeline Transportation of Natural Gas	Pipeline Transportation
486910	Pipeline Transportation of Refined Petroleum Products	Pipeline Transportation
486990	All Other Pipeline Transportation	Pipeline Transportation

Table A-2. Upstream Chemical Products Cluster

NAICS Code	Label	Subcluster Name
325110	Petrochemical Manufacturing	Organic Chemicals
325191	Gum and Wood Chemical Manufacturing	Organic Chemicals
325192	Cyclic Crude and Intermediate Manufacturing	Organic Chemicals
325193	Ethyl Alcohol Manufacturing	Organic Chemicals
325194	Cyclic Crude, Intermediate, and Gum and Wood Chemical Manufacturing	Organic Chemicals
325199	All Other Basic Organic Chemical Manufacturing	Organic Chemicals
325212	Synthetic Rubber Manufacturing	Organic Chemicals
325180	Other Basic Inorganic Chemical Manufacturing	Inorganic Chemicals
325181	Alkalis and Chlorine Manufacturing	Inorganic Chemicals
325182	Carbon Black Manufacturing	Inorganic Chemicals
325188	All Other Basic Inorganic Chemical Manufacturing	Inorganic Chemicals
325120	Industrial Gas Manufacturing	Industrial Gas
325312	Phosphatic Fertilizer Manufacturing	Agricultural Chemicals
325320	Pesticide and Other Agricultural Chemical Manufacturing	Agricultural Chemicals

Table A-3. Construction Products and Services Cluster

NAICS Code	Label	Subcluster Name
233310	Mfg. & Industrial Building Construction	Construction
234920	Pwr/Communication Transmsn Line Construction	Construction
234930	Industrial Nonbuilding Structure Construction	Construction
234990	All Other Heavy Construction	Construction
236210	Industrial Building Construction	Construction
237120	Oil and Gas Pipeline and Related Structures Construction	Construction
237130	Power and Communication Line and Related Structures Construction	Construction
237990	Other Heavy and Civil Engineering Construction	Construction
221310	Water Supply and Irrigation Systems	Water, Sewage, and Other Systems
221330	Steam and Air-Conditioning Supply	Water, Sewage, and Other Systems
332410	Power Boiler and Heat Exchanger Manufacturing	Construction Products
332420	Metal Tank (Heavy Gauge) Manufacturing	Construction Products
332913	Plumbing Fixture Fitting and Trim Manufacturing	Construction Products
332996	Fabricated Pipe and Pipe Fitting Manufacturing	Construction Products
327310	Cement Manufacturing	Construction Components
327331	Concrete Block and Brick Manufacturing	Construction Components
327332	Concrete Pipe Manufacturing	Construction Components
327410	Lime Manufacturing	Construction Components
327420	Gypsum Product Manufacturing	Construction Components
327991	Cut Stone and Stone Product Manufacturing	Construction Components
327993	Mineral Wool Manufacturing	Construction Components
327999	All Other Miscellaneous Nonmetallic Mineral Product Manufacturing	Construction Components
324121	Asphalt Paving Mixture and Block Manufacturing	Construction Materials
324122	Asphalt Shingle and Coating Materials Manufacturing	Construction Materials

Table A-4. Water Transportation Cluster

NAICS Code	Label	Subcluster Name
483112	Deep Sea Passenger Transportation	Water Passenger Transportation
483114	Coastal and Great Lakes Passenger Transportation	Water Passenger Transportation
483212	Inland Water Passenger Transportation	Water Passenger Transportation
483111	Deep Sea Freight Transportation	Marine Transportation Services
483113	Coastal and Great Lakes Freight Transportation	Marine Transportation Services
483211	Inland Water Freight Transportation	Marine Transportation Services
488310	Port and Harbor Operations	Marine Transportation Services
488320	Marine Cargo Handling	Marine Transportation Services
488330	Navigational Services to Shipping	Marine Transportation Services
488390	Other Support Activities for Water Transportation	Marine Transportation Services

336611	Ship Building and Repairing	Boat Building and Repairing
336612	Boat Building	Boat Building and Repairing

Table A-5. Local Industrial Products and Services Cluster

NAICS Code	Label	Subcluster Name
811219	Other Electronic and Precision Equipment Repair and Maintenance	Industrial Repair Services
421930	Recyclable Material Whsle	Industrial Products and Services Wholesaling
421990	Other Miscellaneous Durable Goods Whsle	Industrial Products and Services Wholesaling
423930	Recyclable Material Merchant Wholesalers	Industrial Products and Services Wholesaling
423990	Other Miscellaneous Durable Goods Merchant Wholesalers	Industrial Products and Services Wholesaling
332710	Machine Shops	Industrial Machinery and Distribution
532210	Consumer Electronics and Appliances Rental	Miscellaneous Equipment Rental and Leasing
532310	General Rental Centers	Miscellaneous Equipment Rental and Leasing

Table A-6. Transportation and Logistics Cluster

NAICS Code	Label	Subcluster Name
481111	Scheduled Passenger Air Transportation	Air Transportation
481112	Scheduled Freight Air Transportation	Air Transportation
481212	Nonscheduled Chartered Freight Air Transportation	Air Transportation
488111	Air Traffic Control	Air Transportation
488119	Other Airport Operations	Air Transportation
488190	Other Support Activities for Air Transportation	Air Transportation
481211	Nonscheduled Chartered Passenger Air Transportation	Specialty Air Transportation
481219	Other Nonscheduled Air Transportation	Specialty Air Transportation
488210	Support Activities for Rail Transportation	Ground Transportation Support Activities
488490	Other Support Activities for Road Transportation	Ground Transportation Support Activities
488510	Freight Transportation Arrangement	Ground Transportation Support Activities
488991	Packing and Crating	Ground Transportation Support Activities
488999	All Other Support Activities for Transportation	Ground Transportation Support Activities
484121	General Freight Trucking, Long-Distance, Truckload	Trucking
484230	Specialized Freight (except Used Goods) Trucking, Long-Distance	Trucking

Table A-7. Metalworking Technology Cluster

NAICS Code	Label	Subcluster Name
333511	Industrial Mold Manufacturing	Metalworking Machinery
333514	Special Die and Tool, Die Set, Jig, and Fixture Manufacturing	Metalworking Machinery
333516	Rolling Mill Machinery and Equipment Manufacturing	Metalworking Machinery
333518	Other Metalworking Machinery Manufacturing	Metalworking Machinery
333519	Rolling Mill and Other Metalworking Machinery Manufacturing	Metalworking Machinery
333992	Welding and Soldering Equipment Manufacturing	Metalworking Machinery
333512	Machine Tool (Metal Cutting Types) Manufacturing	Machine Tools and Accessories
333513	Machine Tool (Metal Forming Types) Manufacturing	Machine Tools and Accessories
333515	Cutting Tool and Machine Tool Accessory Manufacturing	Machine Tools and Accessories
333517	Machine Tool Manufacturing	Machine Tools and Accessories
333991	Power-Driven Hand tool Manufacturing	Hand Tools
332721	Precision Turned Product Manufacturing	Fasteners
332722	Bolt, Nut, Screw, Rivet, and Washer Manufacturing	Fasteners
327910	Abrasive Product Manufacturing	Metal Processing
332313	Plate Work Manufacturing	Metal Processing

Table A-8. Electric Power Generation and Transmission Cluster

NAICS Code	Label	Subcluster Name
221112	Fossil Fuel Electric Power Generation	Fossil Fuel Electric Power
221111	Hydroelectric Power Generation	Alternative Electric Power
221113	Nuclear Electric Power Generation	Alternative Electric Power
221114	Solar Electric Power Generation	Alternative Electric Power
221115	Wind Electric Power Generation	Alternative Electric Power
221116	Geothermal Electric Power Generation	Alternative Electric Power
221117	Biomass Electric Power Generation	Alternative Electric Power
221118	Other Electric Power Generation	Alternative Electric Power
221119	Other Electric Power Generation	Alternative Electric Power
221121	Electric Bulk Power Transmission and Control	Electric Power Transmission

Table A-9. Business Services Cluster

NAICS Code	Label	Subcluster Name
551111	Offices of Bank Holding Companies	Corporate Headquarters
551112	Offices of Other Holding Companies	Corporate Headquarters
551114	Corporate, Subsidiary, and Regional Managing Offices	Corporate Headquarters
541611	Administrative Management and General Management Consulting Services	Consulting Services
541612	Human Resources and Executive Search Consulting Services	Consulting Services

541614	Process, Physical Distribution, and Logistics Consulting Services	Consulting Services
541618	Other Management Consulting Services	Consulting Services
541690	Other Scientific and Technical Consulting Services	Consulting Services
533110	Lessors of Nonfinancial Intangible Assets (except Copyrighted Works)	Business Support Services
541199	All Other Legal Services	Business Support Services
541214	Payroll Services	Business Support Services
541930	Translation and Interpretation Services	Business Support Services
541990	All Other Professional, Scientific, and Technical Services	Business Support Services
561210	Facilities Support Services	Business Support Services
561330	Professional Employer Organizations	Business Support Services
561421	Telephone Answering Services	Business Support Services
561422	Telemarketing Bureaus	Business Support Services
561920	Convention and Trade Show Organizers	Business Support Services
514210	Data Processing Services	Computer Services
518210	Data Processing, Hosting, and Related Services	Computer Services
541511	Custom Computer Programming Services	Computer Services
541512	Computer Systems Design Services	Computer Services
541513	Computer Facilities Management Services	Computer Services
541519	Other Computer Related Services	Computer Services
561310	Employment Placement Agencies	Employment Placement Services
561311	Employment Placement Agencies	Employment Placement Services
561312	Executive Search Services	Employment Placement Services
541330	Engineering Services	Engineering Services
541310	Architectural Services	Architectural and Drafting Services
541320	Landscape Architectural Services	Architectural and Drafting Services
541340	Drafting Services	Architectural and Drafting Services
485310	Taxi Service	Ground Passenger Transportation
485320	Limousine Service	Ground Passenger Transportation
485999	All Other Transit and Ground Passenger Transportation	Ground Passenger Transportation
532112	Passenger Car Leasing	Ground Passenger Transportation

Table A-10. Distribution and Electronic Commerce Cluster

NAICS Code	Label	Subcluster Name
493110	General Warehousing and Storage	Warehousing and Storage
493120	Refrigerated Warehousing and Storage	Warehousing and Storage

493190	Other Warehousing and Storage	Warehousing and Storage
425110	Business to Business Electronic Markets	Electronic and Catalog Shopping
454110	Electronic Shopping & Mail-Order Houses-Rtl	Electronic and Catalog Shopping
454111	Electronic Shopping	Electronic and Catalog Shopping
454112	Electronic Auctions	Electronic and Catalog Shopping
454113	Mail-Order Houses	Electronic and Catalog Shopping
425120	Wholesale Trade Agents and Brokers	Wholesale Trade Agents and Brokers
561499	All Other Business Support Services	Support Services
561910	Packaging and Labeling Services	Support Services
422310	Piece Goods, Notions & Other Dry Goods Whsle	Wholesale of Apparel and Accessories
422320	Men's & Boys' Clothing & Furnishings Whsle	Wholesale of Apparel and Accessories
422330	Women's/Children's/Infants' Clothing Whsle	Wholesale of Apparel and Accessories
422340	Footwear Whsle	Wholesale of Apparel and Accessories
424310	Piece Goods, Notions, and Other Dry Goods Merchant Wholesalers	Wholesale of Apparel and Accessories
424320	Men's and Boys' Clothing and Furnishings Merchant Wholesalers	Wholesale of Apparel and Accessories
424330	Women's, Children's, and Infants' Clothing and Accessories Merchant Wholesalers	Wholesale of Apparel and Accessories
424340	Footwear Merchant Wholesalers	Wholesale of Apparel and Accessories
422920	Book, Periodical & Newspaper Whsle	Wholesale of Books, Periodicals, and Newspapers
424920	Book, Periodical, and Newspaper Merchant Wholesalers	Wholesale of Books, Periodicals, and Newspapers
422610	Plastics Materials & Basic Forms/Shapes Whsle	Wholesale of Chemical and Allied Products
422690	Other Chemical & Allied Products Whsle	Wholesale of Chemical and Allied Products
424610	Plastics Materials and Basic Forms and Shapes Merchant Wholesalers	Wholesale of Chemical and Allied Products
424690	Other Chemical and Allied Products Merchant Wholesalers	Wholesale of Chemical and Allied Products
422210	Drugs & Druggists' Sundries Whsle	Wholesale of Drugs and Druggists' Sundries
424210	Drugs and Druggists' Sundries Merchant Wholesalers	Wholesale of Drugs and Druggists' Sundries
422590	Other Farm Product Raw Material Whsle	Wholesale of Farm Products and Supplies
422910	Farm Supplies Whsle	Wholesale of Farm Products and Supplies

422930	Flower/Nursery Stock/Florists' Supplies Whsle	Wholesale of Farm Products and Supplies
422940	Tobacco & Tobacco Product Whsle	Wholesale of Farm Products and Supplies
424590	Other Farm Product Raw Material Merchant Wholesalers	Wholesale of Farm Products and Supplies
424910	Farm Supplies Merchant Wholesalers	Wholesale of Farm Products and Supplies
424930	Flower, Nursery Stock, and Florists' Supplies Merchant Wholesalers	Wholesale of Farm Products and Supplies
424940	Tobacco and Tobacco Product Merchant Wholesalers	Wholesale of Farm Products and Supplies
493130	Farm Product Warehousing and Storage	Wholesale of Farm Products and Supplies
422440	Poultry & Poultry Product Whsle	Wholesale of Food Products
422460	Fish & Seafood Whsle	Wholesale of Food Products
422470	Meat & Meat Product Whsle	Wholesale of Food Products
422480	Fresh Fruit & Vegetable Whsle	Wholesale of Food Products
422820	Wine & Distilled Alcoholic Beverage Whsle	Wholesale of Food Products
424440	Poultry and Poultry Product Merchant Wholesalers	Wholesale of Food Products
424460	Fish and Seafood Merchant Wholesalers	Wholesale of Food Products
424470	Meat and Meat Product Merchant Wholesalers	Wholesale of Food Products
424480	Fresh Fruit and Vegetable Merchant Wholesalers	Wholesale of Food Products
424820	Wine and Distilled Alcoholic Beverage Merchant Wholesalers	Wholesale of Food Products
421210	Furniture Whsle	Wholesale of Furniture and Home Furnishing
421220	Home Furnishing Whsle	Wholesale of Furniture and Home Furnishing
423210	Furniture Merchant Wholesalers	Wholesale of Furniture and Home Furnishing
423220	Home Furnishing Merchant Wholesalers	Wholesale of Furniture and Home Furnishing
421940	Jewelry/Watch/Precious Stone & Metal Whsle	Wholesale of Jewelry, Watches, Precious Stones, and Precious Metals
423940	Jewelry, Watch, Precious Stone, and Precious Metal Merchant Wholesalers	Wholesale of Jewelry, Watches, Precious Stones, and Precious Metals
422110	Printing & Writing Paper Whsle	Wholesale of Paper and Paper Products
422120	Stationery & Office Supplies Whsle	Wholesale of Paper and Paper Products
422130	Industrial & Personal Service Paper Whsle	Wholesale of Paper and Paper Products

424110	Printing and Writing Paper Merchant Wholesalers	Wholesale of Paper and Paper Products
424120	Stationery and Office Supplies Merchant Wholesalers	Wholesale of Paper and Paper Products
424130	Industrial and Personal Service Paper Merchant Wholesalers	Wholesale of Paper and Paper Products
421910	Sporting & Recreational Goods & Supply Whsle	Wholesale of Sporting and Recreational Goods and Supplies
423910	Sporting and Recreational Goods and Supplies Merchant Wholesalers	Wholesale of Sporting and Recreational Goods and Supplies
421920	Toy & Hobby Goods & Supplies Whsle	Wholesale of Toy and Hobby Goods and Supplies
423920	Toy and Hobby Goods and Supplies Merchant Wholesalers	Wholesale of Toy and Hobby Goods and Supplies
422950	Paint, Varnish & Supplies Whsle	Wholesale of Other Merchandise
422990	Other Miscellaneous Nondurable Goods Whsle	Wholesale of Other Merchandise
424950	Paint, Varnish, and Supplies Merchant Wholesalers	Wholesale of Other Merchandise
424990	Other Miscellaneous Nondurable Goods Merchant Wholesalers	Wholesale of Other Merchandise
421820	Farm & Garden Machinery & Equipment Whsle	Wholesale of Farm and Garden Machinery and Equipment
423820	Farm and Garden Machinery and Equipment Merchant Wholesalers	Wholesale of Farm and Garden Machinery and Equipment
421810	Const & Mining (exc Petroleum) Equip Whsle	Wholesale of Construction and Mining Machinery and Equipment
423810	Construction and Mining (except Oil Well) Machinery and Equipment Merchant Wholesalers	Wholesale of Construction and Mining Machinery and Equipment
421830	Industrial Machinery & Equipment Whsle	Wholesale of Industrial Machinery, Equipment, and Supplies
421840	Industrial Supplies Whsle	Wholesale of Industrial Machinery, Equipment, and Supplies
423830	Industrial Machinery and Equipment Merchant Wholesalers	Wholesale of Industrial Machinery, Equipment, and Supplies
423840	Industrial Supplies Merchant Wholesalers	Wholesale of Industrial Machinery, Equipment, and Supplies
421850	Service Establishment Equip & Supplies Whsle	Wholesale of Service Establishment Equipment, and Supplies
423850	Service Establishment Equipment and Supplies Merchant Wholesalers	Wholesale of Service Establishment Equipment, and Supplies

421860	Transportation Equip/Supplies(exc MV) Whsle	Wholesale of Transportation Equipment and Supplies (except Motor Vehicles)
423860	Transportation Equipment and Supplies (except Motor Vehicle) Merchant Wholesalers	Wholesale of Transportation Equipment and Supplies (except Motor Vehicles)
421410	Photographic Equipment & Supplies Whsle	Wholesale of Professional and Commercial Equipment and Supplies
421420	Office Equipment Whsle	Wholesale of Professional and Commercial Equipment and Supplies
421430	Computer & Peripheral Equip & Software Whsle	Wholesale of Professional and Commercial Equipment and Supplies
421440	Other Commercial Equipment Whsle	Wholesale of Professional and Commercial Equipment and Supplies
421450	Medical/Dental/Hospital Equip & Supp Whsle	Wholesale of Professional and Commercial Equipment and Supplies
421460	Ophthalmic Goods Whsle	Wholesale of Professional and Commercial Equipment and Supplies
421490	Oth Professional Equipment & Supplies Whsle	Wholesale of Professional and Commercial Equipment and Supplies
423410	Photographic Equipment and Supplies Merchant Wholesalers	Wholesale of Professional and Commercial Equipment and Supplies
423420	Office Equipment Merchant Wholesalers	Wholesale of Professional and Commercial Equipment and Supplies
423430	Computer and Computer Peripheral Equipment and Software Merchant Wholesalers	Wholesale of Professional and Commercial Equipment and Supplies
423440	Other Commercial Equipment Merchant Wholesalers	Wholesale of Professional and Commercial Equipment and Supplies
423450	Medical, Dental, and Hospital Equipment and Supplies Merchant Wholesalers	Wholesale of Professional and Commercial Equipment and Supplies
423460	Ophthalmic Goods Merchant Wholesalers	Wholesale of Professional and Commercial Equipment and Supplies
423490	Other Professional Equipment and Supplies Merchant Wholesalers	Wholesale of Professional and Commercial Equipment and Supplies
421610	Elec Equip/Wiring Supp/Const Material Whsle	Wholesale of Electrical and Electronic Goods
421620	Electric Appliance/TV/Radio Set Whsle	Wholesale of Electrical and Electronic Goods

421690	Other Electronic Parts & Equipment Whsle	Wholesale of Electrical and Electronic Goods
423610	Electrical Apparatus and Equipment, Wiring Supplies, and Related Equipment Merchant Wholesalers	Wholesale of Electrical and Electronic Goods
423620	Electrical and Electronic Appliance, Television, and Radio Set Merchant Wholesalers	Wholesale of Electrical and Electronic Goods
423690	Other Electronic Parts and Equipment Merchant Wholesalers	Wholesale of Electrical and Electronic Goods
421510	Metal Service Centers & Offices	Wholesale of Metals and Minerals (except Petroleum)
421520	Coal & Other Mineral & Ore Whsle	Wholesale of Metals and Minerals (except Petroleum)
423510	Metal Service Centers and Other Metal Merchant Wholesalers	Wholesale of Metals and Minerals (except Petroleum)
423520	Coal and Other Mineral and Ore Whsle	Wholesale of Metals and Minerals (except Petroleum)
422710	Petroleum Bulk Stations & Terminals	Wholesale of Petroleum and Petroleum Products
422720	Petroleum Prod Whsle (exc Bulk Sta/Terminals)	Wholesale of Petroleum and Petroleum Products
424710	Petroleum Bulk Stations and Terminals	Wholesale of Petroleum and Petroleum Products
424720	Petroleum and Petroleum Products Merchant Wholesalers (except Bulk Stations and Terminals)	Wholesale of Petroleum and Petroleum Products
532411	Commercial Air, Rail, and Water Transportation Equipment Rental and Leasing	Rental and Leasing
532412	Construction, Mining, and Forestry Machinery and Equipment Rental and Leasing	Rental and Leasing
532420	Office Machinery and Equipment Rental and Leasing	Rental and Leasing
532490	Other Commercial and Industrial Machinery and Equipment Rental and Leasing	Rental and Leasing

Table A-11. Local Health Services Cluster

NAICS Code	Label	Subcluster Name
621111	Offices of Physicians (except Mental Health Specialists)	Healthcare Provider Offices
621112	Offices of Physicians, Mental Health Specialists	Healthcare Provider Offices
621210	Offices of Dentists	Healthcare Provider Offices
621310	Offices of Chiropractors	Healthcare Provider Offices
621320	Offices of Optometrists	Healthcare Provider Offices
621330	Offices of Mental Health Practitioners (except Physicians)	Healthcare Provider Offices
621340	Offices of Physical, Occupational and Speech Therapists, and Audiologists	Healthcare Provider Offices
621391	Offices of Podiatrists	Healthcare Provider Offices
621399	Offices of All Other Miscellaneous Health Practitioners	Healthcare Provider Offices
621410	Family Planning Centers	Healthcare Provider Offices
621420	Outpatient Mental Health and Substance Abuse Centers	Healthcare Provider Offices
621491	HMO Medical Centers	Healthcare Provider Offices
621492	Kidney Dialysis Centers	Healthcare Provider Offices

621493	Freestanding Ambulatory Surgical and Emergency Centers	Healthcare Provider Offices
621498	All Other Outpatient Care Centers	Healthcare Provider Offices
621991	Blood and Organ Banks	Healthcare Provider Offices
621999	All Other Miscellaneous Ambulatory Health Care Services	Healthcare Provider Offices
622110	General Medical and Surgical Hospitals	Hospitals
622210	Psychiatric and Substance Abuse Hospitals	Hospitals
622310	Specialty (except Psychiatric and Substance Abuse) Hospitals	Hospitals
339116	Dental Laboratories	Medical Laboratories
621511	Medical Laboratories	Medical Laboratories
621512	Diagnostic Imaging Centers	Medical Laboratories
621610	Home Health Care Services	Home and Residential Care
623110	Nursing Care Facilities	Home and Residential Care
623210	Residential Mental Retardation Facilities	Home and Residential Care
623220	Residential Mental Health and Substance Abuse Facilities	Home and Residential Care
623311	Continuing Care Retirement Communities	Home and Residential Care
623312	Homes for the Elderly	Home and Residential Care
623990	Other Residential Care Facilities	Home and Residential Care
812210	Funeral Homes and Funeral Services	Funeral Service and Crematories
812220	Cemeteries and Crematories	Funeral Service and Crematories
532291	Home Health Equipment Rental	Medical Equipment Distribution and Rental
446110	Pharmacies and Drug Stores	Drug Stores
446130	Optical Goods Stores	Optical Goods Retailing

Table A-12. Biopharmaceuticals Cluster

NAICS Code	Label	Subcluster Name
325411	Medicinal and Botanical Manufacturing	Biopharmaceutical Products
325412	Pharmaceutical Preparation Manufacturing	Biopharmaceutical Products
325414	Biological Product (except Diagnostic) Manufacturing	Biological Products
325413	In-Vitro Diagnostic Substance Manufacturing	Diagnostic Substances

Appendix B. Real GDP by County in 2001, 2010 and 2024 (in Thousands of Dollars)

	2001	2010	2024
Austin	\$916,278	\$1,333,606	\$1,769,939
Brazoria	\$11,446,039	\$13,176,470	\$18,217,082
Chambers	\$1,401,583	\$1,941,127	\$2,888,587

Colorado	\$777,991	\$761,286	\$923,914
Fort Bend	\$12,598,737	\$19,360,410	\$39,054,035
Galveston	\$13,530,086	\$15,119,264	\$20,111,790
Harris	\$249,386,893	\$325,955,471	\$458,701,746
Liberty	\$1,796,148	\$2,025,534	\$2,567,666
Matagorda	\$2,683,536	\$2,343,607	\$2,232,448
Montgomery	\$9,092,327	\$16,624,250	\$39,558,095
Walker	\$1,712,593	\$1,922,032	\$2,436,259
Waller	\$1,014,638	\$1,842,603	\$4,367,085
Wharton	\$2,004,366	\$1,700,670	\$2,118,801
HGAC Total	\$308,361,215	\$404,106,330	\$594,947,447

Appendix C. Population for Each County in 2001, 2010 and 2024

	2001	2010	2024
Austin	24,191	28,372	32,878
Brazoria	248,355	314,499	411,416
Chambers	26,557	35,452	55,988
Colorado	20,192	20,868	21,447
Fort Bend	375,122	590,177	951,028
Galveston	254,545	292,492	367,367
Harris	3,483,124	4,107,542	4,996,331
Liberty	71,632	75,870	116,291
Matagorda	37,912	36,706	36,190
Montgomery	311,693	459,223	751,183

Walker	62,220	68,239	83,460
Waller	33,208	43,558	66,097
Wharton	41,007	41,280	42,065
HGAC Total	4,989,758	6,114,278	7,931,741

Appendix D. Personal Income for Each County in 2001, 2010 and 2024

	2001	2010	2024
Austin	\$29,171	\$40,124	\$67,423
Brazoria	\$28,584	\$37,676	\$60,700
Chambers	\$27,976	\$40,070	\$66,866
Colorado	\$25,485	\$37,198	\$65,601
Fort Bend	\$36,575	\$48,621	\$75,721
Galveston	\$31,053	\$41,507	\$67,777
Harris	\$35,389	\$46,133	\$79,991
Liberty	\$22,012	\$29,266	\$44,266
Matagorda	\$22,737	\$31,842	\$55,823
Montgomery	\$34,771	\$50,002	\$80,512
Walker	\$17,440	\$22,577	\$36,921
Waller	\$22,594	\$32,981	\$55,028
Wharton	\$25,333	\$34,876	\$58,445
HGAC Total	\$34,086	\$45,186	\$76,376

Appendix E. Real GDP by Industry and County in 2001, 2010 and 2024 (in Thousands of Dollars)

Appendix E-1. Austin

Industry	2001	2010	2024
Agriculture	\$0	\$0	\$11,964
Mining	\$78,346	\$68,773	\$30,105
Utilities	\$8,718	\$8,222	\$9,544
Construction	\$97,190	\$103,494	\$108,624
wholesale	\$58,419	\$84,980	\$154,401
Information	\$15,353	\$19,853	\$103,307
Finance	\$57,055	\$54,721	\$58,731
Real Estate	\$96,727	\$117,360	\$237,542
Professional	\$50,564	\$59,297	\$149,975
Management	\$1,721	\$2,687	\$40,532
Administrative	\$13,281	\$24,712	\$43,109
Education	\$1,258	\$10,402	\$22,440
Health Care	\$21,424	\$43,033	\$77,639
Art	\$2,824	\$4,404	\$10,886
Accommodation	\$21,063	\$22,698	\$28,452
Other Services	\$29,227	\$44,052	\$26,508
Public Administration	\$108,598	\$157,791	\$107,244
Manufacturing	\$155,459	\$328,582	\$329,029
Retail	\$51,771	\$120,822	\$244,377
Transportation	\$0	\$0	\$56,060

Appendix E-2. Brazoria

Industry	2001	2010	2024
Agriculture	\$25,758	\$8,731	\$22,963
Mining	\$389,379	\$325,710	\$422,234
Utilities	\$714,136	\$511,251	\$562,559
Construction	\$1,090,114	\$1,152,438	\$1,531,976
wholesale	\$229,763	\$388,625	\$532,171
Information	\$45,165	\$59,481	\$281,399
Finance	\$202,767	\$301,445	\$246,976
Real Estate	\$1,048,546	\$1,562,520	\$2,867,551
Professional	\$288,666	\$370,629	\$812,237
Management	\$16,858	\$6,299	\$122,204
Administrative	\$146,991	\$255,605	\$449,737
Education	\$21,381	\$41,649	\$78,382

Health Care	\$299,987	\$438,851	\$1,105,430
Art	\$24,462	\$45,138	\$121,910
Accommodation	\$187,403	\$259,114	\$420,027
Other Services	\$308,914	\$305,364	\$324,711
Public Administration	\$1,134,878	\$1,335,672	\$1,656,334
Manufacturing	\$4,579,699	\$4,904,517	\$5,164,851
Retail	\$496,312	\$640,348	\$1,283,488
Transportation	\$190,795	\$285,744	\$353,931

Appendix E-3. Chambers

Industry	2001	2010	2024
Agriculture	\$0	\$3,949	\$42,707
Mining	\$239,552	\$114,723	\$178,721
Utilities	\$283,886	\$374,256	\$234,553
Construction	\$37,113	\$136,110	\$222,664
wholesale	\$40,153	\$67,914	\$0
Information	\$550	\$0	\$0
Finance	\$18,221	\$22,136	\$26,538
Real Estate	\$86,130	\$298,340	\$451,048
Professional	\$13,762	\$41,939	\$81,745
Management	\$0	\$0	\$0
Administrative	\$18,090	\$0	\$62,616
Education	\$2	\$0	\$0
Health Care	\$12,915	\$0	\$0
Art	\$5,515	\$7,635	\$6,389
Accommodation	\$16,248	\$22,329	\$56,636
Other Services	\$22,396	\$32,630	\$134,306
Public Administration	\$116,164	\$144,882	\$255,908
Manufacturing	\$346,344	\$636,608	\$565,464
Retail	\$27,406	\$43,055	\$75,404
Transportation	\$0	\$0	\$296,547

Appendix E-4. Colorado

Industry	2001	2010	2024
Agriculture	\$20,200	\$8,283	\$16,677
Mining	\$168,856	\$84,860	\$82,966
Utilities	\$1,310	\$1,075	\$4,395
Construction	\$59,742	\$66,563	\$81,541
wholesale	\$18,244	\$30,061	\$0
Information	\$3,276	\$4,417	\$0
Finance	\$28,272	\$27,521	\$24,031

Real Estate	\$78,039	\$120,395	\$182,247
Professional	\$0	\$15,659	\$21,404
Management	\$0	\$1,613	\$0
Administrative	\$4,819	\$14,063	\$0
Education	\$0	\$3,512	\$0
Health Care	\$0	\$52,604	\$0
Art	\$3,575	\$7,044	\$0
Accommodation	\$23,579	\$22,026	\$0
Other Services	\$25,416	\$22,536	\$0
Public Administration	\$77,698	\$70,253	\$77,942
Manufacturing	\$55,956	\$129,871	\$131,329
Retail	\$54,702	\$48,633	\$85,938
Transportation	\$24,285	\$23,921	\$41,312

Appendix E-5. Fort Bend

Industry	2001	2010	2024
Agriculture	\$44,725	\$44,108	\$14,953
Mining	\$1,068,091	\$677,489	\$1,686,638
Utilities	\$952,280	\$1,065,782	\$911,370
Construction	\$1,788,961	\$1,910,700	\$2,195,838
wholesale	\$594,649	\$1,275,844	\$2,381,107
Information	\$186,139	\$315,558	\$1,880,102
Finance	\$664,482	\$938,110	\$1,016,799
Real Estate	\$1,523,862	\$3,180,324	\$7,488,814
Professional	\$1,530,862	\$1,855,820	\$2,838,495
Management	\$2,217	\$55,394	\$225,927
Administrative	\$221,743	\$672,952	\$1,141,836
Education	\$66,488	\$100,372	\$220,029
Health Care	\$574,991	\$1,006,847	\$2,551,242
Art	\$63,235	\$101,293	\$198,324
Accommodation	\$318,312	\$471,842	\$884,668
Other Services	\$466,980	\$629,567	\$806,206
Public Administration	\$1,540,067	\$1,969,419	\$3,639,747
Manufacturing	\$846,329	\$2,121,524	\$5,618,378
Retail	\$671,531	\$1,238,003	\$3,058,409
Transportation	\$247,816	\$350,690	\$637,931

Appendix E-6. Galveston

Industry	2001	2010	2024
Agriculture	\$11,038	\$3,509	\$3,118
Mining	\$325,107	\$153,426	\$199,805

Utilities	\$579,175	\$343,094	\$349,039
Construction	\$637,868	\$992,945	\$802,968
wholesale	\$211,273	\$339,495	\$374,010
Information	\$67,962	\$131,724	\$216,638
Finance	\$495,342	\$684,495	\$691,450
Real Estate	\$1,100,089	\$1,693,514	\$2,981,485
Professional	\$298,328	\$424,646	\$760,581
Management	\$23,571	\$17,433	\$26,649
Administrative	\$135,350	\$249,100	\$495,301
Education	\$41,817	\$51,341	\$71,915
Health Care	\$375,551	\$461,048	\$708,897
Art	\$83,662	\$100,041	\$138,489
Accommodation	\$498,072	\$485,219	\$640,857
Other Services	\$320,562	\$298,300	\$405,108
Public Administration	\$2,454,816	\$2,594,121	\$3,328,777
Manufacturing	\$4,631,953	\$4,440,593	\$6,244,434
Retail	\$494,128	\$648,344	\$1,279,789
Transportation	\$245,182	\$403,113	\$402,164

Appendix E-7. Harris

Industry	2001	2010	2024
Agriculture	\$79,217	\$71,026	\$71,825
Mining	\$12,862,464	\$13,769,414	\$23,833,823
Utilities	\$5,430,863	\$3,614,700	\$5,682,265
Construction	\$19,912,629	\$16,267,974	\$18,208,995
wholesale	\$21,565,924	\$31,307,556	\$54,868,265
Information	\$4,212,834	\$6,034,689	\$11,960,676
Finance	\$14,714,488	\$17,344,108	\$17,665,578
Real Estate	\$22,569,218	\$30,046,283	\$50,930,318
Professional	\$22,214,312	\$30,458,281	\$48,353,132
Management	\$1,566,415	\$3,493,762	\$11,121,021
Administrative	\$7,798,687	\$11,905,552	\$17,696,514
Education	\$2,895,240	\$3,461,914	\$5,055,714
Health Care	\$10,920,831	\$16,008,190	\$24,528,426
Art	\$1,349,342	\$1,797,619	\$3,658,424
Accommodation	\$7,113,889	\$7,354,591	\$9,623,125
Other Services	\$6,183,278	\$6,099,349	\$6,950,499
Public Administration	\$21,937,908	\$25,868,981	\$30,404,680
Manufacturing	\$36,577,280	\$70,800,446	\$73,286,362
Retail	\$11,216,966	\$12,310,543	\$22,020,655
Transportation	\$23,025,989	\$22,121,831	\$27,641,598

Appendix E-8. Liberty

Industry	2001	2010	2024
Agriculture	\$10,683	\$12,417	\$6,326
Mining	\$250,069	\$267,608	\$112,639
Utilities	\$5,163	\$4,376	\$12,731
Construction	\$158,434	\$119,668	\$238,309
wholesale	\$36,983	\$58,346	\$75,240
Information	\$9,337	\$21,425	\$65,200
Finance	\$52,591	\$52,788	\$46,155
Real Estate	\$202,442	\$379,370	\$655,230
Professional	\$32,579	\$0	\$0
Management	\$0	\$0	\$0
Administrative	\$19,176	\$40,859	\$50,227
Education	\$0	\$1,102	\$0
Health Care	\$0	\$95,238	\$0
Art	\$849	\$1,286	\$0
Accommodation	\$41,230	\$52,222	\$0
Other Services	\$63,429	\$58,644	\$66,332
Public Administration	\$273,609	\$317,603	\$450,148
Manufacturing	\$244,273	\$233,041	\$173,677
Retail	\$133,603	\$156,417	\$240,797
Transportation	\$45,885	\$83,335	\$121,884

Appendix E-9. Matagorda

Industry	2001	2010	2024
Agriculture	\$105,345	\$42,945	\$89,003
Mining	\$399,251	\$182,464	\$35,417
Utilities	\$1,175,838	\$1,241,637	\$1,030,329
Construction	\$97,351	\$52,836	\$108,791
wholesale	\$20,263	\$17,291	\$22,701
Information	\$6,541	\$7,774	\$19,267
Finance	\$37,602	\$33,233	\$20,360
Real Estate	\$150,911	\$166,137	\$0
Professional	\$48,452	\$45,145	\$35,391
Management	\$0	\$0	\$1,057
Administrative	\$0	\$35,604	\$40,768
Education	\$0	\$0	\$2,421
Health Care	\$0	\$0	\$67,097
Art	\$2,432	\$2,584	\$3,920
Accommodation	\$36,052	\$34,686	\$37,150
Other Services	\$56,990	\$44,683	\$28,271

Public Administration	\$184,471	\$179,908	\$161,433
Manufacturing	\$94,437	\$80,830	\$112,673
Retail	\$62,838	\$62,944	\$84,725
Transportation	\$0	\$19,106	\$0

Appendix E-10. Montgomery

Industry	2001	2010	2024
Agriculture	\$11,776	\$10,451	\$9,397
Mining	\$508,768	\$728,127	\$1,973,320
Utilities	\$159,426	\$147,352	\$546,987
Construction	\$967,946	\$1,469,673	\$2,116,149
wholesale	\$478,295	\$1,224,952	\$2,083,170
Information	\$66,745	\$239,376	\$853,604
Finance	\$360,127	\$806,796	\$1,316,942
Real Estate	\$1,760,953	\$2,323,435	\$6,171,333
Professional	\$704,525	\$1,127,688	\$2,754,901
Management	\$19,985	\$161,316	\$1,312,929
Administrative	\$309,516	\$627,153	\$1,112,999
Education	\$42,650	\$107,386	\$184,076
Health Care	\$552,294	\$1,034,036	\$2,415,649
Art	\$121,473	\$110,895	\$263,283
Accommodation	\$384,463	\$710,186	\$1,018,334
Other Services	\$297,430	\$545,351	\$720,444
Public Administration	\$1,009,580	\$1,787,632	\$2,623,413
Manufacturing	\$707,496	\$2,056,821	\$9,104,772
Retail	\$732,797	\$1,163,428	\$2,401,141
Transportation	\$124,970	\$379,496	\$940,326

Appendix E-11. Walker

Industry	2001	2010	2024
Agriculture	\$26,898	\$5,258	\$11,738
Mining	\$9,534	\$6,045	\$27,205
Utilities	\$4,275	\$5,032	\$5,352
Construction	\$44,426	\$57,663	\$92,461
wholesale	\$18,685	\$49,655	\$29,942
Information	\$15,844	\$32,297	\$24,252
Finance	\$48,160	\$51,687	\$54,144
Real Estate	\$143,535	\$220,876	\$353,311
Professional	\$0	\$50,700	\$49,371
Management	\$0	\$0	\$0
Administrative	\$0	\$0	\$0

Education	\$5,941	\$0	\$13,689
Health Care	\$90,029	\$0	\$124,473
Art	\$4,273	\$4,621	\$7,141
Accommodation	\$74,976	\$53,988	\$69,286
Other Services	\$44,400	\$37,461	\$45,388
Public Administration	\$983,501	\$967,473	\$1,055,981
Manufacturing	\$81,869	\$103,303	\$184,678
Retail	\$99,857	\$142,818	\$254,752
Transportation	\$9,224	\$16,139	\$10,076

Appendix E-12. Waller

Industry	2001	2010	2024
Agriculture	\$6,294	\$0	\$37,366
Mining	\$108,352	\$74,295	\$98,347
Utilities	\$0	\$1,888	\$3,046
Construction	\$67,616	\$111,637	\$188,303
wholesale	\$35,189	\$357,143	\$335,946
Information	\$2,656	\$7,979	\$8,759
Finance	\$18,488	\$24,467	\$34,502
Real Estate	\$132,255	\$228,890	\$327,857
Professional	\$24,735	\$60,200	\$0
Management	\$0	\$0	\$0
Administrative	\$6,766	\$17,597	\$83,408
Education	\$0	\$3,566	\$5,349
Health Care	\$0	\$31,284	\$47,388
Art	\$3,310	\$8,308	\$26,995
Accommodation	\$24,698	\$30,821	\$44,466
Other Services	\$29,701	\$30,877	\$52,977
Public Administration	\$236,894	\$289,141	\$390,781
Manufacturing	\$176,925	\$458,524	\$2,169,686
Retail	\$93,046	\$87,179	\$254,615
Transportation	\$10,432	\$0	\$176,838

Appendix E-13. Wharton

Industry	2001	2010	2024
Agriculture	\$130,738	\$197,119	\$111,823
Mining	\$646,246	\$304,139	\$177,395
Utilities	\$10,125	\$67,474	\$488,356
Construction	\$63,986	\$58,497	\$51,716
wholesale	\$48,423	\$95,933	\$90,931
Information	\$6,758	\$8,598	\$12,890

Finance	\$68,053	\$85,263	\$57,301
Real Estate	\$195,795	\$156,460	\$268,569
Professional	\$25,232	\$30,900	\$0
Management	\$0	\$0	\$0
Administrative	\$0	\$0	\$19,468
Education	\$0	\$4,523	\$7,555
Health Care	\$0	\$74,609	\$157,607
Art	\$1,823	\$2,246	\$2,688
Accommodation	\$31,747	\$33,497	\$34,110
Other Services	\$46,833	\$40,543	\$31,600
Public Administration	\$210,888	\$208,072	\$180,935
Manufacturing	\$158,428	\$131,741	\$151,384
Retail	\$97,467	\$111,251	\$202,363
Transportation	\$33,841	\$28,290	\$38,885