

Workforce Demands in Downstream Manufacturing

(Petroleum & Coal Manufacturing and Chemical Manufacturing)

Workforce Solutions

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**Workforce Solutions is an affiliate of the Gulf Coast Workforce Board, which manages a regional workforce system that helps employers solve their workforce problems and residents build careers so both can compete in the global economy. The workforce system serves the City of Houston and the surrounding 13 Texas Gulf Coast counties including: Austin, Brazoria, Chambers, Colorado, Fort Bend, Galveston, Harris, Liberty, Matagorda, Montgomery, Walker, Waller, and Wharton*

AN OVERVIEW OF MANUFACTURING RELATED TO OIL & GAS

The economy of the Gulf Coast Region is largely centered on the energy industry with roughly half of all jobs tied to it in some way. There are numerous steps that must be made for oil and gas to be found, pumped, shipped, processed, and sold. With that being said, the industry has been classified into three sectors to make it easier to understand and discuss:

- Upstream – the exploration, production, and extraction of oil and gas
- Midstream – the transportation, storage, and wholesale marketing of crude or refined petroleum products
- Downstream – the oil and gas operations that take place after production and up to the point of sale

Downstream Manufacturing

This report will focus on manufacturing related to downstream oil and gas, the final step in the three sector process.

In the downstream sector oil and gas arrives at processing plants where it is **refined and processed into various products for sale and distribution**. The end results of downstream manufacturing are numerous covering a wide variety of products. Some of the products commonly produced include:

- Gasoline
- Diesel Oil
- Jet Fuel
- Propane
- Heating Oil
- Liquefied Petroleum Gas (LPG)
- Liquefied Natural Gas (LNG)
- Plastics
- Synthetic Rubber
- Asphalt
- Lubricants
- Petroleum Coke
- Pharmaceuticals
- Antifreeze
- Fertilizers
- Pesticides

While downstream manufacturing is widely known for its relationship to the transportation and power industry, the products listed above point to a relationship with a much broader range of industries. Downstream manufacturing consists of two industries based on the North American Industry Classification System (NAICS): Petroleum & Coal Product Manufacturing and Chemical Manufacturing.

Petroleum & Coal Product Manufacturing (Petroleum Refineries)

The Petroleum & Coal Product Manufacturing industry **incorporates the transformation of crude petroleum into usable products**. The main process in petroleum refining involves the separation of crude petroleum into component products through such techniques as cracking and distillation.

Distillation - the process of vaporizing liquids, crude oil, or one of its fractions in a closed vessel, collecting and condensing the vapors into liquids.

Cracking - the process of breaking down larger molecules of hydrocarbons into smaller ones. When this is done by heating the oil it is known as 'thermal cracking'. If a catalyst is used it is known as 'catalytic cracking'.

The Petroleum & Coal Product Manufacturing industry also includes establishments that further process refined petroleum and coal products and create products such as asphalt coatings and petroleum lubricating oils:

- Petroleum & Coal Product Manufacturing
 - Petroleum Refineries
 - Asphalt Paving and Roofing Materials Manufacturing
 - Other Petroleum and Coal Products Manufacturing

Establishments that manufacture petrochemicals from refined petroleum are classified in Chemical Manufacturing.

Chemical Manufacturing

The Chemical Manufacturing industry involves the **manufacturing of chemicals using basic processes such as thermal cracking and distillation**. Establishments convert feedstocks derived from petroleum, or from petroleum and natural gas liquids, into petrochemicals. **Refining crude petroleum into petrochemicals is excluded from this industry sector**. The Chemical Manufacturing industry is broken up into several different categories:

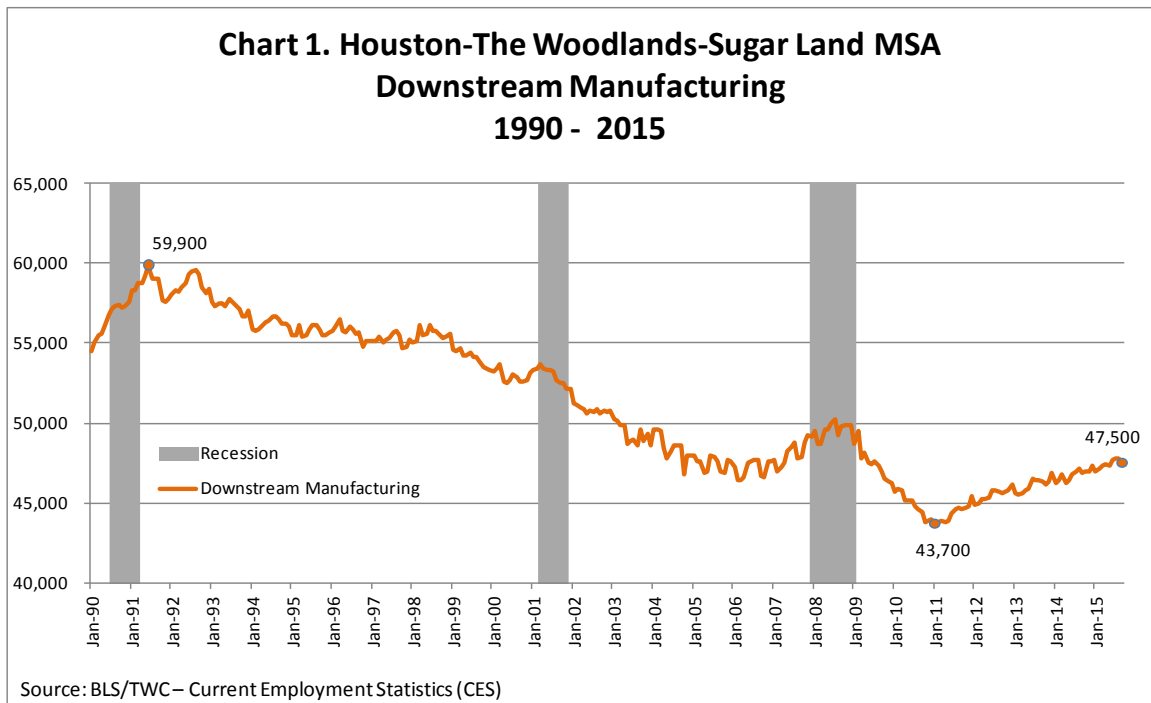
- Chemical Manufacturing
 - Petrochemical Manufacturing
 - Industrial Gas Manufacturing
 - Synthetic Dye and Pigment Manufacturing
 - Other Basic Inorganic Chemical Manufacturing
 - Other Basic Organic Chemical Manufacturing

Downstream Manufacturing Highlights

- Development of shale resources and the surge of natural gas and natural gas liquid production is contributing to historical low feedstock prices and a flurry of major projects in the chemical and petrochemical industry (over \$48 billion in Texas¹)
- U.S. producers use natural gas-based feedstock while most European and Asian producers use oil-based feedstock, the difference in the price is giving the U.S. a distinct competitiveness compared to other regions
- Many of the expansions are geared towards increasing exports which are expected to rise dramatically over the next 15 years
- Significant job growth and economic benefits are expected for the region
- Expansions are causing a shortage of craftspeople (welders, pipefitters, riggers, electricians)

Downstream Manufacturing Employment: Past and Present

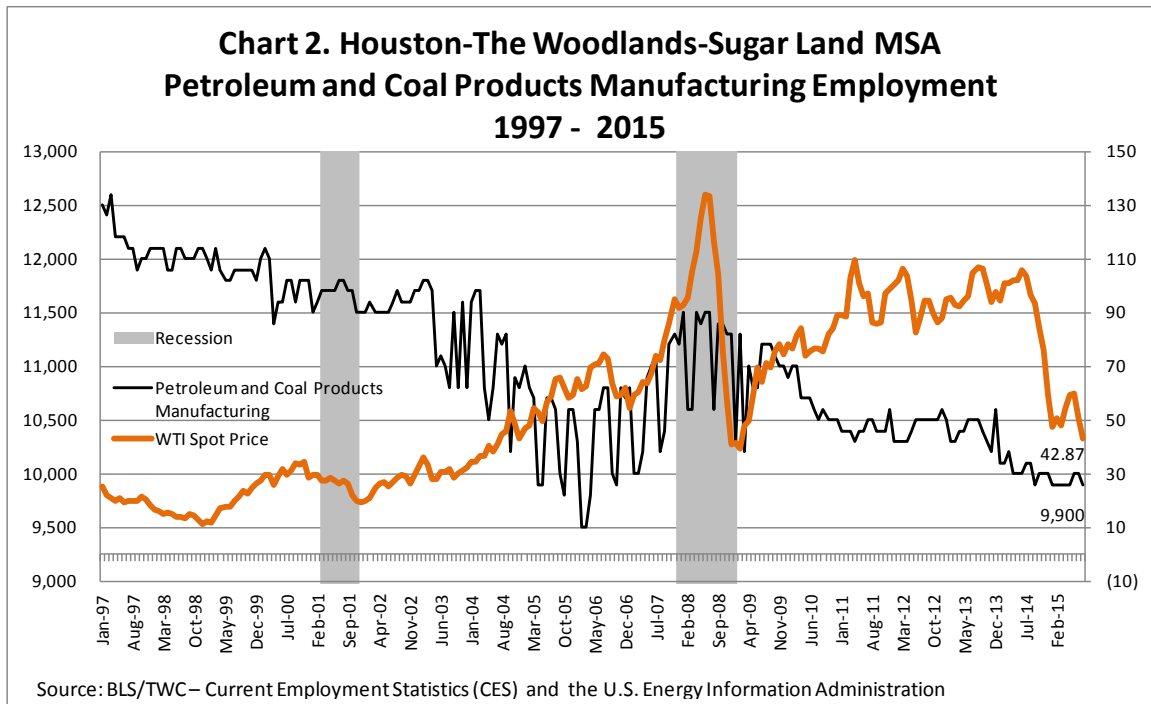
Faced with environmental mandates and rising feedstock costs (natural gas and other hydrocarbon derivative products), the downstream manufacturing sector **endured a long-term period of decline** after peaking in 1991 with employment falling by some 16,000 jobs or 27 percent to 43,700 in January 2011. Recently the industry has become highly profitable from the boom in shale oil-and-gas exploration encouraging billions of dollars in investments. Since January 2011 downstream manufacturing employment has risen by some 3,800 jobs or 8.7 percent (see chart 1).



¹ Texas accounts for 99 projects with a cumulative investment of more than \$48.2 billion by 2023 according to the American Chemistry Council.

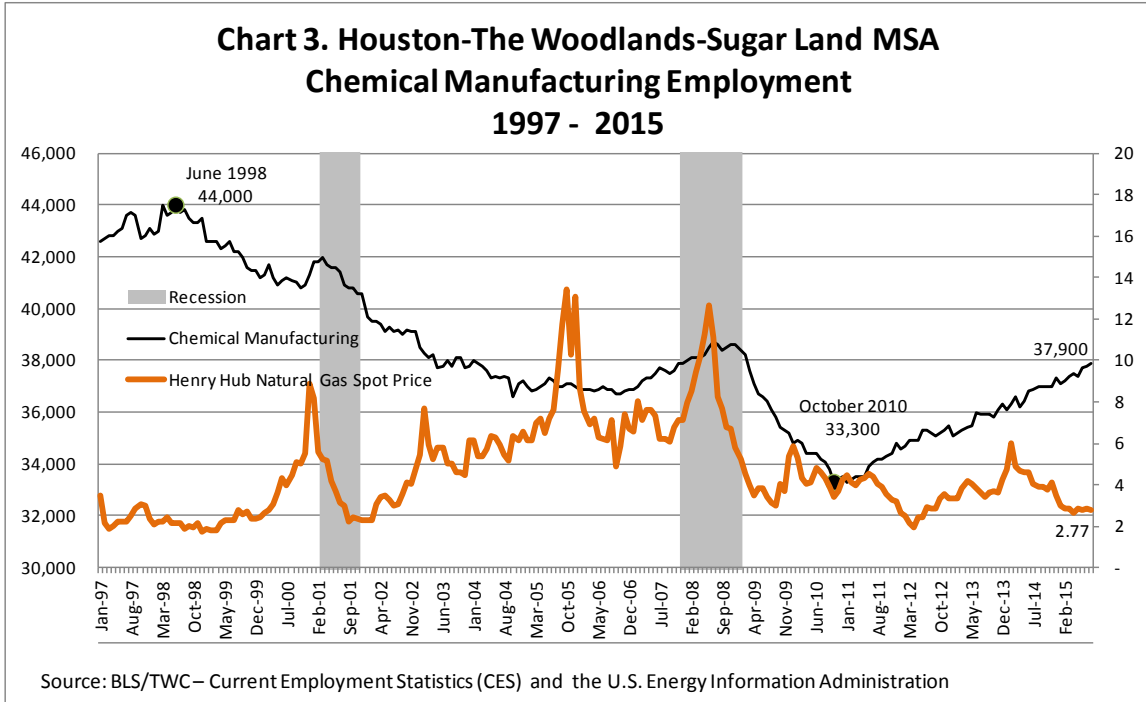
Petroleum and Coal Product Manufacturing (Petroleum Refineries)

The number of new refineries built in the U.S. over the last forty years is very small; in fact the first new refinery in the Gulf Coast Region since 1975 was built by Kinder Morgan in 2014 becoming operational just this year. Unsurprisingly, **the long-term trend of employment in Petroleum & Coal Product Manufacturing has been negative** (see chart 2). U.S. oil production has skyrocketed by nearly 125 million barrels of oil per month over the last five years according to the U.S. Energy Information Administration. The increase in production has been almost entirely for unconventional oil, or light tight oil (LTO). U.S. refiners have primarily invested in processing medium-to heavy-crude making it difficult to process but recently **refineries have been making low cost changes to process greater quantities of LTO with capacity's to do so expected to increase over the next several years.**

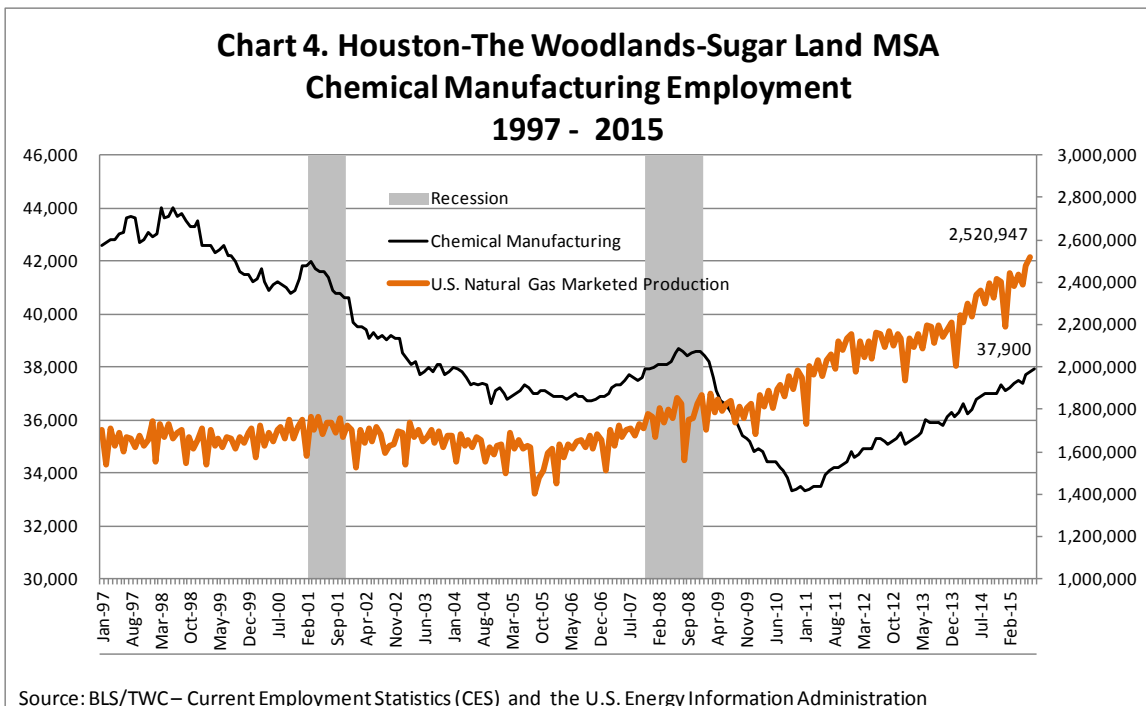


Chemical Manufacturing

Chemical Manufacturing **has also endured a long-term decline** with payrolls falling from the most recent peak of 44,000 in June 1998 to 33,300 in October 2010, down 24.3 percent. The boom in shale exploration has reversed the decline encouraging billions of dollars in investments. Since October 2010 Chemical Manufacturing employment **has risen by 4,400 jobs or 13.2 percent** (see chart 3). Note the decline in natural gas prices over recent years.

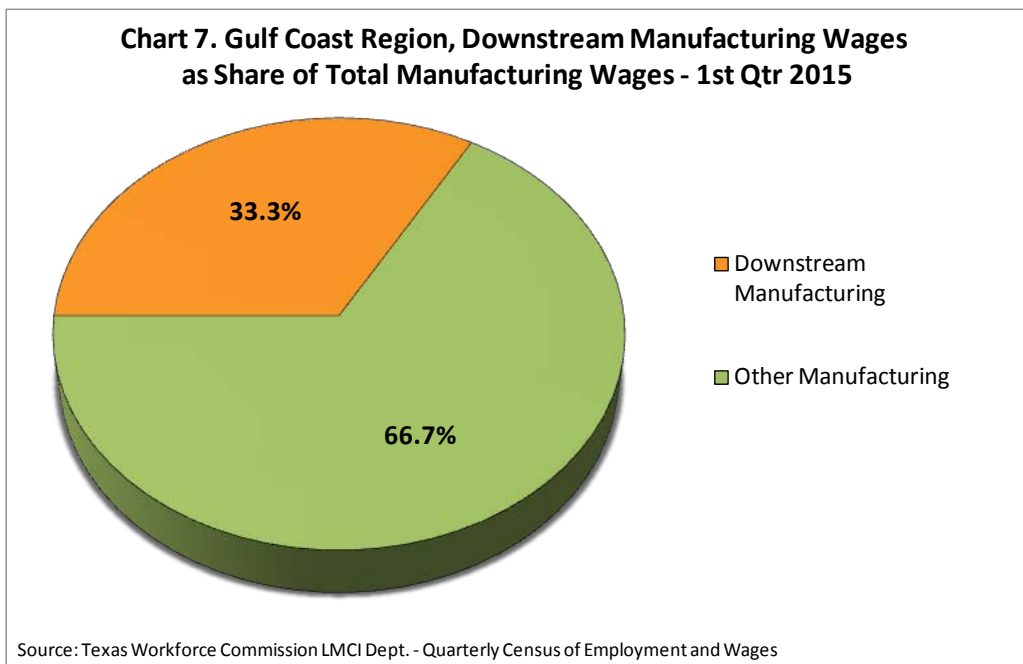
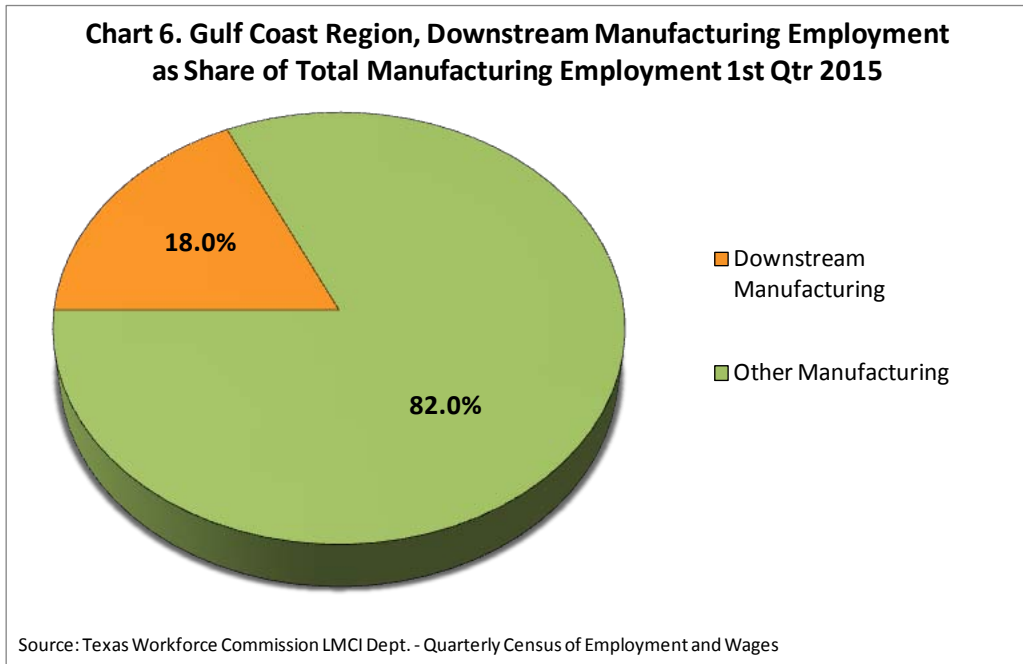


An increase in shale gas production has been the driving factor of a dramatic decline in natural gas prices. With production levels that have dramatically increased in recent years and expectation for it to continue to rise over the next two decades **there has been a resurgence of building and expansions** by many companies that has already resulted in bringing new jobs to the Gulf Coast Region (see chart 4).

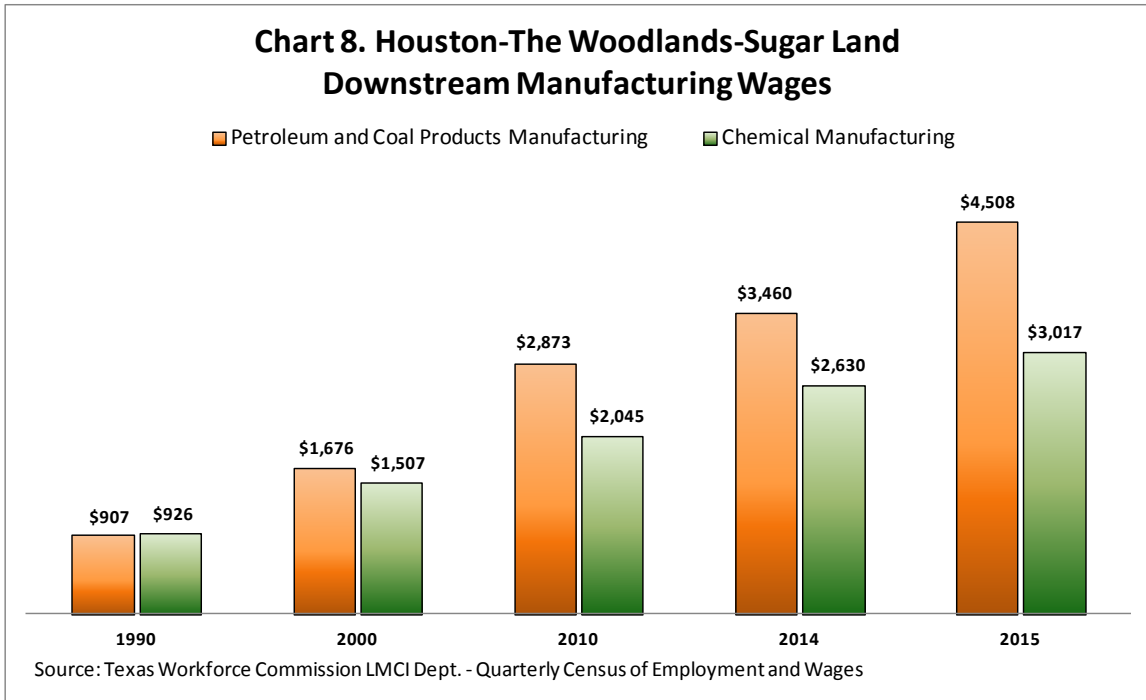


Wages

The manufacturing sector as a whole provides above average wages when compared to all industries in the Gulf Coast Region. At \$1,801 per week, manufacturing wages in the region were 33.2 percent above the average for all industries as of first quarter 2015. While downstream manufacturing employment represented 18 percent of the entire manufacturing industry sector in first quarter 2015, total wages paid represented 33.3 percent of all wages across all of manufacturing (see chart 6 and 7).



Average weekly wages for the two subsectors of downstream manufacturing, Petroleum & Coal Product Manufacturing and Chemical Manufacturing, were almost identical 25 years ago. Wages for both subsectors have grown substantially since then with petroleum & coal product manufacturers taking the lead with the average weekly wage rising 397.0 percent while wages in chemical manufacturing rose 225.8 percent. Wages in Petroleum & Coal Products Manufacturing experienced an especially large boost in first quarter 2015 as refiners reap the benefits of low cost oil².



² The average weekly wage is the numeric calculation of total wages divided by the number of employees, divided by the number of weeks in a quarter. This figure represents wages covered by the Texas Unemployment Compensation Act and includes bonuses, commissions and cash values or remuneration received in any medium other than cash.

Challenges

Workforce Shortages

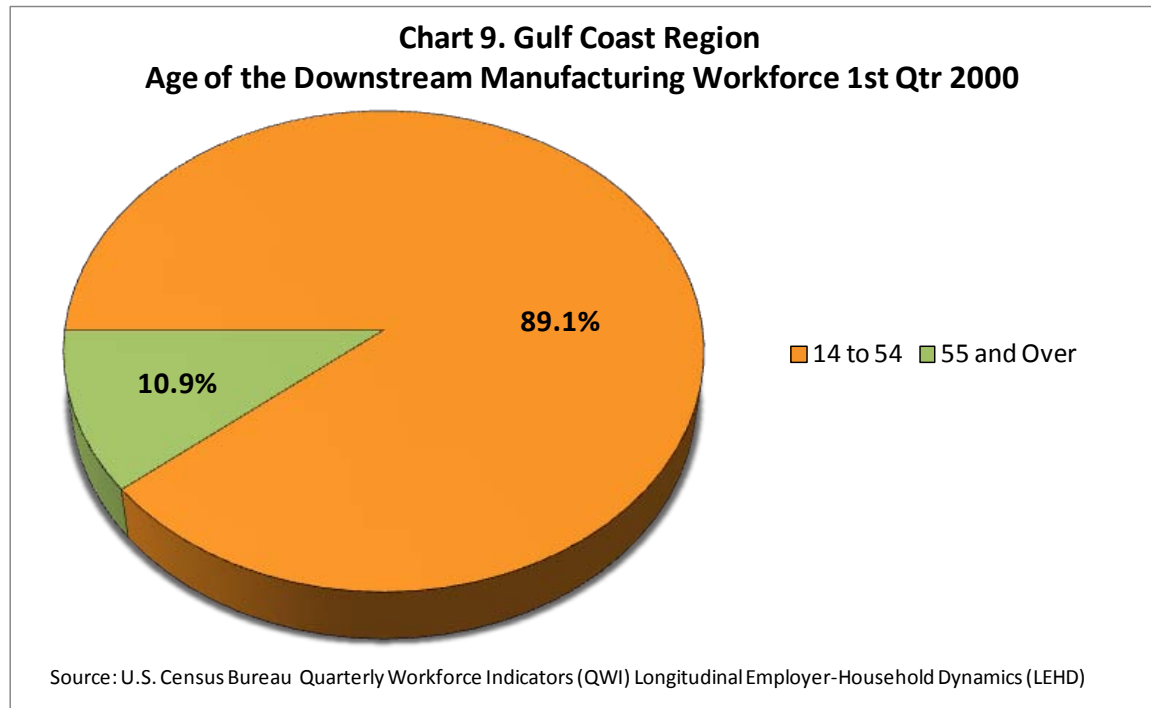
Recent expansions under development and the supporting infrastructure of additional pipelines compound workforce shortages in the construction phase. The shortages are sometimes so acute that project deadlines may be missed or projects cancelled.

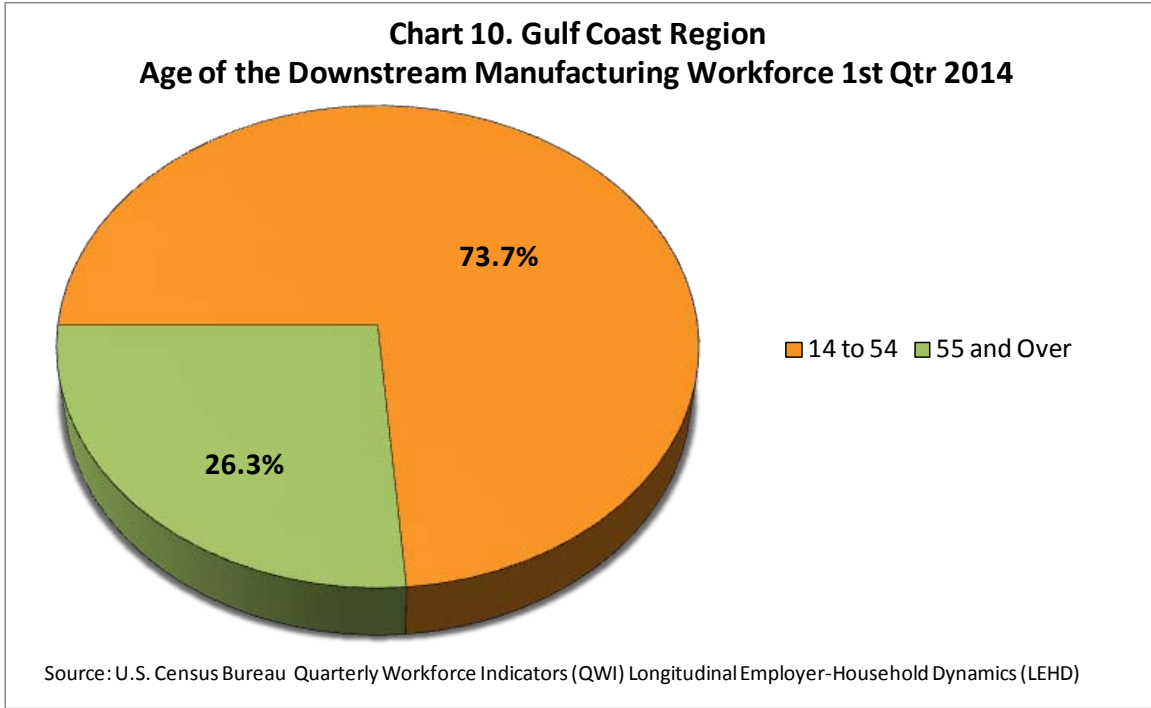
An Aging Workforce

Another factor contributing to the workforce shortage is an aging population. The percentage of the population that is 55 and over has risen by 5 percent since 2000 and is expected to rise another 3 percent by 2018 to 23.36 percent.

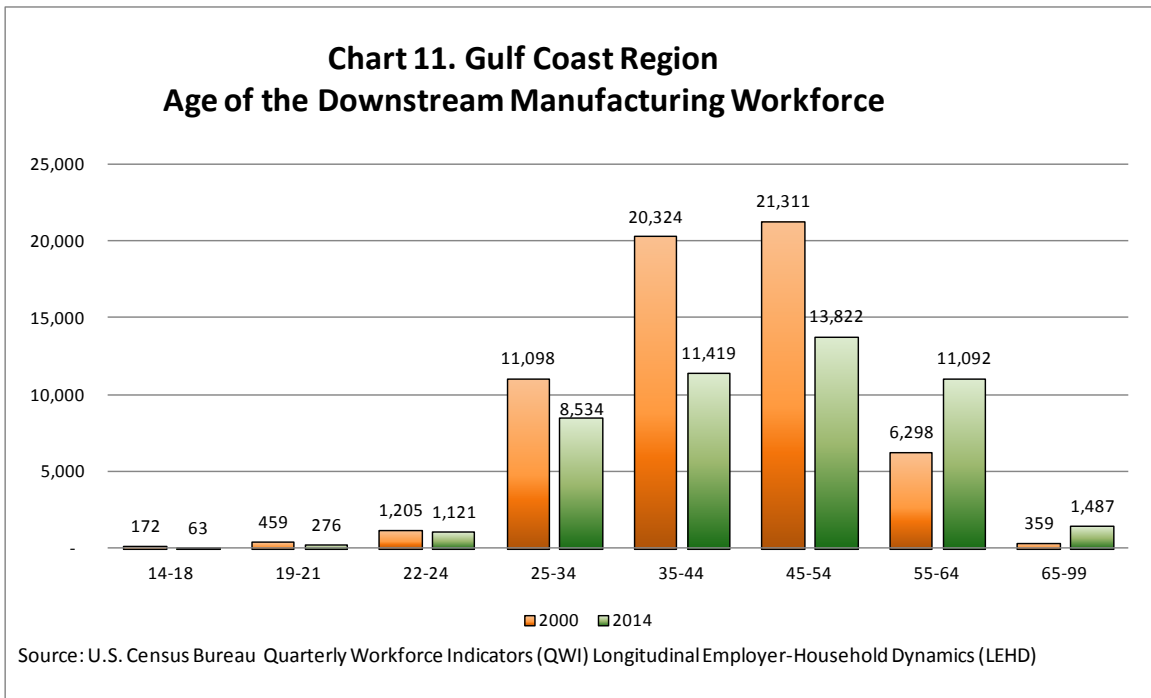
Population by Age								
	2000 Census		2010 CENSUS		2013 ESTIMATE		2018 FORECAST	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent
Total	4,854,389	100.00%	6,087,133	100.00%	6,366,422	100.00%	7,064,464	100.00%
Age 55+	739,122	15.23%	1,156,059	18.99%	1,294,545	20.33%	1,650,040	23.36%

The age of the downstream manufacturing workforce is increasing rapidly with the number approaching retirement age compounding the workforce shortages in the region. The percentage of workers ages 55 and over in downstream manufacturing has more than doubled from 10.9 percent in 2000 to 26.3 percent in 2014 (see chart 9 and 10).





The increased share of employees 55 and over is in part due to smaller retirement portfolios, improved health and along with it an increased life expectancy. Nevertheless, with more than 12,000 rapidly approaching retirement age in downstream manufacturing the industry is posed to lose a large portion of their skilled employees (see chart 11). As baby boomers exit the workforce local companies are faced with the task of facilitating the transfer of knowledge and skills to incoming workers.



Downstream Manufacturing Employment: Future

Employment in the downstream manufacturing industry peaked at approximately 60,000 back in 1991 but the twenty years that followed the industry incurred long-term declines with payrolls falling to near 44,000 by 2011. **Since 2011, workforce demands for the industry have made a dramatic reversal.**

Industry Projections: 2012 to 2022

The Gulf Coast Region’s employment is projected to add **712,430 jobs** from **2012 to 2022**. The 23.8% growth rate is higher than the previously projected 22.7% for the period of 2010 to 2020.

The pace of job **growth in downstream manufacturing** is predicted to be 16.0 percent over the ten year period. While projections are lower than the average of all industries for the entire Gulf Coast Region, they have skyrocketed from a ten year projected increase of 1.0 percent just four years earlier.

Projections indicate that Petroleum & Coal Products Manufacturing and Chemical Manufacturing are expected to expand at a similar pace, 16.5 percent and 15.8 percent respectively. The industry is expected to add more than new 7,500 jobs over the ten year period (see table 1). Total demand for new employees is actually higher since the projections do not include replacement demand of those leaving the industry due to job change or retirement.

Table 1. Gulf Coast Region Downstream Manufacturing Industries Projections 2012-2022

Industry Code	Industry Title	Annual Average Employment 2012	Annual Average Employment 2022	Net Change	Percent Change
324	Petroleum & Coal Products Manufacturing	12,200	14,210	2,010	16.5%
3241	Petroleum & Coal Product Manufacturing	12,200	14,210	2,010	16.5%
325	Chemical Manufacturing	35,090	40,650	5,560	15.8%
3251	Basic Chemical Manufacturing	20,810	24,250	3,440	16.5%
3252	Resin, Rubber, & Artificial Fibers Manufacturing	3,930	4,110	180	4.6%
3253	Agricultural Chemical Manufacturing	1,180	1,380	200	16.9%
3254	Pharmaceutical & Medicin Manufacturing	1,210	1,400	190	15.7%
3255	Paint, Coating, & Adhesive Manufacturing	2,380	2,770	390	16.4%
3256	Soap, Cleaning Compound & Toiletry Manufacturing	1,250	1,460	210	16.8%
3259	Other Chemical Product & Prepararation Manufacturing	4,320	5,290	970	22.5%
	Total Downstream Manufacturing	47,290	54,860	7,570	16.0%

Source: Texas Workforce Commission LMCI Dept.

Occupations in Downstream Manufacturing

The following table represents the top 20 occupations in the downstream manufacturing industry and their projected 2022 employment levels (see table 2). The total number of people working in the Gulf Coast Region across all industries under the capacity of each occupation is actually larger.

Table 2. Gulf Coast Region Top 20 Downstream Manufacturing Occupations

Occupation Code	Industry Title	Annual Average Employment 2012	Annual Average Employment 2022	Net Change	Percent Change	Annual Average Number of Job Openings*	Mean Annual Wage 2014
51-9011	Chemical Equipment Operators & Tenders	4,490	5,160	670	14.9%	255	\$58,159
51-8093	Petroleum Pump System Operators, Refinery Operators, & Gaugers	3,330	3,860	530	15.9%	350	\$62,910
51-1011	First-Line Supervisors of Production & Operating Workers	3,170	3,640	470	14.8%	510	\$72,717
51-8091	Chemical Plant & System Operators	3,010	3,410	400	13.3%	180	\$64,381
17-2041	Chemical Engineers	1,630	1,880	250	15.3%	135	\$128,304
51-9023	Mixing & Blending Machine Setters, Operators, & Tenders	1,580	1,830	250	15.8%	120	\$35,575
49-9041	Industrial Machinery Mechanics	1,180	1,620	440	37.3%	825	\$53,178
19-4031	Chemical Technicians	1,100	1,260	160	14.5%	115	\$56,933
49-9071	Maintenance & Repair Workers, General	1,070	1,230	160	15.0%	1,145	\$37,315
51-9111	Packaging & Filling Machine Operators & Tenders	1,010	1,130	120	11.9%	205	\$33,380
51-9061	Inspectors, Testers, Sorters, Samplers, & Weighers	730	850	120	16.4%	680	\$42,181
17-2112	Industrial Engineers	660	770	110	16.7%	285	\$113,276
11-3051	Industrial Production Managers	650	740	90	13.8%	165	\$126,623
49-1011	First-Line Supervisors of Mechanics, Installers, & Repairers	650	730	80	12.3%	515	\$68,691
17-2171	Petroleum Engineers	590	680	90	15.3%	735	\$168,282
49-9043	Maintenance Workers, Machinery	500	650	150	30.0%	160	\$43,998
17-2141	Mechanical Engineers	560	640	80	14.3%	390	\$106,532
19-2031	Chemists	560	630	70	12.5%	75	\$75,350
43-5061	Production, Planning, & Expediting Clerks	520	570	50	9.6%	365	\$52,255
51-2092	Team Assemblers	460	530	70	15.2%	650	\$28,905

*Annual average number of job openings due to growth and replacement needs across all industries in the Gulf Coast Region.

Source: Texas Workforce Commission LMCI Dept.

Seven of the top 20 downstream manufacturing occupations are currently on the Gulf Coast Workforce Board's list of targeted high-skill high-growth occupations:

- Petroleum Pump System Operators, Refinery Operators, & Gaugers
- Chemical Plant & System Operators
- Chemical Engineers
- Industrial Machinery Mechanics
- Industrial Engineers
- Petroleum Engineers
- Mechanical Engineers

Projection Limitations

Industry and occupation projections are funded by the Employment and Training Administration, U.S. Department of Labor and updated every two years. The methodology involves four primary steps:

- Identify industry historical trends
- Develop industry employment projections
- Develop occupation staffing patterns for each industry
- Develop occupation employment projections

The projections will foretell the general industry and occupational trends and act as an indicator of relative magnitude and probable direction as opposed to an estimate of absolute values. Additional detail on projection methodology and its limitations can be found at: <http://www.tracer2.com/?PAGEID=67&SUBID=114>