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Skilled Trades Employment in the Pipeline Industry: 2006-2015

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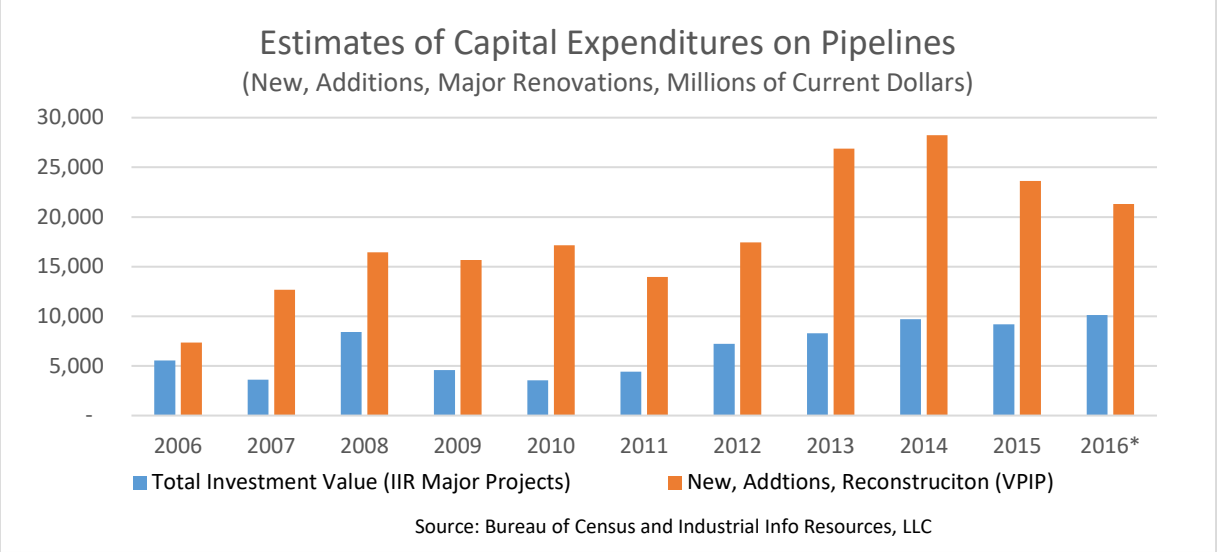
EXECUTIVE SUMMARY:

Pipeline construction is an important contributor to the employment of skilled construction craft workers. Six to twenty-eight billion dollars were spent annually on new, additions to and the reconstruction of existing pipelines from 2006 to 2016 (see Executive Summary Table 1, Estimates of Annual Capital Expenditures).

Executive Summary Table 1

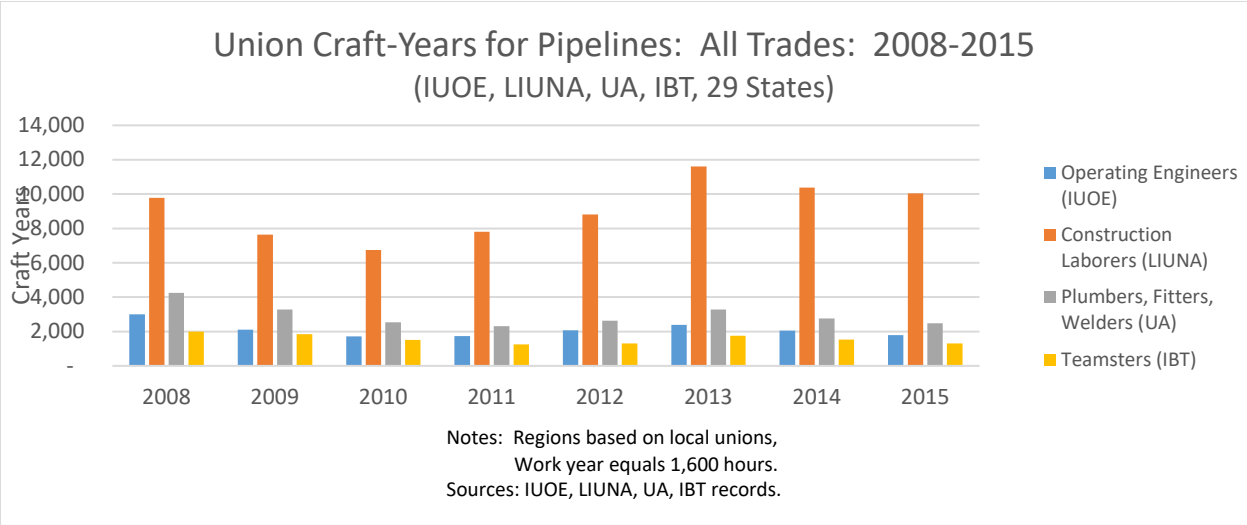


Industrial construction is an important source of jobs for the skilled construction trades. Individuals who engage in industrial construction have certifications, licensing, and training that provide guarantees that they are competent in difficult, specialized work.[1] Pipeline workers are an important segment of this group.

Pipelines are important to the efficient operation of the U.S. economy, and pipeline construction is an important source of family supporting jobs for construction workers. What then are the economic and job impacts of pipeline construction for the construction trades? This report reviews pipeline jobs data from two principal sources. The first *is actual hours worked* on pipeline projects in 29 states by four key unionized trades: i) plumbers, fitters and welders, ii) operating engineers, iii) construction laborers, and iv) teamsters. The union segments of these trades are covered by the National Pipeline Agreement and the National Distribution Agreement.

[1] Employers typically have the right to test potential hires even if unions initially screen and select job candidates. See Section IV, Part B of the National Pipe Line Agreement between the Pipeline Contractors Association and the Laborers International Union of North America, in force 2014-2017, under LIUNA National Agreements, http://www.liuna.org/agreements, retrieved 3-2-2017.

Executive Summary Table 2



Based upon the union work hours data, pipeline construction has provided 130,185 full time equivalent (FTE) jobs for the four trades for twenty-nine states from 2008 to 2015 or, as an annual average, 16,273 FTE's. *Broken down by the four trades, pipeline construction provided average annual employment for 2,943 FTE plumbers, fitters and welders; 2,109 operating engineers ; 1,562 teamsters, and 9,659 construction laborers* [2]. These were family supporting jobs that were well-paid and carried good benefits[3] (See Executive Summary Table 2).

The annual average of 16,273 FTE craft worker jobs, however, underestimates the number of jobs associated with pipeline construction between 2008-2015. First, based on the highest estimate suggested by our sources, these four unions represent no more than 60% of the union jobs covered by pipeline agreements.[4] Adjusting the data to account for the additional 40% of the union work force, dividing Table 2 data by .60, lifts estimated union employment to 27,122 annual FTE jobs for the 29 states.

What about the U.S. as a whole? The 2012 Economic Census of Construction, indicates that the twenty-nine states included in this study account for 65% of the value of U.S pipeline

[2] Calculations for job years use an annual total of 1,600 hours, which is representative for union workers, as opposed to the usual standard of 2,080 hours.

[3] According to the U.S. Bureau of Labor Statistics, the wage differential between union and nonunion workers in 2016 was substantial with union members earning a median $1,168 per week, while nonunion workers earned $780 per week. Please see Union Membership and Representation Section of the North American Industrial Classification System for Sector 23, Construction, Industries at a Glance, https://www.bls.gov/iag/tgs/iag23.htm.

[4] The more conservative estimate stems from the Labors International Union of North America where one source suggests that LIUNA members account for 90% of pipelines of 36+" in diameter and 80% of pipelines between 24" and 36". For pipelines 16" to 24", non-union workers take an increasing portion of pipeline work with pipelines under 16" composed of a majority non-union workers. Other sources have estimated the overall market share of 50% for the four trades.

construction activity. Adjusting pipeline employment to account for this 35% of employment in the remaining 21 states, dividing the 27,122 by 1/.65, raises the annual averages employment for the unionized trades to over 41,700 jobs.

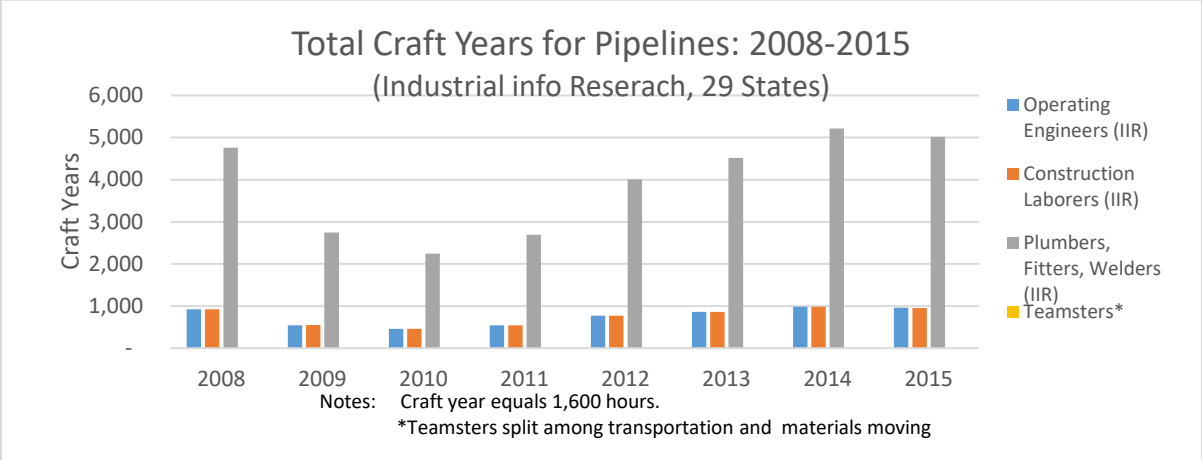
Finally, total national employment in pipeline construction includes skilled non-union tradesmen. This is comprised mainly of tradesmen employed by non-signatory contractors. Assuming that unionized trades are 60% of employment for all tradesmen engaged in pipeline construction, total FTE employment for all construction workers employed in all trades rises to more than 69,500 per year.

What is the wage impact of pipeline construction? Confining ourselves to the 41,700 union FTE jobs per year, using the BLS estimate for median weekly earnings in the construction industry of $1,168 for union members, and adjusting for the 1,600-hour man year (versus the 2,080 hour man year used by the Bureau of Labor Statistics), the annual direct impact from union wages in pipeline construction is $1.9 billion for all 50 states and the District of Columbia. Adding a conservative benefits rate of twenty percent to this total brings the overall direct economic impact of union pipeline construction to over $2.3 billion per year. These totals are impressive and should be brought to the attention of policy makers and the public.

Additional Data:

This study draws upon a second set of estimates for skilled trades jobs associated with pipeline construction. Private information provider Industrial Info Resources, LLC, collects pipeline construction information and estimates craft utilization to model the man hour demand for 13 skilled occupations. The study includes the same 29 states covered by the union hours data.

Executive Summary Table 3



Executive Summary Table 3 provides these alternative estimates. Comparison of the two sources highlights how differences in the definition of pipeline work affects these measures.

Plumbers, Pipefitters and Welders are the largest occupation in the IIR data and employment of this occupation varies between 2,000 and 5,000 from 2008 to 2015. In contrast, the union data in Executive Summary Table 2 shows that union projects employed between 2,000 and 4,000 Plumbers, Pipefitters and Welders over this period but that the largest occupation by far was laborers with between 6,000 and 12,000 FTE equivalent workers employed between 2008 and 2015. This marked difference is due to the different treatment of pipeline preparatory and clean-up operations by the unions and IIR.

Analyzing the two sources finds broadly similar trends in pipeline construction jobs. Much of the apparent differences between the two data sources reflect differences in the definition of pipeline work and whether the measure is limited to union craft workers or captures all craft workers.[5,6]

INTRODUCTION:

Pipelines are an essential feature of transportation in the United States. According to some estimates, the U.S. pipeline infrastructure accounts for almost two-thirds of the transport of energy commodities in the nation. The pipeline network includes 2.6 million miles of lines. Its operation is overseen by the Pipeline and Hazardous Materials Safety Administration. Permitting interstate pipelines is the responsibility of the Federal Energy Regulatory Commission (FERC); state agencies are responsible for intrastate pipelines.

The current study aims at examining the role of the skilled construction trades in pipeline construction using data from a number of sources. It focuses on man hours/years worked on pipeline projects 2008-2015 using construction data and skilled trade utilization estimates from private data provider Industrial Information Resources, LLC, federal construction statistics from the Bureaus of Census and Labor, and union man hours and utilization information from the United Association (UA), International Union of Operating Engineers (IUOE), Laborers International Union of North America (LIUNA), and International Brotherhood of Teamsters' Building Materials and Construction Trades Division (IBT). These data sources are very rich.

[5] Although the Executive Summary Table 3 numbers are limited to the occupations for which we have data on union employment, IIR also provides estimates for nine other construction occupations, including carpenter, electrician, insulator, ironworker, millwright, and scaffold builder.

[6] Both sources – union and IIR data, display similar patterns of activity over time, but the union hours data places the employment peak during the first half of the decade, while IIR places the peaks in the second half. The author's own view is that differences between the union calculations and the IIR estimates are principally due to differences in how the pipeline universe is defined and covered. The IIR data, provides higher job numbers for plumbers, pipefitters, and steam fitters during the final historical years, but lower job numbers for operating engineers and substantially lower numbers for construction laborers. Some of the difference is consistent with a smaller universe of pipeline construction projects.

The past five years have witnessed a resurgence in pipeline construction after a period when capital spending declined in response to the steep recession of 2008-2009 and activity fell. According to the federal Construction Value-Put-in Place series, construction spending on pipelines reached a trough in 2011, dropping to under $14.0 billion before staging a notable recovery, rising to $28.2 billion in 2014 then slipping to $23.6 billion in 2015.

Pipeline construction data from Industrial Information Resources, LLC, using a subset of the same 29 states, displays a similar pattern, but at substantially lower levels of employment. IIR estimates total installed construction costs for pipelines in 2011 at $7.3 billion, rising to $12.6 billion in 2014. It reaches a new high-water mark in 2016 with total spending of $14.0 billion.[7]

Pipeline construction in turn drives demand for the skilled construction trades. Over the course of the years 2008-2015, data from multiple sources shows occupational employment following trends in pipeline construction. The real questions are not about patterns of activity, but about their levels. How important are pipelines to the skilled construction trades? What levels of employment do they generate? These are difficult questions because they depend in part on how inclusive our definitions are of pipelines and pipeline systems.

The following sections deal in turn with i) introducing the conceptual framework for analyzing pipeline construction, ii) comparing measures of pipeline construction activity, iii) examining skilled trade utilization for union pipeline contracts, and iv) comparing measures of pipeline derived demand for workers from different sources, specifically labor hours from key unions and IIR estimates of skilled trades employment on pipelines.

[7] Data from the 2012 Economic Census of Construction shows that the twenty-nine states for which IIR provided estimates of pipeline construction comprised approximately two-thirds (65%) of the U.S. total.

CONCEPTUAL FRAMEWORK:

Understanding the employment consequences of pipeline construction for the skilled trades requires having reasonable estimates for the volume of pipeline construction and for the number and type of jobs associated with pipeline projects. We cannot correctly size the pipeline construction market, calibrating its job consequences, without having credible estimates of the volume of pipeline construction. However key sources disagree about its magnitude.

One reason different sources disagree lies with differences in what portions of the pipeline systems they choose to measure. Understanding the roles of the skilled construction trades requires clarifying what types and components of pipelines are covered by different measures of construction.

Pipeline Systems: There are three principal types of pipelines within a system – gathering, mainline, and distribution. There are additional components to pipeline systems as well. These include compressor stations, storage facilities, and out-buildings. In addition, pipeline systems may be defined to cover processing plants. Finally, there many types of pipelines – pipelines can transport crude petroleum, petroleum products, natural gas, natural gas liquids, carbon dioxide, and chemicals. (Still other types of pipelines, for example water pipelines, exist as well, but are not discussed here.)

i) Gathering pipelines are pipes that connect to individual petroleum or natural gas wells, funneling them together to bring the crude petroleum or raw natural gas to a processing facility or a transmission pipeline. Gathering systems can be extensive with pipelines of more than twenty inches in diameter that extend fifty or more miles.

ii) Transmission (mainline) pipelines transport significant volumes of crude or refined petroleum, natural gas, petroleum products, etc. over substantial distances. Transmission pipelines include compressor stations, storage facilities, and other support structures that bring the product to distribution hubs. Transmission pipelines often extend hundreds or thousands of miles and have diameters of thirty inches or more.

iii) Distribution pipelines transport natural gas, petroleum products, etc. to distribution points where they connect to mains that move it to commercial, industrial, other establishments or residences. Distribution systems use progressively smaller pipes to move the product to end users. An important distinction between mainline and distribution pipelines is that the latter have much lower pressures[8].

iv) Distribution mains move energy and chemicals – usually natural gas – from distribution hubs to consumers.

v) Natural gas plants and other refinery-like facilities take raw natural gas, natural gas liquids or crude petroleum and separate or process the constituent hydrocarbons. In the case of natural gas and natural gas liquids -- ethane, butane and pentanes – and remove

[8]The author thanks Gregory Davis, Executive Director, President's Office, Laborers International Union of North America for making this point.

impurities like carbon dioxide and water. The purified gas is then "pipeline quality", suitable for transport to consumers. Petroleum pipelines can transport crude or refined products.

Types of Construction: In measuring construction activity, there are four "types" of construction, categories that describe the activities undertaken– new construction, additions to existing structures, major renovation and rehabilitation, and repair, maintenance and overhaul. Expenditures for the first three of these categories are without apparent exception classified as capital spending, for which companies use their capital budgets.

New Construction is the building of new pipelines, which requires multiple tasks: surveying, clearing and grading, trenching, pipe stringing, welding and coating, burying and backfilling, testing and restoration. These tasks are undertaken by skilled crews who work sequentially on sections of the pipeline[9].

i) The permitting authority for interstate pipelines is the Federal Energy Regulatory Commission. Construction plans typically break pipelines into sections, called "spreads".

ii) Spreads cover different distances, are constructed over different terrains, and so require multiple crews with different mixes of construction skills. Each spread may have multiple contractors.

Major Renovation and Rehabilitation requires approval from regulatory authorities: individual states issue permits for intrastate pipelines, while the Federal Energy Regulatory Commission (FERC) issues permits for interstate pipelines.

i) Much of the U.S. pipeline infrastructure is old, requiring repair or replacement. The safety of older pipelines is of particular concern. The Pipeline Safety, Regulatory Certainty, and Job Creation Act of 2011 was designed to improve pipeline safety regulation.

ii) The federal authority overseeing pipelines is the Pipeline and Hazardous Materials Safety Administration, which is active in rulemaking aimed at boosting safety and improving the operation, maintenance and inspection of U.S. pipelines.

Additions to or reversals of existing structures require approvals similar to new construction. Approval from regulatory authorities with jurisdiction is required.

i) Increasing volumes of natural gas and natural gas liquids from the newly accessed shale oil deposits have given companies reasons to add capacity to existing pipelines and build new pipelines to link production with distribution hubs.

Maintenance, repair and overhaul are the actions a business undertakes, either through its own employees or contracting others to keep or restore an asset to good operating condition.

[9] Taken from a discussion of pipeline construction by the Williams Company. Please see http://co.williams.com/pipeline-construction/.

Maintenance and repair spending is typically included in company financial reports as operational expenses, entered for the year in which they are undertaken.

i) For pipelines, maintenance means examining, cleaning and testing, which can be accomplished through the use of internal devices like “pigs”, spot checks for corrosion along the outside of the pipeline, and hydrostatic testing*, i.e.,* the use of pressurized water to test for leaks.

ii) Maintenance of pumping or compression stations means reconditioning equipment and cleaning tanks or other features of the pumping stations.

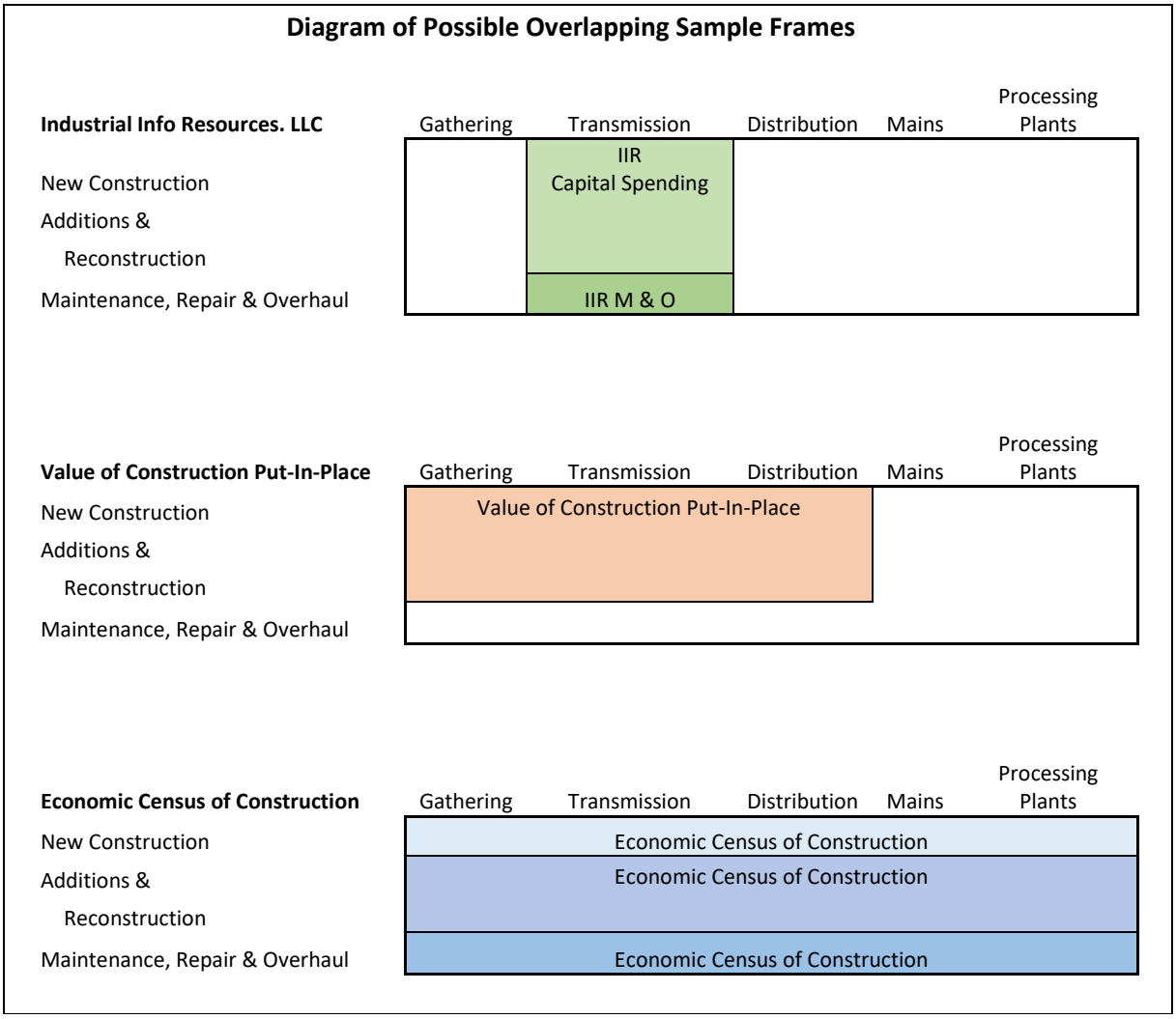
iii) Repair work is necessary when corrosion or other degradation of pipelines raises safety or operational concerns. It typically requires evacuation of the pipeline with workers repairing or replacing the compromised sections.

THE PIPELINE UNIVERSE:

The demand for the skilled trades is derived from construction activity, so defining the construction universe is essential to interpreting the work that pipeline construction generates.

Table 1

Diagram of Possible Overlapping Sample Frames



As illustrated in Table 1, there are multiple ways to measure pipeline construction. They show how the major sources of construction data used in this study can support different conclusions about the volume of pipeline construction. Some of these differences can be explained in terms of coverage – what segments of the pipeline construction industry are covered by the different data sources.

The most direct approach to estimating the pipeline universe is to collect information about pipelines themselves, which is often a difficult task. It requires enumerating interstate pipelines, information that can be collected from FERC permits. In addition, it requires collecting data for intrastate pipelines, presumably from state regulatory agencies. Even then, there might be missed pipeline projects depending upon the state's permitting rules. Finally, substantial portions of pipeline work may never go out to bid, being performed by pipeline company staff or by contractors under agreement to perform specific tasks on a regular basis.

A second approach is to capture pipeline companies' capital expenditures. In that case, it is necessary to review a long list of companies and their subsidiaries and allocate capital spending among pipeline projects and other uses. Neither the first nor second approach is quick or easy, or even when finished, necessarily provides a complete picture of pipeline construction.

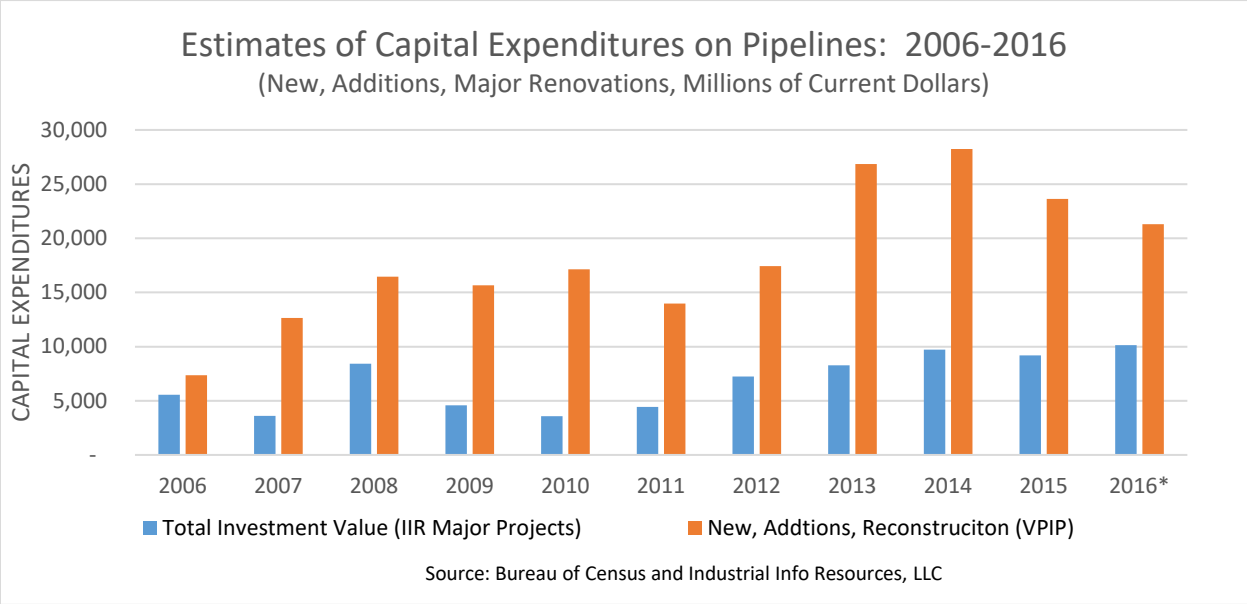
Industrial Information Resources, LLC relies heavily on its inventory of pipelines. IIR collects and cleans information about the inventory of pipeline projects, which it uses in conjunction with estimates of the labor intensity by trade to calculate man hours or man-years. This approach means that the levels and patterns of demand for the skilled trades rely in large part on the accuracy and completeness of the inventory of pipelines. IIR focuses its data collection efforts on "major" projects, acknowledging the impracticality of building an exhaustive dataset.

In contrast, *the Bureau of Census' Value of Construction Value Put-In-Place (VPIP)* statistics provide alternate and substantially higher estimates of new pipeline construction, additions to and renovations to existing capacity. For the period 2008-2015, The VPIP estimates are derived from annual capital spending information collected by federal agencies and a sample of pipeline construction projects[10]. At the annual frequency, the VPIP estimates construction spending separately for oil and gas pipelines.[11] (see Table 2.)

[10] In general, the VPIP statistics are based on probability samples of projects drawn from public and private sources. The actual procedure in estimating pipeline construction however apparently uses measures of capital spending.

[11] The Commerce Department, for the purposes of the Put-In-Place measures of construction, classifies oil and gas pipelines under the broader "Power" category. The divergence in levels between the IIR major projects series and the VPIP construction spending numbers may reflect expenditures on gathering and distribution pipelines required to develop and distribute natural gas and natural gas liquids from shale basins. For an overview of the methodology, please see http://www.census.gov/construction/c30/methodology.html.

Table 2



The Bureau of Census also reports detailed estimates of pipeline construction every five years via the Economic Census of Construction. The Bureau's methodology for pipelines mixes a census of large and medium-sized firms with samples of small, very small, and non-employer establishments,[12].

The new construction-additions-major renovations line of estimates for pipelines from the Economic Census of Construction is even higher than the VPIP estimates. In 2007 and 2012, the new, additions, and major renovations line of North American Industrial six-digit Classification 237120, Oil and Gas Pipeline and Related Structures, is a multiple of the IIR topline estimates. (See Table 3.)

It is to be expected that the Economic Census of Construction efforts to completely cover establishments that comprise the pipeline sector yields the highest estimates for the economic value of construction activity. The estimates reflect all structures associated with the North American Industrial Classification Code 231720, Oil and Gas Pipeline and Related Structures Construction. They include gathering lines, distribution lines, pumping stations, natural gas pipeline construction, gas mains, storage tank construction, and in addition may include related oil refinery, petrochemical plant, and natural gas processing plant construction. "All structures

[12] Report forms are sent to all large and medium-sized firms. In addition, Census mails report forms to a sample of small businesses with employees. For very small firms, data are taken from administrative records of other federal agencies. The same is the case for "non-employer firms that is those with no paid employees". Please see https://www.census.gov/construction/c30/pdf/methodology.pdf under section entitled "Regulated Investor-Owned Utilities Construction.

(including buildings) that are integral parts of oil and gas networks (e.g. storage tanks, pumping stations, and refineries) are included in this industry." [13]

Table 3

Comparison of IRR, VPIP and Economic Census Pipeline Estimates -- in Millions of Current Dollars

Construction Spending Measure	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016*
Industrial Info Resources (29 states)*											
Total Investment Value (IIR Major Projects)	5,555	3,607	8,421	4,583	3,562	4,422	7,235	8,276	9,706	9,185	10,121
Maintenance, Repair, Overhaul Value	3,962	3,964	3,677	2,739	2,676	2,874	2,746	2,840	2,939	3,168	3,237
Value of Construction Put-In-Place											
New, Addtions, Reconstruciton (VPIP)	7,359	12,655	16,443	15,670	17,145	13,971	17,435	26,867	28,236	23,634	21,314
Maintenance & Repair	-	-	-	-	-	-	-	-	-	-	-
Economic Census (NAICS 237120)											
New, Additions, Reconstruction (VPIP)	-	21,160	-	-	-	-	32,786	-	-	-	-
Maintenance & Repair	-	9,297	-	-	-	-	8,008	-	-	-	-

Correlation, Total Investment Value (IIR Major Projects), Value Put-In-Place (New, Adds, Renovations) = .73

Notes:

NAICS 237120 cover "pipeline systems", which includes feeder lines, gas processing plant, transportation pipelines, and distribution pipelines.

Value Put-in-Place appears to include feeder lines, transporation lines, transportaion pipelines and distribution pipelines.

IIR estimates break out repair and maintenance in addition to major projects. The major projects IIR presents are transportation pipelines.

In comparing the results from these sources, the IIR topline estimates of capital expenditures for new, additions, renovations and improvements *move with changes* in the Bureau of Census' Value Put-In-Place series very well – the simple correlation coefficient based on annual data 2006-2015 is equivalent to .73. There is, however, a substantial difference in levels with VPIP estimates of construction spending a median three times the IIR major project estimates, which IIR bases on the announced total investment value of pipeline projects.

[13] See 2017 North American Industrial Classification System, code 231720, Oil and Gas Pipeline and Related Structures Construction, http://www.census.gov/cgi-bin/sssd/naics/naicsrch?code=237120&search=2017%20NAICS%20Search.

THE SKILLED TRADES UNIVERSE:

Understanding the employment impact of pipeline construction means measuring the jobs that pipeline construction activity creates. Like measuring construction, reconciling estimates of craft worker jobs associated with pipelines is challenging. A comprehensive picture of employment by trade is hard to assemble. What are the occupations of interest and what are the data sources available for measuring them?

There are many construction occupations for which the federal government collects employment data. Thirteen are usually seen as key: boilermaker, carpenter, electrician, instrumentation technician, insulator, ironworker, construction laborer, millwright, operator, painter, scaffold builder, welder, and plumber, pipefitter, and steamfitter.

Of special interest, however, are four occupations that traditionally play central roles in pipeline crews. Three are among the trades listed above: operators (operating engineers), construction laborers, and plumbers, pipefitters, and steamfitters. The fourth is "drivers," the occupation responsible for moving people and equipment around and between job sites. Where is data available that details the utilization of these trades on construction pipelines? And what are the strengths and weaknesses of each source?

Construction unions' workhours data comes from joint labor-management pension funds. As part of the administration of the pension system, the funds collect information on pay, payroll and, most importantly to this study detailed information on work hours. Information from the four international unions covered by the National Pipe Line Agreement (NPLA)[14] and National Distribution Agreement (NDA)[15] provide one picture of skilled trades demand. IIR estimates of these trades provide another picture that is broadly similar in terms of trends.[16]

The four major unions that have negotiated NPLAs and NDAs should report fewer total workdays than those estimated by Industrial Information Resources, LLC. A significant proportion of pipeline construction work is not conducted by union workers under union

[14]Most of the bargaining agreements between contractors and unions apply to transportation (mainline) pipeline and underground cable work in the U.S. But for at least one union, the United Association, the agreement covers gathering as well as transportation pipelines – the construction, installation, double jointing, re-beveling, treating, insulation, reconditioning, testing, taking-up, relaying, or relocation of pipelines or any segments thereof transporting coal, gas, oil, water, or other transportable materials, vapors or liquids, including portions of such pipelines within private property boundaries, up to the first metering station or connection. (See for example, http://www.local798.org/assets/2014-final-pipeline-agreement---signed.pdf.)

[15]Applies to all distribution pipeline and utility construction, including other underground distribution facilities for public or private utilities (except sewer and water lines) in the U.S. The agreement covers the repair, maintenance, construction, installation, treating and reconditioning of distribution pipelines transporting coal, gas, oil or other similar materials, vapors or liquids (except sewer and water lines), as well as conduit, telephone lines and power lines. (See Labors International Union of North America, http://www.liuna.org/agreements.)

[16] Both sources of data move together; tabulations of man-years from the union tend to follow roughly the same patterns as estimates of work-years from IIR. However, they often embody different levels -- union craft-years are sometimes appreciably greater in magnitude.

contracts. Many contractors are not members of the Pipe Line Contractors Association or the Distribution Contractors Association. As a result, the trade hours drawn from the union data should cover only a part of the market.[17]

The two agreements that are negotiated by the Pipe Line Contractors Association cover the United Association of Journeymen and Apprentices of the Plumbing and Pipefitting Industry of the United States and Canada (UA), the International Union of Operating Engineers IBOE), and the Laborers International Union of North America (LIUNA) and the International Brotherhood of Teamsters, Chauffeurs, Warehousemen and Helpers of America (IBT)[18]. The last National Pipeline Agreement came into force June 1, 2014 and lapsed on June 4, 2017[19]. The follow-on agreement has a term from June 5, 2017 through May 31, 2020.

The alternative approach, used by IIR, is also presented in the following discussions. It samples individual pipeline projects for their construction labor needs (or derives those rates from broader datasets), calculates labor utilization rates for the pipeline construction universe, then applies these rates to a dataset of individual pipelines. As noted before, there are two difficulties. The first is correctly estimating utilization rates, either by obtaining a useful sample or correctly deriving it from other data. The second is correctly estimating the pipeline construction universe.

The following sections present both sources, relying primarily on labor union data, but also showing IIR estimates for the trades covered by the national pipeline agreement. The reason for this focus is that pipeline construction is undertaken by working groups comprised mainly of individuals from four trades -- i) plumbers, pipefitters and steamfitters, who align and weld pipe segments, ii) operators of backhoes, graders, and other equipment, iii) laborers who perform a variety of tasks from removing scrub to guiding pipeline segments, and iv) individuals who move building materials and workers. There are other trades that work on pipeline segments to be sure, including pumping stations, cryogenics plants, and other facilities. For the purposes of this study, however, the focus will be on the four trades covered by the national pipeline agreements.

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[17] IIR has allocated pipeline construction employment relatively evenly across trades. If craft labor utilization rates were derived from a broad pool of public works or utility data, they would include trades that are lightly used in pipeline construction. Discussions of the NPLA in particular suggest that teamsters, laborers, operators, and plumbers (with fitters and welders) do the majority of skilled trade tasks associated with pipeline construction. Work on associated facilities or buildings, like storage tanks, compression stations or out-buildings, requires electricians, insulators and other trades as well. One approach is to use IIR estimates of the trades into, even while focusing on the union hours data. The IIR estimates are provided in the Appendices.

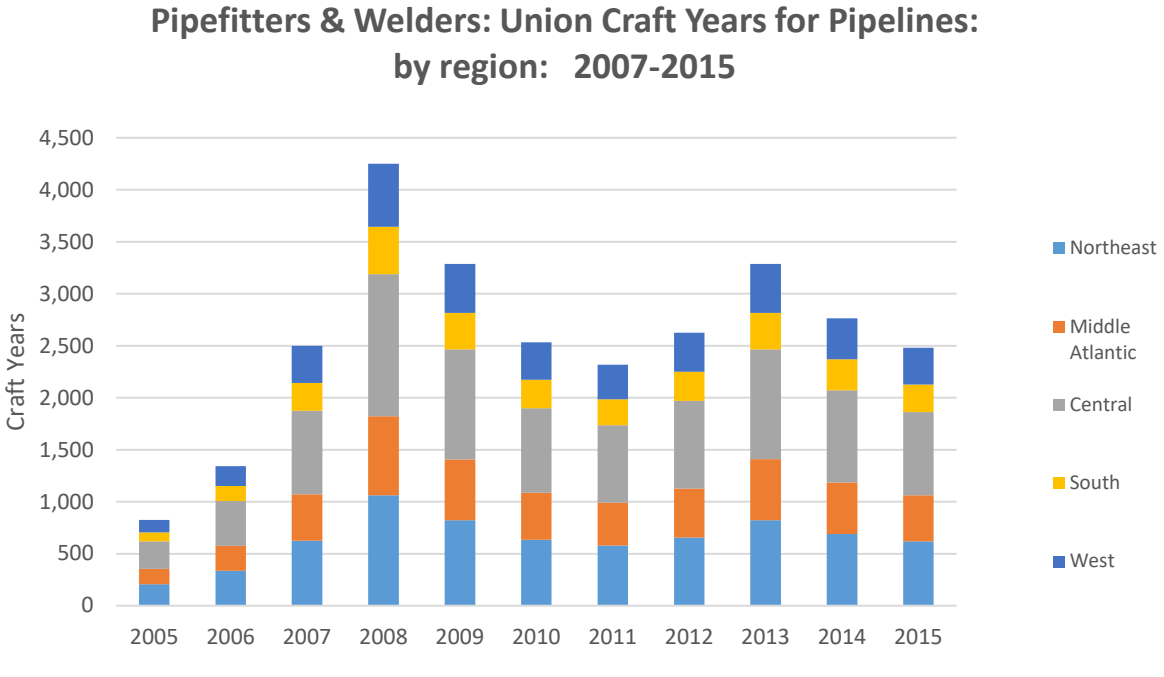
[18] In general, the teamsters (IBT) are responsible for moving people, equipment, and materials to and from the worksite; their responsibilities are enumerated in the contract. The plumbers and pipefitters (UA) prepare pipe for joining, lining up the pipe, handling clamps, and joining (welding) the pipe. Operators (IUOE) drive heavy equipment. Laborers (LIUNA) perform a variety of tasks, including budding, drilling, dealing with hazardous waste, loading, tamping, and working more generally in a pipe gang or bending crews.

[19] Industrial Information Resources, LLC estimates of derived demand for the skilled construction trades include boilermakers, painters, and others that are not among the four unions covered by the National Pipeline Agreements.

Plumbers, Pipefitters, Steamfitters:

The most tangible measures of pipeline employment for plumbers, pipefitters and steamfitters come from the United Association (UA), whose members cut, bend and fabricate pipe or tubing segments and join those segments by threading them, using lead joints, welding, brazing, cementing or soldering. Under the National Pipe Line agreement, UA fitters and welders can work on both transportation (mainline) and gathering pipelines that directly connect to mainline pipelines. The National Distribution Agreement covers the same unions and distribution contractors.

Table 4



Note: Region designation from UA data. Work year equals 1,600 hous per year.
Source: United Association of Plumbers, Fitters, Welders & Service Techs.

The pattern of activity begins at low levels in 2005, rises dramatically to over 4,000 man years in 2008, drops to a trough of approximately 2,300 in 2011 (see Tables 4 and 5). Subsequent declines reflect cuts to capital budgets by pipeline companies in the wake of the "Great Recession." Activity then climbs for two years, although at almost 3,300 man years, it remains

well below its previous peak. In the final year of the historical horizon, activity slips beneath 2,500 man-years.[20]

Table 5

Pipefitters & Welders: Union Craft Years for Pipelines 2005 - 2015

Source: United Association Plumbers, Fitters, Welder and Service Techs, 29 States.

UA_Region	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Northeast	206	335	625	1,063	821	634	579	657	822	691	620
Middle Atlantic	147	240	447	759	587	453	414	469	587	493	443
Central	265	431	804	1,367	1,056	815	745	844	1,057	888	797
South	88	144	268	456	352	272	248	281	352	296	266
West	118	192	357	607	469	362	331	375	470	395	354
UA Totals	824	1,342	2,501	4,252	3,285	2,536	2,317	2,626	3,288	2,763	2,480
% change		63%	86%	70%	-23%	-23%	-9%	13%	25%	-16%	-10%

Pipefitters & Welders: Total Craft Years for Pipelines

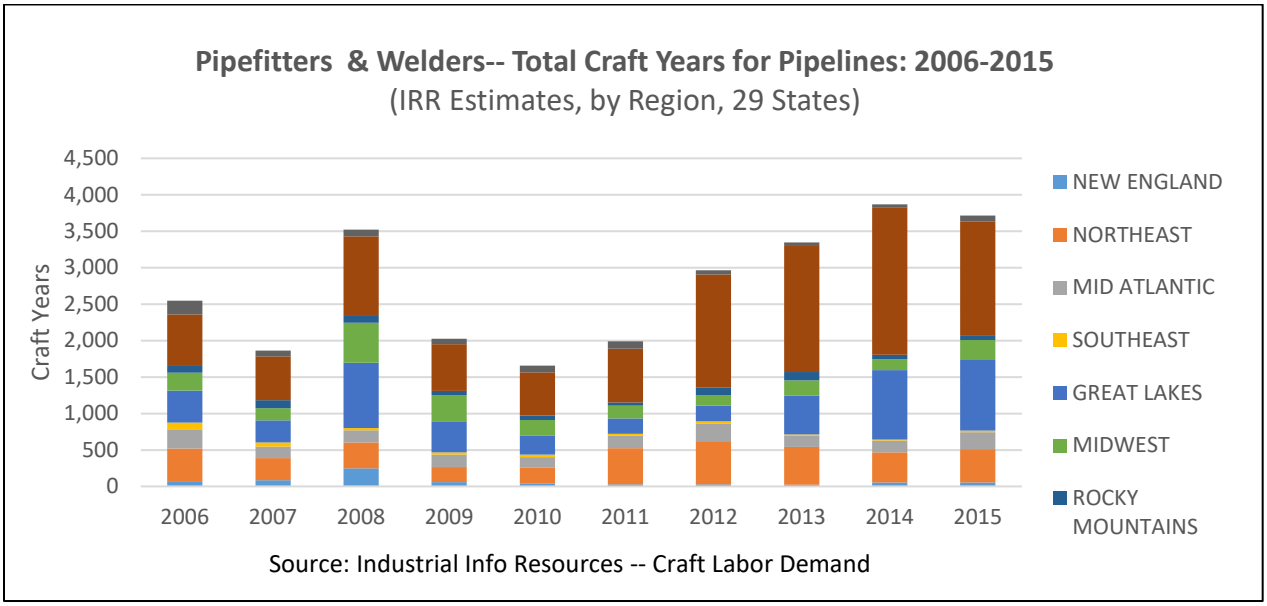
Source: IIR Estimates for Plumbers, Fitters, Welders, and Service Techs, 29 States)

	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
IIR Totals		2,549	1,861	3,521	2,205	1,655	1,988	2,964	3,346	3,867	3,716
% change			-27%	89%	-42%	-18%	-20%	49%	13%	16%	-4%
Correlation (UA Data, IIR Estimates)		*51%*									

Among the regions, the Central predominates, but the Northeast, also performs very well. Gains in both regions are robust over the first three years of history with both exceeding 1,000 man years by 2008. Then, over the next three years, activity declines, dropping almost fifty percent across the board in response to the recession and its subsequent cuts to capital spending. Activity improves rapidly during the next two years, but even in 2013, UA hours do not achieve new highs. Finally, during the years, 2014-2015, activity drops, roughly mirroring the patterns for pipeline construction overall.

[20] As noted in the Executive Summary, the union data comprises only a part of the market and the true man-years numbers are larger, perhaps double the numbers cited here. In trying to size total demand for plumbers, pipefitters, and steamfitters, we assume that the union market share is 60%.

Table 6



The modelled man years estimates from Industrial Research, LLC present a slightly different story (see Tables 6 & 7). Employment for plumbers, pipefitters and steamfitters begins at 2,549 in 2006, dipping, then jumping to a near term peak of 3,521 in 2008, before falling to a trough in 2010. Subsequently, activity climbs strongly for four years before roughly stabilizing between 3,500 and 4,000. The IIR trends in total employment at the national level are comparable to the UA data, but patterns for the two measures diverge during the latter years of the time horizon.

Table 7

Pipefitter and Welder Craft Years, Capital Projects

Regions	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
New England	52	68	231	46	27	18	20	14	44	45
Northeast	358	213	271	145	163	436	534	463	345	376
Mid Atlantic	203	96	109	128	95	127	205	124	117	187
Southeast	79	45	22	22	f	20	25	6	6	13
Great Lakes	326	190	790	344	187	136	154	453	884	907
Midwest	185	103	488	323	172	131	110	178	115	223
Rocky Mtn.	68	87	82	37	45	27	84	102	45	40
Southwest	537	432	928	524	476	594	1,391	1,557	1,859	1,396
West Coast	157	43	58	50	67	75	36	29	17	62
U.S. Totals	1,965	1,276	2,979	1,621	1,260	1,564	2,559	2,928	3,433	3,249
% change		-35%	133%	-46%	-22%	24%	64%	14%	17%	-5%

Craft Years -- Maintenance, Repairs & Overhaul

Regions	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
New England	18	18	17	12	11	11	9	9	11	11
Northeast	90	90	84	62	60	61	55	55	66	79
Mid Atlantic	62	62	58	44	43	42	36	34	44	45
Southeast	12	12	11	9	8	8	7	6	7	7
Great Lakes	113	113	105	80	77	75	65	77	72	73
Midwest	63	63	59	39	39	41	35	36	32	42
Rocky Mtn.	24	24	22	17	17	16	14	13	16	14
Southwest	168	168	155	118	117	147	167	171	167	176
West Coast	34	34	32	24	23	23	19	18	19	20
U.S. Totals	584	585	542	404	395	424	405	419	433	467
% change		0%	-7%	-26%	-2%	7%	-4%	3%	3%	8%

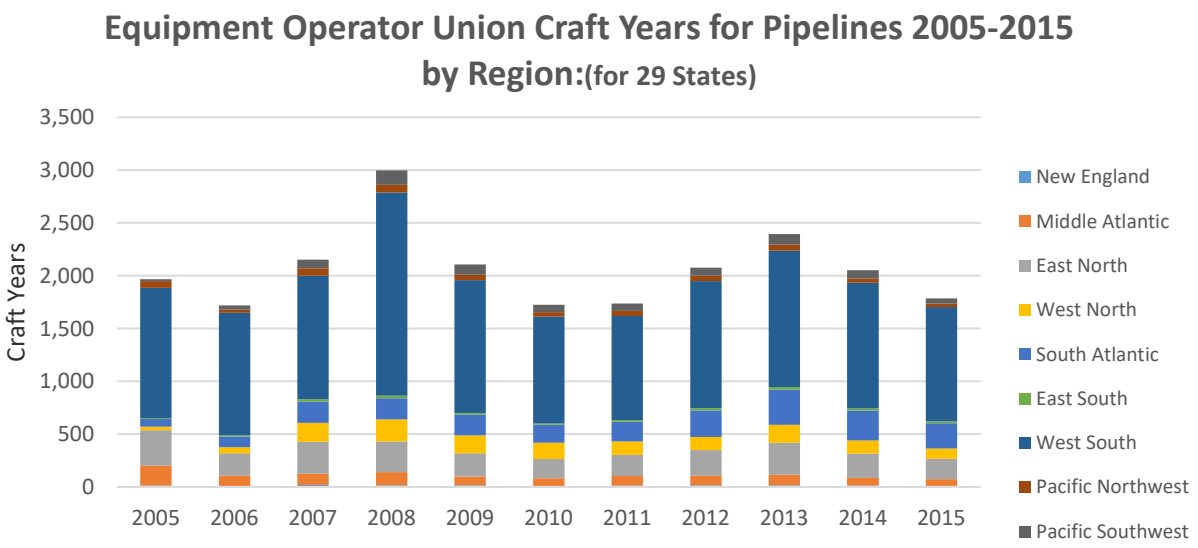
IIR provides estimates both for capital spending and for maintenance, repairs, and overhaul. Of the components of total man years for pipelines, spending for capital projects is the more volatile, ranging from 1,260 man years in 2010 to over 3,200 in 2015. Estimates for maintenance, repair and overhaul are both smaller in magnitude and variation with man hours ranging from an estimated 395 in 2010 to 585 in 2007.

Operating Engineers:

Operating engineers are primarily heavy equipment operators, mechanics, and surveyors in the construction industry; their work on pipelines is associated with orientation, digging, grading, bending drilling, and covering. The most concrete estimates of operators' hours come from the International Union of Operating Engineers.

As before, we note that the general pattern of the IUOE work year data (2005-2015) generally corresponds to the pattern of pipeline construction in the Census Bureau's Value Put-In-Place series and trends along with the International Brotherhood of Teamster numbers (see Tables 8 & 9). Activity peaks in 2008, declines to a trough of 1,724 work days in 2010, then rises, but never nears its previous peak.[21] In other words, the employment levels of operating engineers follow the same pattern as pipefitters, an overall peak in 2008, followed by declines associated with the subsequent deep recession, and then a substantial rebound during 2011-2013.

Table 8



Notes: Region based on local union. Work year equal 1,600 hours.
Source: : International Union of Operating Engineers.

What is different for operating engineers is their sustained and very high level of activity in the West South region. Over the course of eleven years, the South Central in aggregate provides almost 60% of operators' work activity. That predominance is surprising given the modest degree of unionization in most southern states. With the exception of 2008, when activity in

[21] The aggregations are due to the author based upon tabulations of data from the IUOE. In cases where union jurisdictions crossed regional boundaries, i.e., Texas and New Mexico, or Indiana and Kentucky, regional totals attributions may be subject to revision.

the West South Central region jumped 64%, work years in the region remain in a narrow band, varying from a trough of 982 work years in 2011 to a high of 1,290 in 2014. There are other differences as well – for example there is no lift from Middle Atlantic during the second five years of the historical period.

Table 9

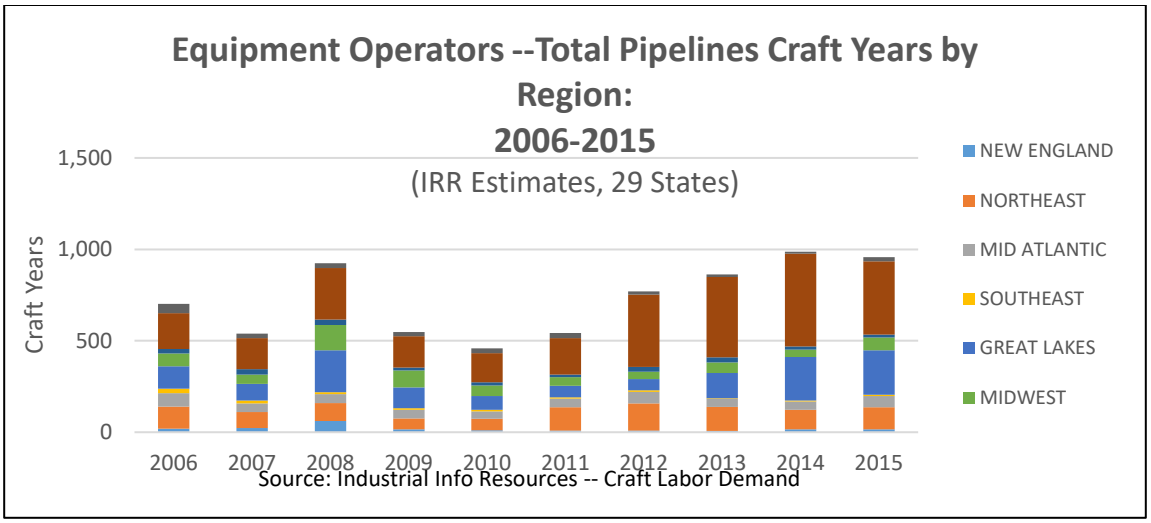
Equipment Operators: Union Craft Years for Pipelines: 2005-2015
Source: International Union of Operating Engineers. 29 States.

Regions	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
New England	13	11	18	15	17	10	12	15	17	12	10
Middle Atlantic	189	94	107	124	81	74	91	93	100	75	64
East North	336	212	303	290	221	182	201	242	302	230	193
West North	31	59	177	209	171	152	127	124	169	122	96
South Atlantic	74	99	200	200	196	170	186	251	336	282	242
East South	9	14	23	25	16	14	17	21	24	21	15
West South	1,234	1,158	1,170	1,923	1,255	1,012	982	1,204	1,290	1,190	1,083
Pacific NW	63	32	70	73	53	42	49	51	57	41	35
Pacific SW	18	38	83	138	97	68	70	76	100	79	47
IUOE Totals	1,967	1,717	2,151	2,997	2,107	1,724	1,735	2,077	2,395	2,052	1,785
% change		-13%	25%	39%	-30%	-18%	1%	20%	15%	-14%	-13%

Equipment Operators -- Total Craft Years for Pipelines: 2005-2015
Source: IIR Estimates for Operating Engineers, 29 States

Regions	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
IIR Totals	NA	703	540	926	547	457	540	772	860	989	959
% change			-23%	71%	-41%	-16%	18%	43%	11%	15%	-3%
Correlation (IUOE data, IIR Estimates)			*42%*								

Table 10



In contrast, IIR estimates of operator jobs follow pipeline construction during the historical period 2006-2015 (see Tables 10 &11). Employment is at moderate levels at the outset, first drops, surges to almost one thousand craft-years in 2008 before cuts to capital spending lead to a steep decline during 2009-2010. Compared to plumbers, pipefitters and steamfitters, IIR jobs are fewer in number—about one-quarter of the total. The Southwest is predominant, followed by the Great Lakes and Northeast, the latter which includes Pennsylvania in the IIR regionalization.

Table 11

Operators Craft Years -- Capital Projects

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
New England	12	16	55	11	6	4	5	3	10	11
Northeast	85	50	64	34	39	103	126	110	82	89
Mid-Atlantic	48	23	26	30	22	30	49	29	28	44
Southeast	19	11	5	5	6	5	6	1	1	3
Great Lakes	77	45	187	81	44	32	37	107	209	215
Midwest	44	24	116	77	41	31	26	42	27	53
Rocky Mtn.	16	21	19	9	11	6	20	24	11	9
Southwest	127	102	220	124	113	140	329	368	440	330
West Coast	37	10	14	12	16	18	9	7	4	15
U.S. Totals	465	302	705	384	298	370	605	693	812	769
% change		-35%	133%	-46%	-22%	24%	64%	14%	17%	-5%

Operator Craft Years -- Maintenance, Repairs & Overhaul

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
New England	7	7	7	5	4	4	4	4	5	5
Northeast	37	37	34	25	24	25	22	22	27	32
Mid-Atlantic	25	25	23	18	17	17	14	14	18	18
Southeast	5	5	5	3	3	3	3	3	3	3
Great Lakes	46	46	42	32	31	30	26	31	29	30
Midwest	26	26	24	16	16	17	14	14	13	17
Rocky Mtn.	10	10	9	7	7	7	6	5	6	6
Southwest	68	68	63	48	48	59	68	69	68	71
West Coast	14	14	13	10	9	9	8	7	8	8
U.S. Totals	238	238	220	164	159	171	165	169	177	190
% change		0%	-8%	-25%	-3%	8%	-4%	2%	5%	8%

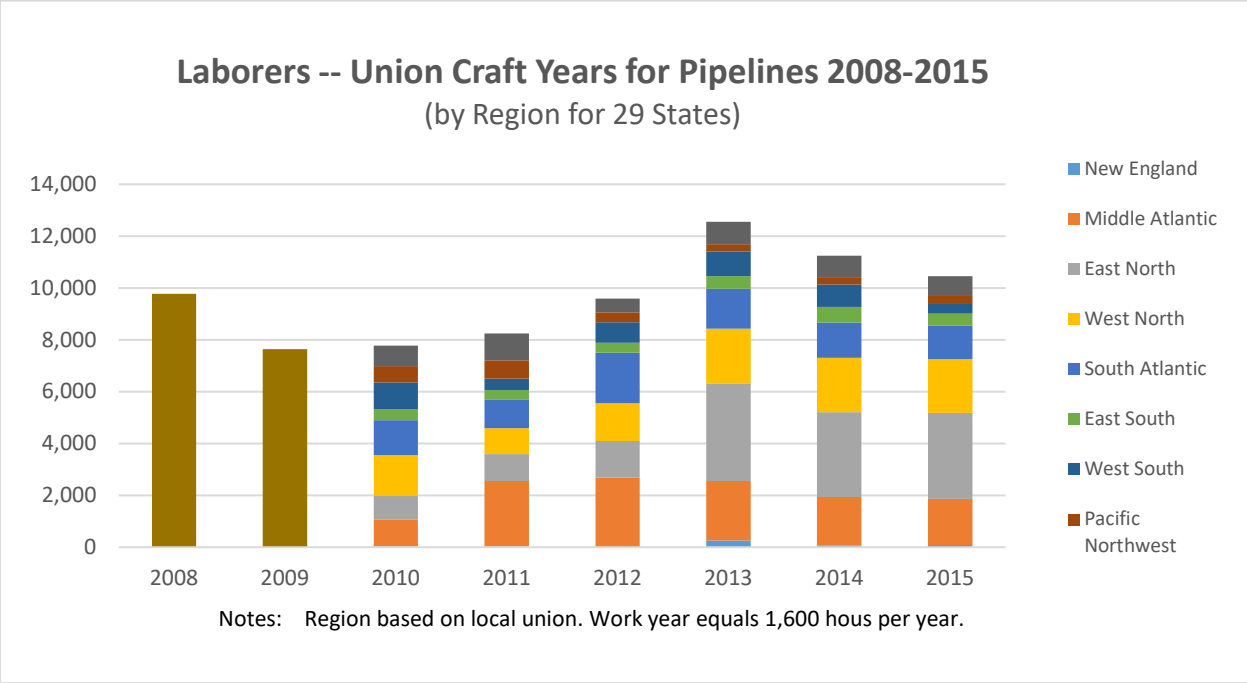
Source: Industrial Info Resources, Craft Labor Demand Estimates

As in previous cases, the union data shows similarity in its movements with IIR estimates, but displays some differences as well. What is the same is both the IUOE worker data and the IIR estimates identify a near term spike in activity for 2008, followed by subsequent declines 2009-2010. At the close of the time period, 2011-2015 however, IIR and IUOE numbers diverge – both rise but the IUOE number fail to reach new highs. In particular, there are declines in operator jobs for both 2014 and 2015 in the union data.

Construction Laborers:

The tasks of laborers employed on pipeline projects include budding, drilling, dealing with hazardous waste, loading, tamping, and working more generally in a pipe gang or bending crew. The comparatively numerous employment levels for construction laborers reflect the many tasks they perform on pipelines, clearing and scrubbing, to restoring the landscape after the pipeline is buried.[22]

Table 12



Notes: Region based on local union. Work year equals 1,600 hous per year.

Detailed estimates of the construction laborers come from the Laborers' International Union of North America (see Tables 12 and 13). The most notable characteristic of the LIUNA data is the large number of LIUNA jobs compared to other occupations. They are a great deal more numerous than intuition or IIR data would suggest. At 10,449 in 2015, laborer jobs exceeded teamsters (1,968) and operating engineers (1,785) by a factor of five or more.[23]

The national pattern is again similar to the other trades covered by National Pipeline and National Distribution Agreements. From a near term peak in 2008, LIUNA drops 22%, remaining low for another year, then starts to climb, reaching an eight-year high of 12,554 man years

[22] Multiple crews may work in sequence on the same section of pipeline, initially scrubbing and clearing, then stringing pipe, then filling and restoring. Laborers can perform most of these tasks, although on non-union pipelines, they could be performed by helpers or others. I thank Greg Gregory Davis, Executive Director, President's Office, Laborers International Union of North America for this observation.

[23] The high utilization for laborers is associated with the many tasks they perform at different stages of pipeline construction: clearing for the right-of-way, stringing pipe, setting up skids, as well as backend activities like restoring vegetation and landscape. Plumbers, fitters, and welders, on the other hand, are likely to work intensely for a shorter period, moving on to the next sections. The author would like to thank Mr. Tom Gross, Director of Pipeline and Gas Distribution, United Association, for his time and help explaining worksite practices.

before descending 17% to close 2015 at 10,449 man-years. What is different is that activity in 2013 is comparatively stronger than for the other three trades, teamsters, operating engineers, and plumbers, fitters and welders. Among regions, the Middle Atlantic, East North and West North regions are on average comparatively robust, together accounting for 54% of total activity 2010 through 2015. During the final three years, 2013-2015, it is the East North – Indiana, Ohio, Illinois, Michigan and Wisconsin – that stand outs, accounting for 30% of work years.

Table 13

Laborers -- Union Craft Years for Pipelines: 2008-2015
Source: Laborers International Union of North America. All States

Region	2008	2009	2010	2011	2012	2013	2014	2015
New England	-	-	22	19	13	260	61	86
Middle Atlantic	-	-	1,053	2,530	2,681	2,296	1,881	1,778
East North	-	-	900	1,042	1,404	3,761	3,268	3,313
West North	-	-	1,585	1,003	1,454	2,117	2,098	2,075
South Atlantic	-	-	1,341	1,108	1,954	1,536	1,356	1,303
East South	-	-	431	359	386	481	605	451
West South	-	-	1,020	442	785	955	865	412
Pacific Northwest	-	-	633	701	380	288	282	301
Pacific Southwest	-	-	787	1,040	538	860	827	730
Unassigned	9,774	7,637	-	-	-	-	-	-
LIUNA Total	9,774	7,637	7,772	8,244	9,595	12,554	11,243	10,449
% change		-22%	2%	6%	16%	31%	-10%	-7%

Equipment Operators --Total Craft Years for Pipelines: 2008-2015
Source: IIR Estimates for Laborers, 29 States

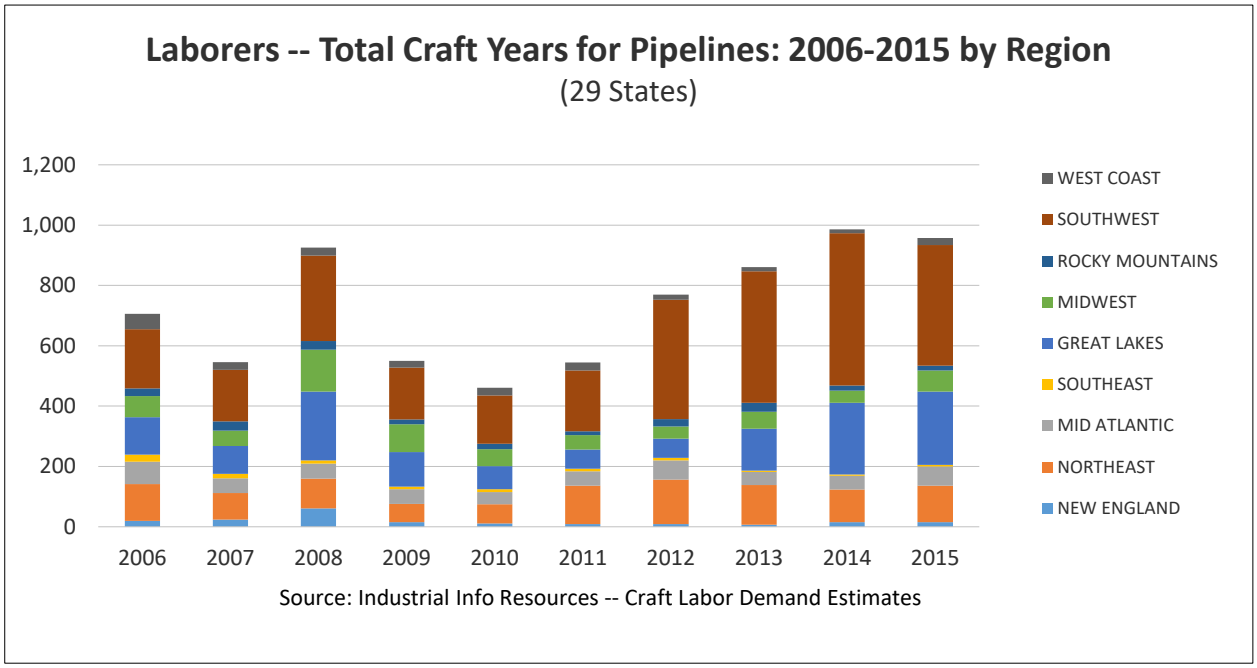
	2008	2009	2010	2011	2012	2013	2014	2015
IIR Totals (Estimated)	925	550	461	545	769	861	986	957
% change		*-41%*	*-16%*	*18%*	*41%*	*12%*	*14%*	*-3%*
Correlation (LUINA data, IRR estimates)		*0.83*						

Alternate and lower estimates for pipeline derived employment are provided by Industrial Information Resources[24]. Like other IIR estimates of trade employment, changes in employment during 2006-2015 follow the same patterns of pipeline construction activity. The twenty-nine state totals begin the period at 925 in 2008 before declining by 50% to a trough of 461 man years in 2010 (see Tables 14 & 15). Thereafter, demands for construction laborers rise

[24] Conversations with union members suggest that construction laborers' hours are high for pipelines. Many of the tasks associated with building pipelines require physical labor by individuals. Further, there may be multiple crews each with a high proportion of laborers working sequentially on the same sections of pipe, clearing, scrubbing, aligning, then leveling and restoring landscape.

over the next four years to reach a ten year high of almost 1,000 man years in 2014 before slipping during 2015.

Table 14



Substantial differences between estimates of laborer work years from IIR and actual work year data from Laborers International Union of North America are a puzzle to be solved. The two do however track together with a simple correlation of .83.

Based on the IIR estimates, the Southwest is predominant throughout the historical period, reflecting strength in Texas, in particular. Pipelines from the Eagle Ford to both Mexico and the Texas Gulf Coast have been needed to move newly developed natural gas and natural gas liquids to export markets. The Great Lake States, which include North Dakota and Ohio, rank second by regional total during the final forecast years, reflecting developments in the Bakken, efforts to bring Canadian petroleum south to Gulf Coast markets, and more recent exploitation of the Utica Shale.

Table 15

Laborer Craft Years -- Capital Projects

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
New England	12	16	54	11	6	4	5	3	10	11
Northeast	84	50	63	34	38	102	125	108	81	88
Mid Atlantic	47	22	25	30	22	30	48	29	27	44
Southeast	18	10	5	5	6	5	6	1	1	3
Great Lakes	76	44	185	81	44	32	36	106	207	212
Midwest	43	24	114	76	40	31	26	42	27	52
Rocky Mtn.	16	20	19	9	11	6	20	24	11	9
Southwest	126	101	217	123	111	139	325	364	435	326
West Coast	37	10	14	12	16	17	9	7	4	14
U.S. Totals	459	298	696	379	295	366	598	684	803	760
% change		-35%	133%	-46%	-22%	24%	64%	14%	17%	-5%

Laborer Craft Years -- Maintenance, Repairs & Overhaul

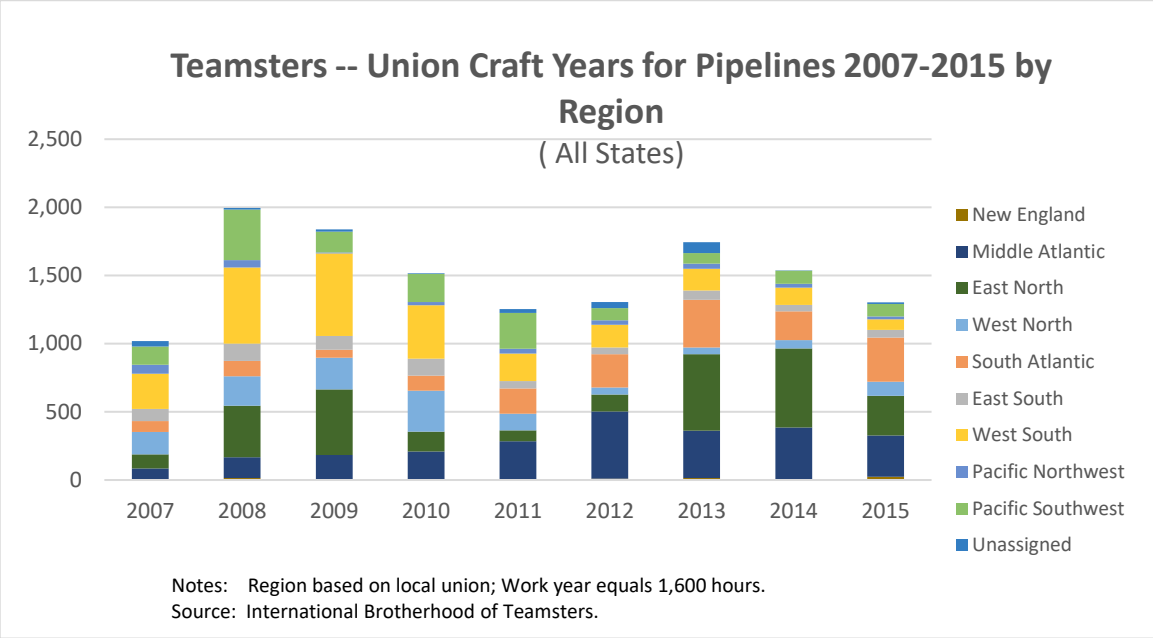
	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
New England	8	8	7	5	5	5	4	4	5	5
Northeast	38	38	35	26	25	26	23	23	28	33
Mid Atlantic	26	26	24	19	18	18	15	14	19	19
Southeast	5	5	5	4	3	3	3	3	3	3
Great Lakes	48	48	44	34	32	32	27	33	30	31
Midwest	27	27	25	17	16	17	15	15	13	18
Rocky Mtn.	10	10	9	7	7	7	6	5	7	6
Southwest	71	71	66	50	50	62	70	72	71	74
West Coast	14	14	13	10	10	10	8	8	8	8
U.S. Totals	247	247	229	171	167	179	171	177	183	197
% change		0%	-7%	-26%	-2%	7%	-4%	3%	3%	8%

Source: Industrial Info Resources, Craft Labor Demand Estimates

Teamsters (Drivers, Material Movers, and Related Jobs):

Industrial Information Resources does not estimate drivers and related jobs -- they are categorized in the North American Industrial Classification System under the Transportation and Material Moving Occupations[25]. However, material mover and related jobs are covered under the national pipeline agreements through the International Brotherhood of Teamsters[26], Building Material and Construction Trade Division. Teamsters move material and people to and from construction sites, as well as around construction sites[27].

Table 16



Notes: Region based on local union; Work year equals 1,600 hours.
Source: International Brotherhood of Teamsters.

As documented in Tables 16 and 17, over the course of nine years 2007-2015, annual teamster man years range between 1,000 and 2,000 beginning at a low level of 1,020 in 2007, jumping 96% to a peak of 1,997 man years in 2008, slipping during 2009-11 to a trough of 1,254 before rebounding in 2013 and then slipping during the final years of the period. An inspection of regional activity suggests the national pattern confounds important differences at the regional level.

For example, pipeline construction hours for teamsters in the Middle Atlantic region are heaviest during the years 2012 through 2015, roughly corresponding to heavy drilling for

[25] Please see discussion of classifications at https://www.bls.gov/soc/soc_2010_user_guide.pdf.
[26] An important difference between drivers, material movers and similar jobs, is that at non-union sites, the tasks may be performed by laborers or helpers, who can step into a vehicle and drive it to where it needs to go, shifting distributions among the trades.
[27] For this study, man years were calculated as equivalent to 1,600 man hours. The standard for government data is usually one man year equals 2,080 man hours, but within the skilled trades, 1,600 is preferable.

natural gas in the Marcellus Shale and subsequent efforts to move the gas to Eastern markets[28]. In contrast, activity is front loaded in the West North Central region, which includes North Dakota, where the development of the Bakken Shale occurred earlier. Finally, the comparatively low levels of IBT activity in West South region (Arkansas, Louisiana, Oklahoma, and Texas) during recent years likely reflects the lower unionization in those states. Pipeline construction in Texas has been intense for years, reflecting development in multiple resource basins.

Table 17

Teamsters -- Union Craft Years for Pipelines: 2007-2015

Source: IBT Data for Teamsters. 29 States

Region	2007	2008	2009	2010	2011	2012	2013	2014	2015
New England	8	15	7	3	8	10	14	2	24
Middle Atlantic	77	153	177	205	278	493	347	384	302
East North	102	378	481	146	79	124	562	580	291
West North	164	214	231	301	121	53	50	62	103
South Atlantic	79	113	60	109	186	243	349	211	324
East South	91	128	102	125	54	49	69	45	57
West South	258	560	604	391	201	165	158	128	78
Pacific Northwest	66	53	8	24	35	35	39	27	19
Pacific Southwest	133	371	152	207	265	89	76	96	94
Unassigned	40	13	17	4	27	45	81	4	10
IBT Totals	*1,020*	*1,997*	*1,838*	*1,516*	*1,254*	*1,306*	*1,745*	*1,539*	*1,302*
% change		*96%*	*-8%*	*-18%*	*-17%*	*4%*	*34%*	*-12%*	*-15%*

Other Construction Occupations:

[28] Work years are tabulated based on detailed hours entries from International Brotherhood of Teamsters – thank you IBT. The detail is exceptional and allows a very careful examination of teamster utilization in pipeline work at the state level. The data is voluminous.

Union agreements with the Pipe Line Contractors Association and the Distribution Contractors of America cover workers from four key trades, but other trades participate in pipeline construction. Some of these workers may be employees of general contractors for whom they undertake tasks as directed. PLCA Agreements explicitly exclude these workers from the requirement that workers be union members.

Estimates for other trades are available from IRR, from their across-the-board estimates of skilled labor utilization for pipelines. These estimates are found in Appendix B (Graphical and tabular materials for these occupations are contained in the Appendices).

What these tables confirm is that the bulk of construction employment –- certainly in the unionized sector and probably for non-union jobs as well –-is focused on i) plumbers, pipefitters and steamfitters, ii) operating engineers, iii) construction laborers, and iv) drivers and materials movers (teamsters).[29]

Estimates of Nation-Wide Effects of Pipeline Construction:

An annual average of 16,273 union fitters, operators, laborers and teamsters craft worker FTE's are employed in pipeline construction and maintenance in the 29 states included in this report. How many craft workers are employed in all 50 states and the District of Columbia? We do not have direct estimates of employment in the other 21 states, but we have the net value of pipeline construction from the 2012 census of construction for the 29 states included in this study ($23,434,025) and for all the states in total ($ 36,187,544). The 29 states represent 65% of national value of construction. Assuming the proportion of craft workers involved in pipeline construction is similar between states, national craft employment among the big four union crafts in the 29 states would be 27,122 FTE workers. The big four crafts are no more than 60% of all union pipeline employment; total annual union employment for all crafts would be 41,726. Finally, union craft workers comprise about 60% of total, union and non-union employment. Total national craft employment would be 69,500 full-time jobs annually.

Using the BLS estimate for median weekly earnings in the construction industry of $1,168 for union members and adjusting for the difference in annual hours, the annual direct impact from wages in pipeline construction is over $1.9 billion per year for the nation. Adding a conservative benefits rate of twenty percent to this total brings the overall direct economic impact of union pipeline construction jobs in all 50 states to over $2.3 billion per year.

[29] Provisions in the pipeline agreements allow general contractors to use their own workers to do construction jobs at the worksite, provided the workers are regular employees.

Appendix A: Data Sources

Industrial Info Resources, LLC.

General: Industrial Info Research, LLC estimates the investment value of major pipelines constructed during 2008-2015 averaged $8.8 billion dollars per year, or $79.0 billion for the entire period. Activity was heavily weighted toward southwestern states (Oklahoma, Texas); together they comprised 39% of the overall total for the 29 states included in the sample. The Great Lakes (Illinois, Indiana, Michigan, Ohio, Wisconsin) account for 19% of activity, the Northeast (New York, New Jersey, Pennsylvania) follow with 15%, while the Midwest (Iowa, Minnesota, North Dakota, South Dakota) comprised 9% of the to 7,547 plumbers, 5,408 operators, 24,765 laborers, and 4,006 teamsters for a U.S. total of twenty-nine state total.

High levels of regional activity correspond roughly to regions where new drilling techniques allow producers to access shale oil and natural gas deposits. In Texas, shale resources are located in the Barnett, Permian, and Eagle Ford basins. In the Northeast, the Marcellus Shale Formation extends from New York State through Pennsylvania to West Virginia. The Bakken formation in North Dakota along with much smaller Gammon in South Dakota have also been the scene of exploration and production activity.

The largest pipeline completed or under construction in the IIR $50 million+ inventory is TransCanada's $1.4 billion Liberty Grass Root Gulf Coast Crude Oil Pipeline, a section of the Keystone Pipeline project that moves crude petroleum from Cushing, Oklahoma to Nederland, Texas. The second largest pipeline, Energy Transfer Partners $1.0 billion Midland Grassroot Lone Star Express Natural Gas Liquids Pipeline, was built to move NGL from the Permian Basin to fractionalization and storage facilities in Mount Belvieu, Texas.

Pipeline Data: The principal data are collected by Industrial Info Resources (IIR), Sugarland, Texas, which tracks more than 100,000 active industrial construction projects throughout the world that is those that are in the planning stages or under construction, as well as 155,000 that are completed, on-hold or cancelled[30]. The construction database for this study includes historical pipeline construction projects for twenty-nine states. Data fields include, but are not limited to

- Plant parent/owner/operator
- Project total investment value
- Project status (Active, Canceled, Complete, On Hold, Unconfirmed)
- Timing for project kickoff, AFEs, bid docs, RFQs and completion
- Union status
- Key equipment needs
- Environmental requirements

*Construction Trades Data***:** The construction trades under the microscope are Boilermaker, Carpenter, Electrician, Instrumentation Technician, Insulator, Ironworker, Construction Laborer,

[30] See http://www.industrialinfo.com/database/project_database.jsp

Millwright, Operator, Painter, Plumber and Pipefitter, Scaffold Builder, and Welder. These trades are among the standard occupational classifications which the federal government uses to count occupational employment in the United States. The employment impacts are measured in man-hours.

Historical Period:	Annual, 2006-2016[31].
Skilled Trades:	Boilermaker, Carpenter, Electrician, Instrumentation Technician, Insulator, Ironworker, Construction Laborer, Millwright, Operator, Painter, Plumber and Pipefitter, Scaffold Builder, and Welder.
Geographies:	The twenty-nine states for which there is (estimated) trades data hours are:
New England:	Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, Vermont.
Northeast:	New Jersey, New York, Pennsylvania.
Mid-Atlantic:	Maryland, North Carolina, Virginia, West Virginia.
Midwest:	Illinois, Iowa, Minnesota, North Dakota, South Dakota.
Great Lakes:	Indiana, Michigan, Ohio, Wisconsin.
Southeast:	Georgia.
Southwest:	Oklahoma, Texas.
Rocky Mountain:	Montana.
Pacific:	California, Oregon, Washington.

United Association of Plumbers, Fitters, Welders and Service Techs.

The United Association of Plumbers, Fitters, Welders and Service Techs provides aggregated data of annual service hours by (UA) region for the period 2005-2015, a total of fifty-five lines of data. The data come from local unions which submit their work-hours to the national for record keeping and the calculation of benefits.

Historical Period:	Annual, 2005-2015.
Skilled trades:	Plumbers, Pipefitters, Steamfitters, and Welders.
Geographies:	Five regions, twenty-eight states.
New England:	Connecticut, Massachusetts, Maine, New Hampshire, New York, Rhode Island, Vermont.
Northeast:	Maryland, North Carolina, New Jersey, Virginia, West Virginia.
Midwest:	Iowa, Illinois, Indiana, Michigan, Minnesota, North Dakota, Ohio, South Dakota, Wisconsin.
West:	California, Montana, Oregon, Washington.
South:	Georgia, Oklahoma, Texas.

[31] The IIR data includes historical data 2006 through 2015, and a combination of historical and forecast data for 2016. Hours data from the individual trade unions however end in 2015, which serves as a cutoff in this study.

International Union of Operating Engineers.

The international Union of Operating Engineers provides annual hours data by local union. In this study, the state in which the union is located provides the geographical information used in the regional analysis. Some locals may cover workers in multiple states – for example Local 841 operates in both Indiana and Illinois. Typically, although not always, those states are located in the same region.

Historical Period:	Annual, 2005-2015.
Skilled Trades:	Operators/Operating Engineers.
Geographies:	Thirty states, nine regions, modified BEA regions with Pacific Northwest and Pacific Southwest.
New England:	Connecticut, Massachusetts, Rhode Island.
Middle Atlantic:	New Jersey, New York, Pennsylvania.
East North Central:	Illinois, Indiana, Michigan, Ohio
West North Central:	Iowa, Minnesota, North Dakota, South Dakota, Wisconsin.
South Atlantic:	Delaware, Georgia, North Carolina, Virginia, West Virginia.
East South Central:	Kentucky.
West South Central:	Oklahoma, Texas.
Pacific Northwest:	Idaho, Montana, Washington.
Pacific Southwest:	California, New Mexico, Nevada, Utah.

Labors International Union of North America.

The Laborers International Union of North America provides very rich datasets. They include information about total U.S. hours under the National Pipeline Agreement, total U.S. hours split between mainline and distribution pipelines (the Distribution Pipeline Agreement), a listing of Union and Non-Union Pipelines, and a listing of Distribution Pipeline Hours 2012-2013 with owners, jobsites, contractors, and file numbers with tens of thousands of entries. The analysis relied primarily upon State Hours Data that does a breakout by PLCA (mainline agreement) and DCA (distribution agreement).

Historical Period:	Annual 2008-2015.
Skilled Trades:	Construction Laborers.
Geographies:	Forty-nine states, DC and Chicago. Eight regions.
New England:	Connecticut, Massachusetts, Maine, New Hampshire, New York, Rhode Island, Vermont.
Mid-Atlantic:	District of Columbia, Maryland, North Carolina, Pennsylvania, Virginia, West Virginia.
Eastern:	Delaware, New Jersey.
Great Lakes:	Illinois-Chicago, Michigan, Minnesota, North Dakota, Wisconsin.
Midwest:	Arkansas, Illinois, Indiana, Iowa, Kansas, Missouri, Nebraska, Oklahoma, South Dakota, Texas.
OVSS:	Alabama, Florida, Georgia, Kentucky, Louisiana, Mississippi, Ohio, South Carolina, Tennessee.
Northwest:	Colorado, Idaho, Montana, Nevada, Oregon, Utah, Washington, Wyoming.
Pacific Southwest:	Arizona, California, New Mexico.

International Brotherhood of Teamsters, Building Material and Construction Trade Division.

The International Brotherhood of Teamsters data, like the LIUNA data, is extensive. It provides detailed record week by week from 2007 through most of 2015 of working hours by contractor, number of employees, amounts credited, and local union number. A single year can include nearly one thousand line items so that the assembled quarterly information in database format contains in excess of 25,000 lines. Cross referencing the local unions to their state locations, it is possible to aggregate by region and year.

Historical Period:	Quarterly, 2007-2016.
Skilled Trade;	Teamsters (drivers, transporters, and related workers).
Geographies:	Forty-three states and the District of Columbia.
New England:	Connecticut, Massachusetts, Maine, New Hampshire, New York, Rhode Island, Vermont.
Middle Atlantic:	New Jersey, New York, Pennsylvania.
East North:	Illinois, Indiana, Michigan, Missouri, Ohio.
West North:	Iowa, Kansas, Minnesota, Wisconsin.
South Atlantic:	District of Columbia, Florida, Georgia, Maryland, North Carolina, Virginia, West Virginia.
East South:	Alabama, Kentucky, Mississippi, Tennessee.
West South:	Arkansas, Louisiana, Oklahoma, Texas.
Pacific Northwest:	Alaska, Idaho, Montana, Oregon, Washington.
Pacific Southwest:	Arizona, California, Colorado, Nevada, New Mexico.

Appendix B: IIR Estimates of Other Trade Employment/Work-Years

The current study focuses on demand for the skilled trades due to laying pipeline, but pays less attention to other features of pipeline systems, for example compressor stations, storage tanks, outbuildings, and other structures.

Compressor or pumping stations include piping and valves, scrubbers and compressors, cooling systems, generators, and backup power systems. Storage includes piping and tanks. Gas processing separates other hydrocarbons and removes impurities and natural gas liquids before its insertion into the pipelines. Compressors keep the natural compressed and move it along the pipeline. Pumping stations move crude oil or products along their pipelines.

The normal operation of compressor and pumping stations does not require workers present, so the need for structures to house individuals is limited. Compressor and pumping station crews build the stations, which are usually located every 50 to 90 miles. The crews that build these stations include electricians, insulators, welders, plumbers and pipefitters, among others. Industrial Info Research, LLC, estimates pipeline employment for thirteen major skilled construction trades, three of which – plumbers, pipefitters, and steamfitters -- operators (operating engineers) -- construction laborers – have been reviewed elsewhere. What are the principal remaining trades?

According to IIR, the remaining ten trades add an average of over six thousand man-years annually to labor demand for the period 2008-2015. The addition brings average annual man-years to over 33,000, when added to our previous total jobs estimate. Recall that the twenty-nine states in the IIR sample comprise about two-thirds of total pipeline construction, so that a rough adjustment to the IIR totals below leads to an average annual addition of 6,089 jobs for 2008-2015. The resulting IIR estimate – pipelines produced an annual average of 10,487 direct skilled trade jobs for twenty-nine states during the period 2008-2015. Assuming that the sample of the twenty-nine states is 65% of the national total, the resulting total is 16,135 full time equivalent jobs for the trades[32].

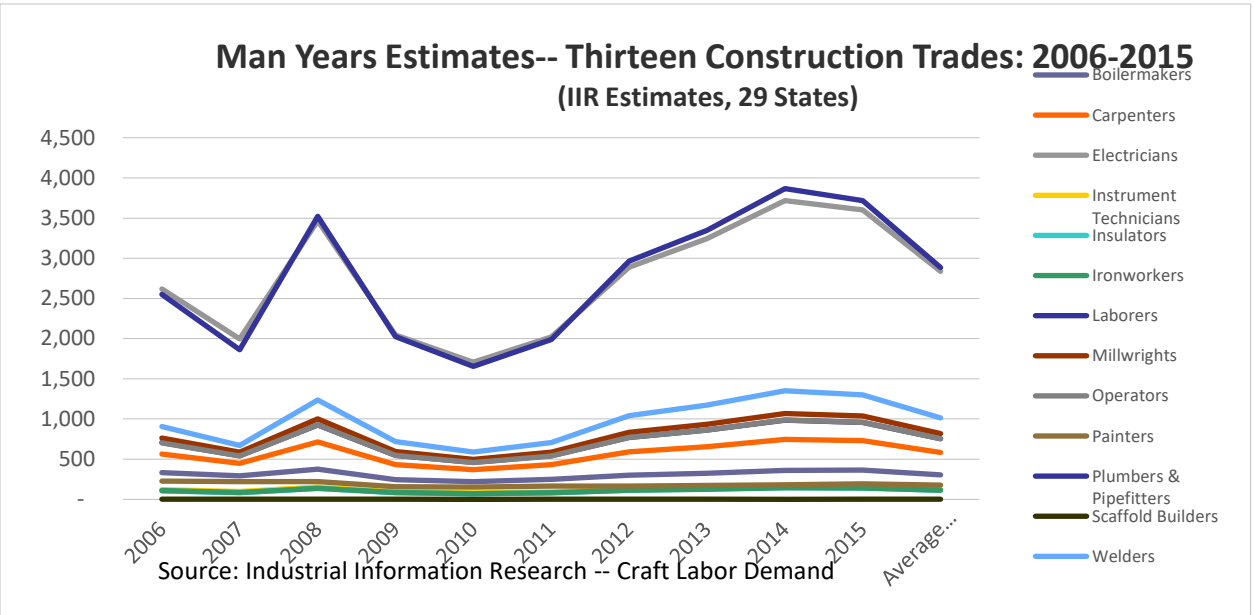
[32] This total appears a bit low compared to our earlier estimates, but recall that the IIR estimates are for major mainline pipelines only.

Table A1

Total Man-Years for "Other" Skilled Construction Trades Sources: Industrial Infor Research, LLC.											
	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	Average 2008-2015
Boilermakers	332	292	376	245	221	249	300	327	362	364	305
Carpenters	564	450	715	434	370	432	590	657	747	730	584
Electricians	2,616	1,997	3,467	2,045	1,707	2,023	2,890	3,242	3,718	3,601	2,837
Instrument Technicians	123	100	154	94	81	94	126	140	159	156	125
Insulators	107	80	138	82	69	81	115	129	147	143	113
Ironworkers	110	88	138	84	72	84	114	127	144	141	113
Millwrights	762	587	1,001	594	498	588	833	933	1,068	1,037	819
Painters	228	223	220	159	153	166	167	174	183	194	177
Scaffold Builders	1	0	1	0	0	0	1	1	1	1	1
Welders	907	670	1,239	717	589	705	1,040	1,172	1,352	1,302	1,014
Total Man-Years	5,750	4,488	7,449	4,455	3,759	4,424	6,176	6,901	7,880	7,668	6,089

One of the consequences of modeling demand for the skilled trades as a function of pipeline construction is that demand for the individual trades trend together. When pipeline activity rises, demand for the different skilled trades tends to rise proportionately. In contrast, studies with differing utilization rates across building types and differing mixes of building types over time produce variation in labor demand.

Table A2

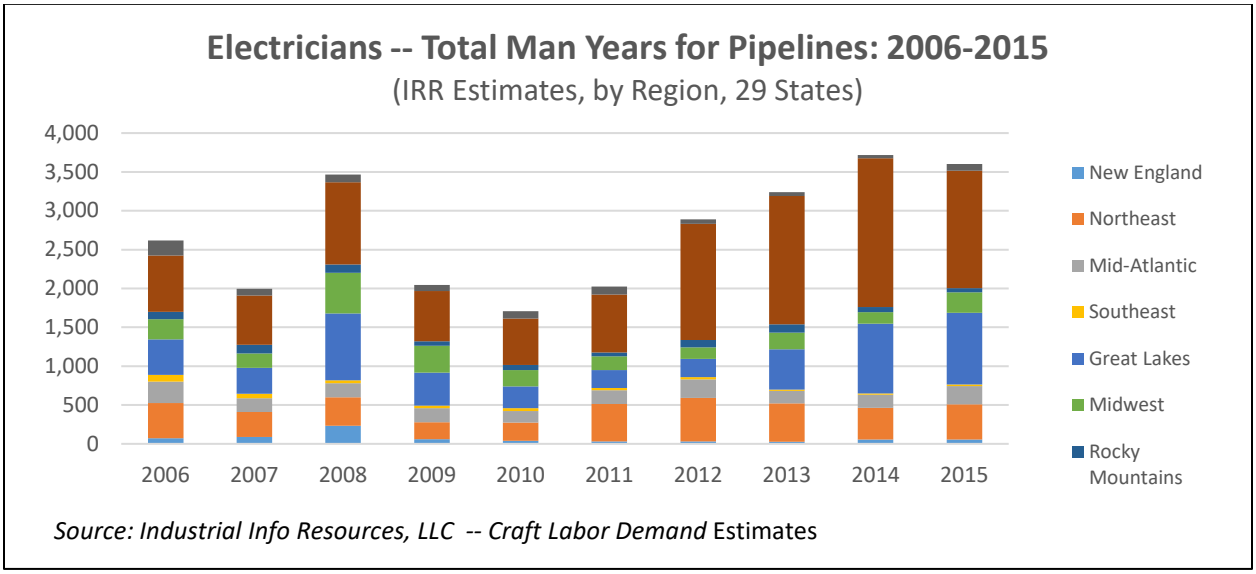


Source: Industrial Information Research -- Craft Labor Demand

Worker demand in such studies is driven by a combination of utilization rates and construction activity. One approach derives utilization rates for the individual trades as ratios of man hours (or years) per physical units of construction, for example pipefitters per unit distance or per million dollars of spending. The approach can be extended to create multiple measures that separately calculate work hours by pipeline diameter or by topographical features.

What follows are tables and graphs that detail IIR estimates of pipeline-derived demand for selected skilled trades. By far the largest contributors among the trades that are not covered by the National Pipe Line or National Distribution Agreements are the electricians, who wire compressor stations, deal with generators and set up back up power supplies.

Table A3



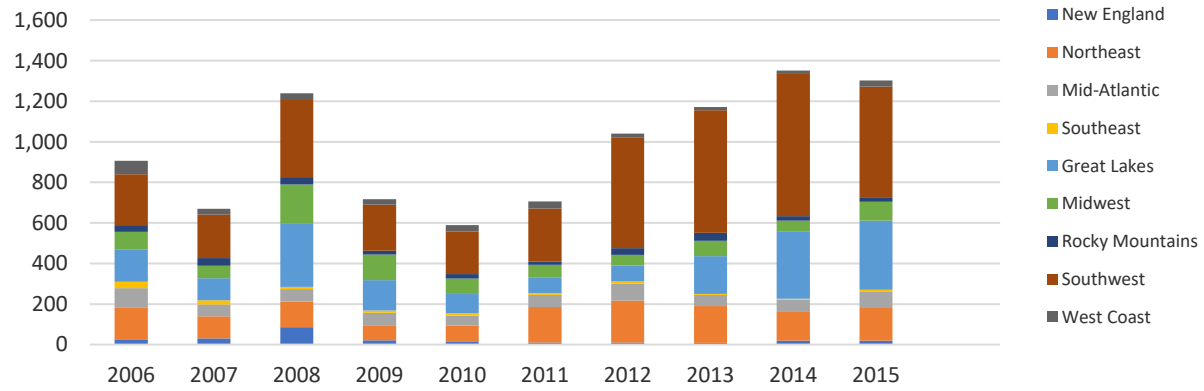
Source: Industrial Info Resources, LLC -- Craft Labor Demand Estimates

Electricians -- Man Years --Total										
	2006	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**
New England	74	88	232	58	41	32	32	26	56	57
Northeast	453	323	366	220	234	481	561	497	406	453
Mid-Atlantic	273	177	182	179	147	175	236	161	169	234
Southeast	89	58	36	33	36	30	32	15	15	22
Great Lakes	457	335	863	426	279	232	233	520	900	922
Midwest	259	184	525	348	211	178	149	212	150	262
Rocky Mountain	96	112	105	58	65	48	95	110	64	56
Southwest	726	632	1,061	643	599	747	1,493	1,650	1,914	1,511
West Coast	191	88	98	80	94	100	60	52	43	84
U.S. Totals (29 States)	*2,616*	*1,997*	*3,467*	*2,045*	*1,707*	*2,023*	*2,890*	*3,242*	*3,718*	*3,601*
% change		*-24%*	*74%*	*-41%*	*-17%*	*19%*	*43%*	*12%*	*15%*	*-3%*

Source: Industrial Info Research, LLC.

Welders are the second largest contributor in terms of pipe line man-years, but constitute a special case. There is no national union devoted to welders alone, but instead an “American Welding Society”, which devotes itself to training and welding safety and technique. The decision to join a trade union for a welder instead focuses on where and how the worker uses his or her welding skills, whether working on pressure vessels (boilermakers), steel framing for buildings or refineries (ironworkers), or fitting pipes and plumbing (plumbers, pipefitters, and steamfitters).

Table A4

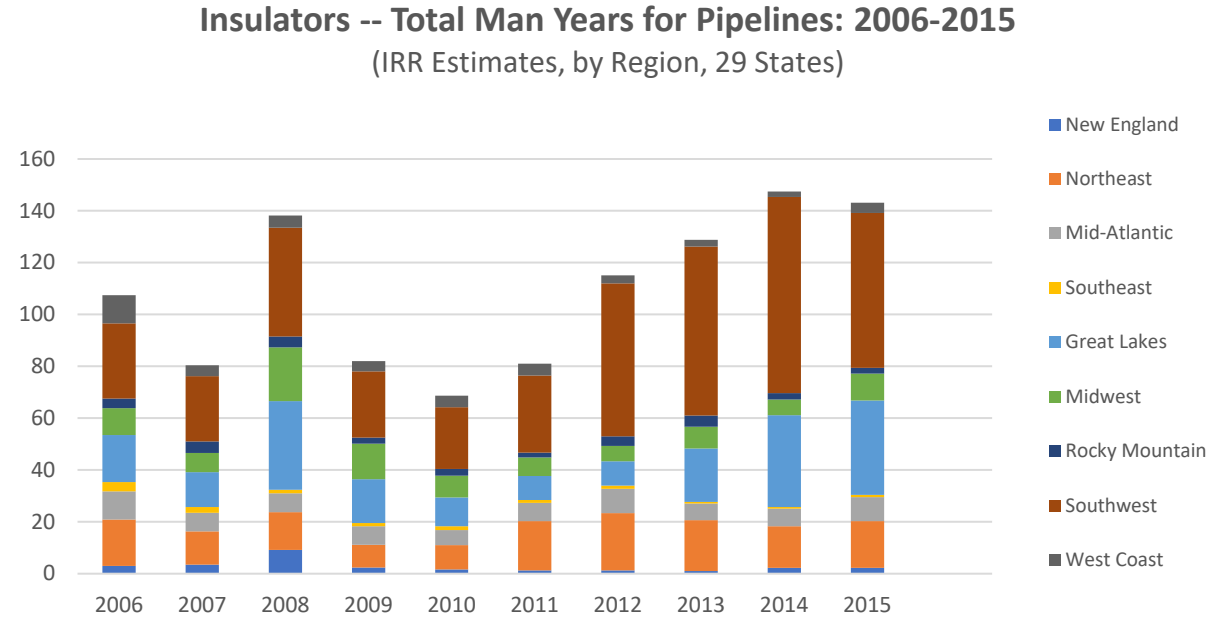


Source: Industrial Info Resources -- Craft Labor Demand Estimates

Welders -- Total Man-Years -for Pipelines 2006-2015										
Man Hours -- Total	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**
New England	25	31	86	21	14	10	11	8	20	20
Northeast	159	109	126	74	80	174	205	181	145	160
Mid-Atlantic	94	58	60	61	49	60	85	56	58	82
Southeast	32	20	12	11	13	10	11	5	5	7
Great Lakes	157	110	313	150	95	77	79	186	332	341
Midwest	89	60	191	127	75	61	51	75	52	93
Rocky Mountains	33	39	37	20	22	16	34	40	22	19
Southwest	251	215	381	227	210	262	544	603	705	549
West Coast	67	28	32	27	32	35	20	17	14	29
U.S. Totals (29 States)	*907*	*670*	*1,239*	*717*	*589*	*705*	*1,040*	*1,172*	*1,352*	*1,302*
% change		*-26%*	85%	-42%	-18%	20%	47%	13%	15%	-4%
Source: Industrial Info Research, LLC.										

Insulators are also important in the construction of compressor and pumping stations since compressing natural gas produces heat, which must be dissipated.

Table A5



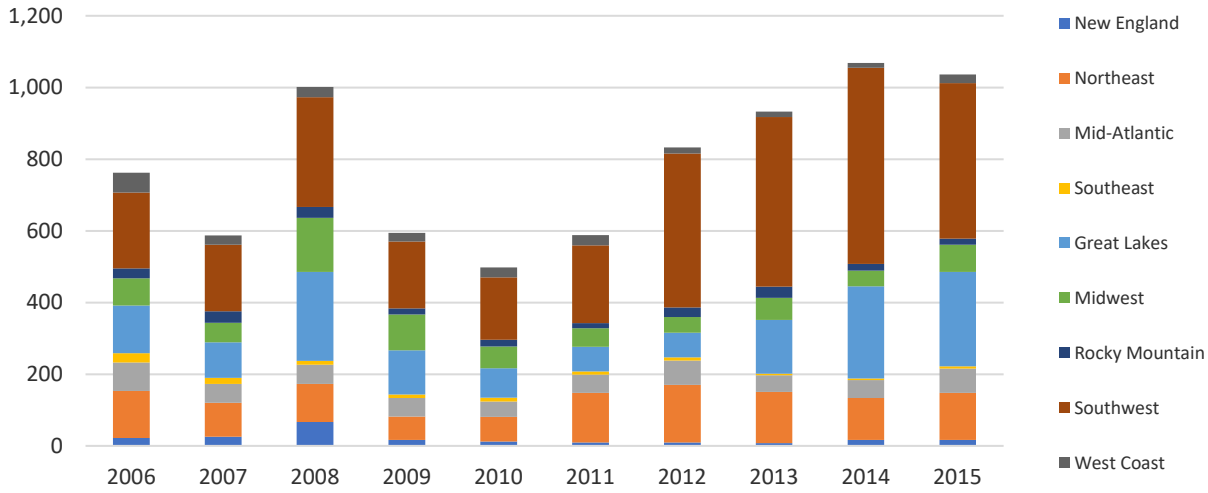
Source: Industrial Info Resources, LLC. -- Craft Labor Demand Estimates

Insulators -- Total Man-Years -for Pipelines 2006-2015										
	2006	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**
New England	3	3	9	2	2	1	1	1	2	2
Northeast	18	13	15	9	9	19	22	20	16	18
Mid-Atlantic	11	7	7	7	6	7	9	6	7	9
Southeast	4	2	1	1	1	1	1	1	1	1
Great Lakes	18	13	34	17	11	9	9	21	36	36
Midwest	10	7	21	14	8	7	6	8	6	10
Rocky Mountain	4	4	4	2	3	2	4	4	3	2
Southwest	29	25	42	26	24	30	59	65	76	60
West Coast	11	4	5	4	4	5	3	3	2	4
U.S. Totals (29 States)	*107*	*80*	*138*	*82*	*69*	*81*	*115*	*129*	*147*	*143*
% change		*-25%*	72%	-41%	-16%	18%	42%	12%	14%	-3%

Source: Industrial Info Research, LLC.

Other major contributors to pipeline hours are millwrights and carpenters, whose historical profiles closely match the patterns of the other trades. Millwrights are responsible for installing, dismantling, repairing and moving machinery in factories and power plants and construction sites, including placing heavy equipment at a job site.

Table A6



Source: Industrial Info Resources, LLC. -- Craft Labor Demand

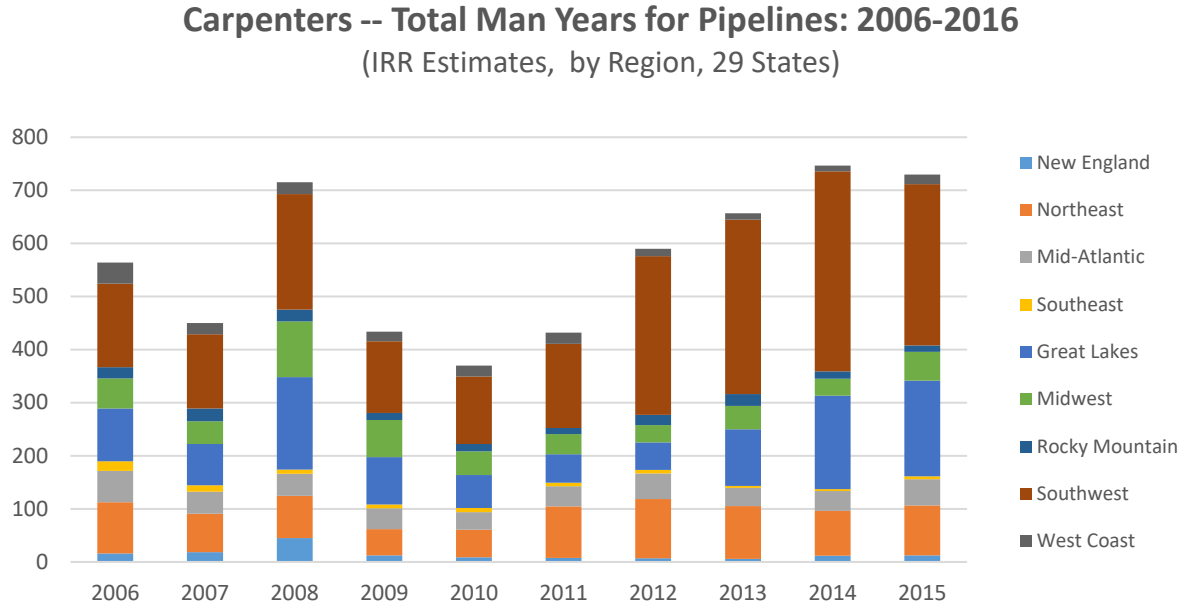
Millwrights -- Total Man-Years -for Pipelines 2006-2015

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
New England	22	26	66	17	12	9	9	8	16	17
Northeast	132	95	107	65	69	138	161	143	117	131
Mid-Atlantic	80	52	54	52	43	51	68	47	50	68
Southeast	26	17	11	10	11	9	9	4	5	6
Great Lakes	134	99	248	123	82	68	68	150	257	264
Midwest	76	55	151	100	61	52	44	61	44	76
Rocky Mountain	28	33	31	17	19	14	27	32	19	16
Southwest	212	185	306	186	174	217	429	473	548	434
West Coast	55	26	29	23	27	29	18	15	13	24
U.S. Totals (29 States)	*762*	*587*	*1,001*	*594*	*498*	*588*	*833*	*933*	*1,068*	*1,037*
% change		*-23%*	71%	-41%	-16%	18%	42%	12%	14%	-3%

Source: Industrial Info Research, LLC.

The roles of carpenters in either laying pipe or building compressor stations are not so obvious. The trade having the least derived demand is scaffold builders with total demand at barely a single man year during most years 2006-2015.

Table A7



Source: Industrial Info Resources -- Craft Labor Demand Estimates

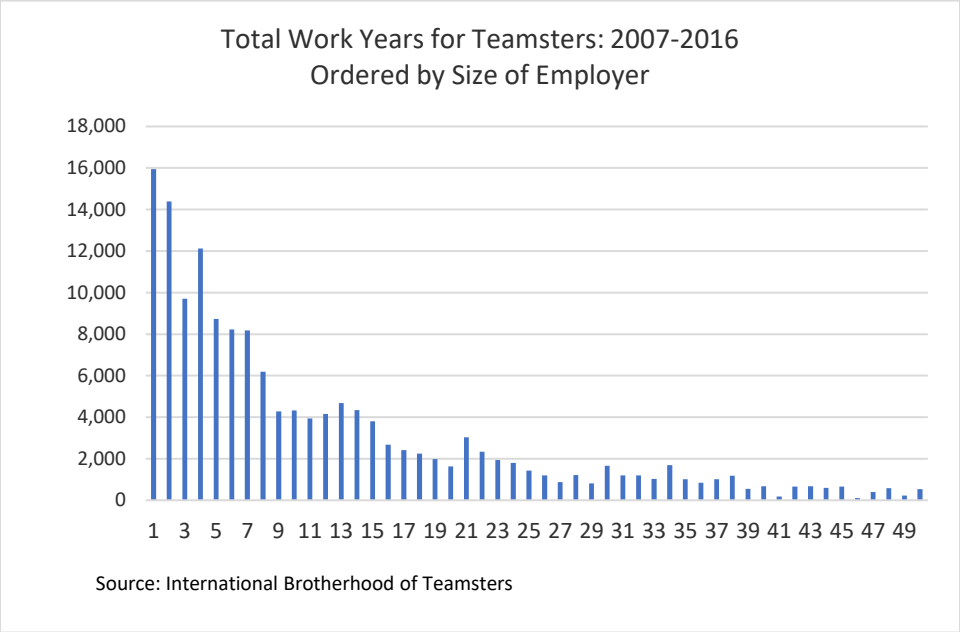
Carpenters -- Total Man-Years -for Pipelines 2006-2015										
	2006	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**
New England	16	19	45	12	9	7	7	6	12	12
Northeast	96	72	79	49	52	97	111	99	84	94
Mid-Atlantic	59	41	42	39	33	38	49	34	37	49
Southeast	18	12	8	7	8	7	7	4	4	5
Great Lakes	100	77	174	90	62	53	52	107	176	180
Midwest	57	43	105	70	44	38	32	44	32	54
Rocky Mountain	21	24	22	13	14	11	19	22	14	12
Southwest	157	140	217	135	127	158	299	328	377	303
West Coast	40	21	22	18	20	22	14	12	11	18
U.S. Totals (29 States)	*564*	*450*	*715*	*434*	*370*	*432*	*590*	*657*	*747*	*730*
% change		*-20%*	59%	-39%	-15%	17%	36%	11%	14%	-2%

Source: Industrial Info Research, LLC.

Appendix C: Work Years by Employer

An interesting aspect of the IBT data is its usefulness in examining the distribution of work years among employers. Typically, a small number of companies account for the vast majority of hours. The case of the Teamsters work on pipelines is no different; of the 199 employers of teamsters with contracts during 2007-2015, the single largest accounted for 9% of workdays with the top twenty-eight accounting for 80% of total activity.

Table A8



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