PETROLMI
LABOUR MARKET ANALYSIS AND INSIGHTS

ENFORM

LABOUR MARKET OUTLOOK 2017 TO 2021

CANADA'S OIL AND GAS INDUSTRY

MARCH 2017

Canada

Funded in part by the Government of Canada's Sectoral Initiatives Program
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Executive Summary

Canada's oil and gas industry is emerging from two years of low oil prices and extensive reductions in spending and jobs with more efficient operations and a leaner and more productive workforce. With less volatile oil prices, rebounding rig counts and government approvals for pipelines and liquefied natural gas (LNG) projects, the industry welcomed 2017 with cautious optimism.

By the end of 2016, Canada's oil and gas direct workforce was reduced to about 174,000 – 25% fewer jobs than 2014 peak levels. After losing an estimated 52,500 direct and thousands of indirect jobs over the past two years, 2017 will be a pivotal year for the industry. A number of factors over the coming months will determine whether oil prices rebound and remain above US$50 per barrel (/bbl) and a modest recovery is truly underway. Should oil prices stay below US$50 for the remainder of 2017, industry is expected to resume cost-cutting measures.

Due to current market uncertainty, the **Labour Market Outlook 2017 to 2021 for Canada's Oil and Gas Industry** report presents workforce projections for two scenarios, generated using PetroLMI's labour forecasting model.

- **Modest Recovery:** oil price averages US$55/bbl in 2017 and increases to US$75 by 2020–2021. Natural gas is between C$2.70 and C$3.25 per gigajoule (/GJ). This results in increased industry spending and employment.
- **Delayed Recovery:** growth is delayed to 2018 as the average oil price averages US$46.50 in 2017 and increases only to US$60 by 2020–2021. Natural gas is between C$2.15 and C$2.55/GJ.

Whether Canada's oil and gas industry experiences a modest or delayed recovery and expands or contracts its workforce in 2017 will influence the labour supply/demand dynamics for the duration of the forecast period.

Exploration and production capital and operating expenditures and industry employment, 2014 to 2021

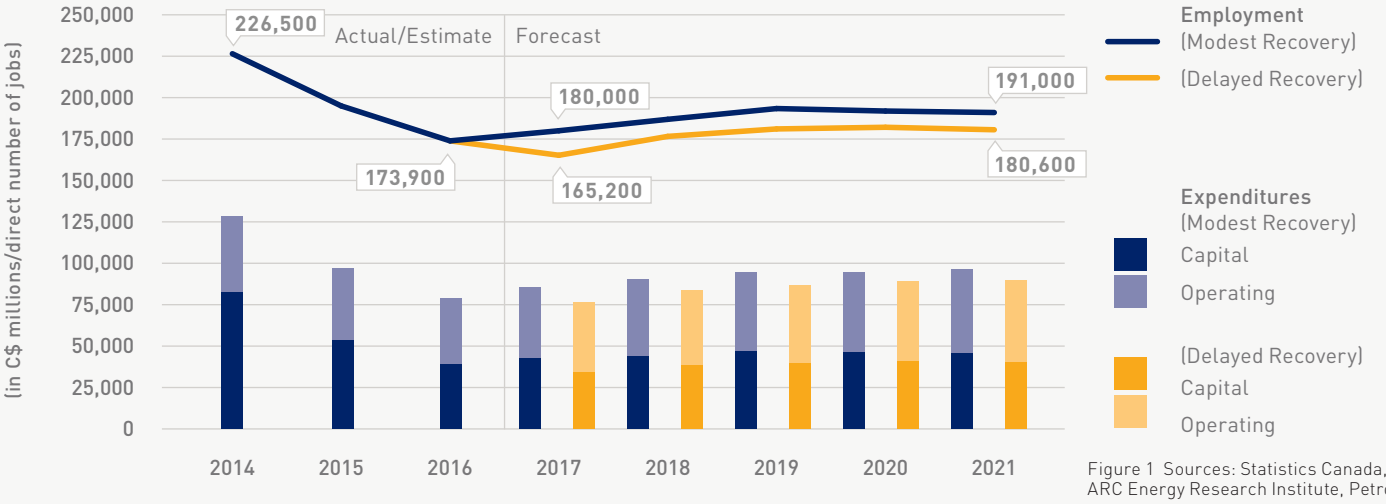


Figure 1 Sources: Statistics Canada, ARC Energy Research Institute, PetroLMI

Note: PetroLMI's forecasting model correlates workforce requirements to "employment drivers" including capital and operating spending within oil sands and non-oil sands (non-oil sands is also labelled as conventional E&P in this report) and oil sands production. These employment drivers differ by industry sector and by occupation. Workforce numbers have been rounded. Refer to scope and methodology and assumptions and scenario setting sections for more details.

Employment outlook to 2021

In a **Modest Recovery** scenario, the industry will require an additional 6,000 workers in 2017 and another 11,100 workers between 2018 and 2021. In total, the industry would create 17,100 net new jobs over the next five years and would experience a stable, average growth rate of 3 to 4% annually. In a **Delayed Recovery** scenario, a third year of low oil prices, would moderate total job gains with 6,700 net new jobs within the five-year forecast. In 2017, 8,700 jobs could be lost as low oil prices result in another round of cost and organizational restructuring. Although job recovery would be delayed by a year in this scenario, the growth rate is significantly higher with industry adding 15,400 new jobs between 2018 and 2021. These projections do not include jobs vacated by age-related attrition.

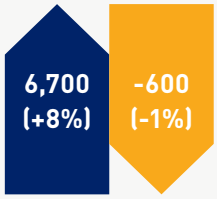
Based on investment and production output projections for the Delayed and Modest Recovery scenarios, an **annual average of 508,000 to 554,000 direct and indirect jobs respectively** will be supported by industry in the next five years. Indirect jobs are primarily in oil and gas engineering and other construction, wholesale and retail trade, professional and consulting services, manufacturing, transportation and other technical and business sectors.

Employment projections by sub-sector

Due to uncertainty regarding the sustainability of oil prices and industry investment, each industry sector is impacted differently over the duration of the forecast period. Neither oil and gas services nor conventional E&P are expected to return to 2014 employment levels regardless of which scenario unfolds. For the oil sands and pipelines sectors job growth is expected starting in 2017, with both sectors surpassing 2014 levels by 2021.

Oil and gas services:

81,500
2016 Estimated Employment
(27,900 jobs lost since 2014)

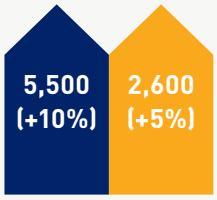


Job Gains/Losses in 2017 – 2021
(**Modest** and **Delayed** Recovery)

2017 will be a challenging year regardless of the scenario. In a Modest Recovery, increases in activity levels may have companies scrambling to find field workers. In a Delayed Recovery, the sector is anticipated to significantly shed jobs in 2017 due to continued restructuring. Although job growth begins in 2018 and is accompanied by labour shortages, the overall employment change from 2016 to 2021 is -1%.

Conventional E&P:

53,800
2016 Estimated Employment
(21,600 jobs lost since 2014)



Job Gains in 2017 – 2021
(**Modest** and **Delayed** Recovery)

Despite adding jobs starting in 2017 in a Modest Recovery and in 2018 for a Delayed Recovery scenario, companies are unlikely to add full-time employees until there is greater confidence that prices and investment are stable. Since E&P occupations do not transfer as easily into other industries, it is anticipated that labour supply will be readily available.

Oil sands:

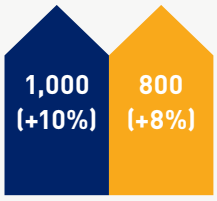
28,900
2016 Estimated Employment
(2,400 jobs lost since 2014)

Job Gains in 2017 – 2021
(**Modest** and **Delayed** Recovery)

Job losses within capital-driven roles in 2017 will be offset by new operations roles as major projects currently under construction are completed and move into production. The sector's focus on operational reliability and efficiency will drive occupational demand between 2018 and 2021.

Pipelines:

9,700
2016 Estimated Employment
(600 jobs lost since 2014)



Job Gains in 2017 – 2021
(**Modest** and **Delayed** Recovery)

Growth in natural gas production is the key differentiator in pipeline employment demand. Implementation of the latest technology, including more automation and further efficiency and productivity gains, could reduce worker requirements further.

Figure 2 Source: PetroLMI

Note: While two scenarios are provided for total industry, oil and gas services, conventional E&P and pipelines, the oil sands sector has one scenario due to only a single set of assumptions for oil sands spending and production. Forecasted oil production does not take into account any pipeline capacity constraints during the five-year period. Natural gas production in the Modest Recovery assumes higher production levels from Western Canada due to additional pipeline capacity.

Age-related attrition

If assumptions regarding retirement rates hold steady, approximately 4,000 direct oil and gas employees may retire in 2017 and approximately 22,000 to 23,000 within the five-year forecast.

Although companies express concern about the loss of experience resulting from two years of workforce reductions, the continued focus on cost containment suggests not all job vacancies resulting from age-related attrition will be filled going forward. Further restructuring may result in the elimination of some of these roles. The implementation of technology, such as automation and digitization, could also reduce the need to fill some vacant positions. Companies surveyed in early February noted that replacing retired workers will depend on the position, type of work involved and availability of other options to accomplish the work. As a result, age-related attrition is not factored into the overall labour demand projections in this report.

Labour supply/demand gaps

The moderate increase in activity levels experienced in the first quarter of 2017 has already created labour shortages for some occupations. As activity levels continue to rise, labour supply/demand gaps will become more widespread particularly in 2018 and 2019 due to two factors:

- The addition of jobs for a number of occupations at a pace greater than the industry average.
- The shrinkage of the labour force due to fewer new workers seeking employment in the industry, and experienced workers leaving for other industries.

In a **Modest Recovery** scenario, hiring difficulties for some occupations begin in 2017 and continue for the duration of the forecast period. In a **Delayed Recovery** scenario, shortages do not occur until 2018; however, they are more acute as even more workers seek employment elsewhere with layoffs continuing for a third consecutive year. The table below highlights the occupations that will have a higher growth rate than industry average and are forecasted to encounter a labour shortage.

Occupations projected to experience hiring challenges in 2017 (Modest Recovery):

- Geological, petroleum and mining technologists
- Industrial electricians
- Inspectors in public and environmental health and safety
- Managers in natural resources production, drilling and well servicing
- Oil and gas drilling, servicing and related labourers
- Oil and gas well drillers, servicers, testers and related workers
- Oil and gas well drilling workers and service operators
- Purchasing agents and officers, including landmen
- Purchasing managers
- Supervisors and contractors, oil and gas drilling and services

Additional occupations expected to experience hiring challenges in 2018–2019, both scenarios:

- Civil engineers
- Geologists and geophysicists
- Heavy equipment operators
- Heavy-duty equipment mechanics
- Industrial and manufacturing engineers
- Instrumentation technicians
- Natural and applied science policy researchers, consultants and program officers
- Petroleum engineers
- Power engineers and power systems operators
- Professional occupations in advertising, marketing and public relations

Note: In the Delayed Recovery scenario, the same occupations listed on the left are projected to undergo hiring challenges beginning in 2018.

Conclusion

Some recovery is projected for Canada's oil and gas industry in the next five years with 6,700 to 17,100 net new jobs created depending on whether a recovery begins in 2017 or 2018. In addition, a portion of the 22,000 to 23,000 job vacancies that are expected due to age-related attrition will contribute to increased hiring activity.

Regardless of whether the industry experiences a Modest or Delayed Recovery, job creation is projected to plateau in 2020 – 2021 due to productivity improvements and industry's limitations to be able to compete in the global energy market – at least within the five-year forecast.

In order to sustain growth beyond 2021, market diversification is required. The United States, traditionally Canada's primary consumer, has fast emerged as a key competitor – for both market share and industry investments. Maintaining a lean and productive workforce, as well as operational efficiencies through innovation and technology, will be key to remaining competitive. Canada's industry will also need to focus on effectively managing the labour and skill shortages that have impacted costs and productivity in the past.

At the same time the oil and gas workforce will play a key role in industry's ability to compete globally. Their technical skills and knowledge will lead to further innovation and the development of technology to facilitate the industry's transition to a global energy supplier while adapting to widening competitive pressures and new carbon regulations.

Introduction

It has been a grueling two years for Canada's oil and gas industry. In response to the steep decline in oil prices that began in late 2014, the exploration and production (E&P) sector reduced its capital spending in 2015 to roughly half of 2014 levels. As oil prices dipped below US$30 per barrel in early 2016, the industry entered a second year of reduced investments.

Companies across the industry also undertook deep cuts to expenses and sought out cost-saving measures in their product lines, assets, workforces, organizational structures and processes. The Fort McMurray wildfires in May 2016 added to the industry's woes by forcing the shut in of many oil sands operations, interrupting an estimated $1 billion of production, while also curtailing the work of service and pipeline operators.

Job losses and continued uncertainty

In alignment with PetroLMI's Lower scenario projections in its April 2016 **Labour Market Outlook 2016 to 2020 for Canada's Oil and Gas Industry** report, approximately 52,500 direct oil and gas jobs were lost in 2015 and 2016, along with thousands of indirect jobs in oil and gas-related construction, manufacturing, transportation and other technical and business sectors. As a result, the oil and gas industry entered 2017 with an estimated employment of 174,000 direct workers, a 25% reduction from the 2014 peak employment level of over 226,500 workers.

Cost restructurings of the past two years resulted in many companies positioning themselves to be profitable at US$50–$55 per barrel (/bbl) of oil. With a less volatile oil price, rebounding rig counts and government approvals for the development of pipelines and liquefied natural gas (LNG) projects, the industry welcomed 2017 with cautious optimism. The industry had repositioned itself to operate in a lower oil price environment. At the same time, however, some market uncertainties remain including infrastructure challenges for Canada's oil and gas industry to compete in the global energy market.

With that, the extent of employment growth for the industry over the next year also remains less certain. This year's report, **Labour Market Outlook 2017 to 2021 for Canada's Oil and Gas Industry**, therefore, considers two potential scenarios based on favourable and less favourable pricing and market conditions and takes into consideration the competitive factors that continue to affect industry activity.

The report provides workforce projections to 2021, including employment projections and corresponding job growth, potential hiring activity resulting from age-related attrition[1] and labour supply opportunities and challenges. Demand and supply forecasts are provided for the total industry as well as by key occupation. Demand projections are also available by sub-sector and are presented in a separate section. Lastly, the impact of oil and gas activity on indirect jobs across Canada is also detailed in the report.

PetroLMI's labour market outlooks are intended to provide information to the oil and gas industry, education and training institutions, and governments to assist with workforce planning, program and policy development. The projections are based on spending and production assumptions at the time of research.

"To be sure, the industry will continue to endure, 'up and down and over and out' in 2017 and beyond. Environmental regulations, cross-border tax differentials, market access, geopolitics, and alternative energy systems are a few of the many challenges facing the industry."

Peter Tertzakian, Executive Director,
ARC Energy Research Institute

[1] Oil and gas companies surveyed do not plan on filling 100% of the job vacancies resulting from workforce retirements. Therefore, unlike previous PetroLMI outlooks, this report does not present Net Hiring Requirements (i.e., hiring due to industry expansion plus age-related attrition).

Scope and methodology

PetroLMI's labour market projections are produced using a modelling system developed in 2006 and continuously refined in consultation with industry, labour market economists and workforce planning analysts.

The model produces labour demand projections for the upstream and midstream oil and gas industry (i.e., yearly employment, expansion and replacement demand) by sector and by occupation.[2] The model also projects potential labour supply and unemployment rates for the total industry and by occupation to help identify labour supply/demand gaps and opportunities.

- **Employment:** number of direct workers required to support industry production and spending levels.
- **Expansion demand:** also referred to as *employment (or job) growth or contraction*, is the change in employment levels or new jobs created or lost between two periods plus adjustments.
- **Replacement demand:** also defined as *age-related attrition*, denotes the number of jobs vacated due to retirements and natural deaths among the oil and gas labour force.
- **Labour supply/demand gap:** comparison of industry's potential labour supply against its labour demand to determine whether industry will experience a labour surplus or shortage. Measured in terms of projected unemployment rate relative to the balanced unemployment rate.

In-scope occupations

The model is able to produce labour market projections for 48 occupations considered core to Canada's upstream and midstream sectors, which account for 65% of the industry's current workforce. The occupations have been mapped to the National Occupational Classification (NOC) 2011 version.

An "other occupations" category captures the residual workforce (remaining 35%) and is the sum of all other occupations directly employed within industry. This methodology ensures the total industry workforce is captured within the forecast and also enables PetroLMI to provide occupational projections and analysis. Refer to Appendix 1 for sample job titles within the 48 and "other" occupations detailed in the model.

Employment and expansion demand

To project employment, the model starts with baseline employment numbers derived from Statistics Canada and/or direct industry surveys then uses 'employment drivers' to identify the required workforce levels to support the level of industry activity (i.e., spending and/or production) in a given year. The model does this by sector and occupation with some adjustments for labour productivity and other factors.

Industry Sector	Employment Drivers				
	Conventional E&P CAPEX	Conventional E&P OPEX	Oil sands CAPEX	Oil sands OPEX	Oil sands production
Oil and gas services: contracted exploration, extraction and production services to the oil sands and non-oil sands E&P sectors and includes the following sub-sectors: • **Drilling and completion services**, including drilling and service rig activities • **Geophysical services** (also known as seismic) including survey, permitting and reclamation, line construction and data acquisition • **Petroleum services** pertain to oilfield services including, but not limited to, acidizing wells, cementing and perforating well casings, well testing and servicing, pumping, and oil well logging.	●	●	●	●	
Conventional E&P: exploration and production of oil and gas for onshore and offshore conventional and unconventional reserves except oil sands.	●	●			
Oil sands: involves the extraction, production and upgrading of bitumen specifically within mining, in situ and upgrading operations.			●		●
Pipelines: storage and mainline transmission of oil and gas.		●		●	

Table 1 Notes:

CAPEX = capital expenditures; OPEX = operating expenditures, both adjusted to take out inflation which does not create jobs.

Oil sands production forecast was sourced from the Canadian Association of Petroleum Producers' Crude Oil Production Forecast released June 23, 2016 and adjusted to disregard the production drop resulting from the Fort McMurray wildfires since the temporary shut-ins did not directly result in permanent operations layoffs.

Sectors considered out-of-scope: downstream, LNG construction and operations, construction including engineering, manufacturing, truck transportation, professional, technical and scientific services, financial, etc.

[2] For the purpose of this report, total industry and sub-sector workforce numbers are rounded to the nearest hundreds except for pipelines which are for the most part rounded to the nearest 10 or 50 as appropriate (due to smaller numbers). Occupational projections are rounded to the nearest five with some exceptions as noted in the report. Accordingly, numbers may not add up.

Replacement demand

The model uses historical, average retirement age and takes into account the age demographic trends of each occupation in scope to forecast yearly age-related attrition rates. These are then applied to the labour force numbers for each occupation to derive the potential number of job openings due to replacement demand.

Labour supply and demand/supply gaps

PetroLMI's labour supply model starts with the industry's historical share of Canada's labour supply and then calculates the industry's potential supply based on its ability to attract workers through its offer of employment or labour demand as it relates to competition from other industries. Two labour supply sources are considered:

- **New entrants:** workers entering the labour force for the first time.
- **In-mobility:** workers that are changing careers part way through their work life, including changing industries and/or occupations and immigrating to Canada (excludes temporary foreign workers).

Labour supply/demand gaps are assessed by comparing industry's projected unemployment rates with the balanced unemployment rate for the occupation or industry overall. For industry overall, the balanced unemployment rate is determined to be 6%. At the occupational level however, the balanced unemployment rate varies. A labour surplus is assumed if the projected unemployment rate is above the balanced unemployment rate. Conversely, a labour shortage is expected if the unemployment rate falls below the balanced rate.

Assumptions and scenario setting

Due to current uncertain market conditions, two sets of industry workforce projections based on different commodity pricing, natural gas production and conventional E&P spending scenarios are presented in this report. Assumptions for oil production output (both conventional and oil sands) and oil sands capital and operating expenditures are the same for both scenarios. The two scenarios for this outlook report include:

- **Modest Recovery:** assumes more favourable pricing and market conditions, resulting in increased industry spending starting in 2017.
- **Delayed Recovery:** growth is delayed to 2018 as oil price averages below US$50 in 2017, causing further declines in conventional E&P capital spending.

The following table outlines the key differences between the scenarios from 2017 to 2021:

Modest Recovery:

Favourable commodity prices encourage a 40% increase in capital investment in the conventional E&P sector in 2017 and a 52% increase overall to 2021.

Oil

Oil price averages US$55/bbl in 2017 and increases to $75 by 2020–21.

Oil supply/demand balance is achieved in 2017 as material cuts to global production occur within OPEC and non-OPEC countries.

Natural gas

Average annual AECO Price is between C$2.70 to $3.25/GJ.

Natural gas demand grows as Canada maintains its current markets and sees growth in industrial demand. Also assumes higher production levels from Western Canada due to additional pipeline capacity.

Delayed Recovery:

Capital investment in the conventional E&P sector declines another 1% in 2017 due to lower commodity prices but increases overall by 25% to 2021.

Oil

Average oil price averages US$46.50/bbl in 2017 but increases to $60 for 2020–21.

Global oil market continues to be oversupplied in 2017 as target production cuts are not met but market conditions improve in 2018.

Natural gas

Average annual AECO Price is between C$2.15 to $2.55/GJ.

Natural gas output is relatively flat to 2021 with slower demand from current markets offset by increased industrial demand.

Notes:

Oil price in US$/bbl WTI; Natural gas price in C$ per gigajoules, AECO Hub Price Index.

Sources:

Pricing and expenditure forecasts supplied by ARC Energy Research Institute as of January 10, 2017 which incorporates the production outlook from the Canadian Association of Petroleum Producers' June 2016 Crude Oil Forecast, Markets and Transportation report.

PetroLMI conducted industry consultations in December 2016 and January 2017 to confirm the two scenarios, assumptions and resulting labour demand projections and analysis.

Both scenarios share the following projections for the forecast period from 2017 to 2021:

- **Conventional E&P:** operational spending remains relatively flat from 2016 to 2021. Sector spending does not reach 2014 levels within the forecast period.
- **Natural gas:** growth in investment and production is required to support the transition from coal-fired electricity generation, as well as increased industrial usage, particularly in the oil sands. A small LNG plant[3] is expected to be operational before the end of the forecast period, however, it does not drive increased natural gas production beyond current supplies.
- **Oil sands:** expansion projects under construction prior to 2014 will transition into operations, driving a 31% increase in oil sands production through to 2021. No new major oil sands projects are anticipated within the forecast period. The majority of oil sands capital spending declines as the sector shifts its focus to maintenance, repair and optimization of operations in order to drive operational reliability and efficiency. 2016 marked a turning point for oil sands as operating expenditures outpaced capital expenditures for the first time since 2009.

2017 – A PIVOTAL YEAR FOR CANADA'S OIL AND GAS INDUSTRY

In the first quarter of 2017, oil prices were trending around US$50/bbl, prompting increased levels of industry spending and activity. Whether this trend continues or swings downward in the months ahead, it positions 2017 as a pivotal year for Canada's oil and gas industry.

There are a number of factors at play. The Organization of the Petroleum Exporting Countries' (OPEC) cuts in oil production was the main driver behind the oil price increases. Achieving an average annual oil price well above US$50/bbl in 2017 will depend on how the world's oil producers address the supply imbalances that began in 2014. As the price increases, producers from all jurisdictions will likely look to generate more revenues by increasing production.

If an oversupply of oil is re-established in 2017 driving oil prices to average well below US$50/bbl, further delay in Canada's oil and gas industry recovery is expected. A third year of lower oil prices would stall investment and production growth until demand outpaces supply. Oil prices would start increasing in 2018.

Regardless of which direction oil prices are headed, continued productivity and efficiency improvements will be essential for industry profitability and could impact investment. The industry is transitioning due to carbon regulation. Market diversification remains critical to Canada's ability to compete and while government approvals on potential pipeline and LNG projects are encouraging, final investment decisions have not yet been made on these large, game-changing projects. All of this will impact the industry's hiring needs and challenges to 2021.

E&P (conventional and oil sands) spending to 2021

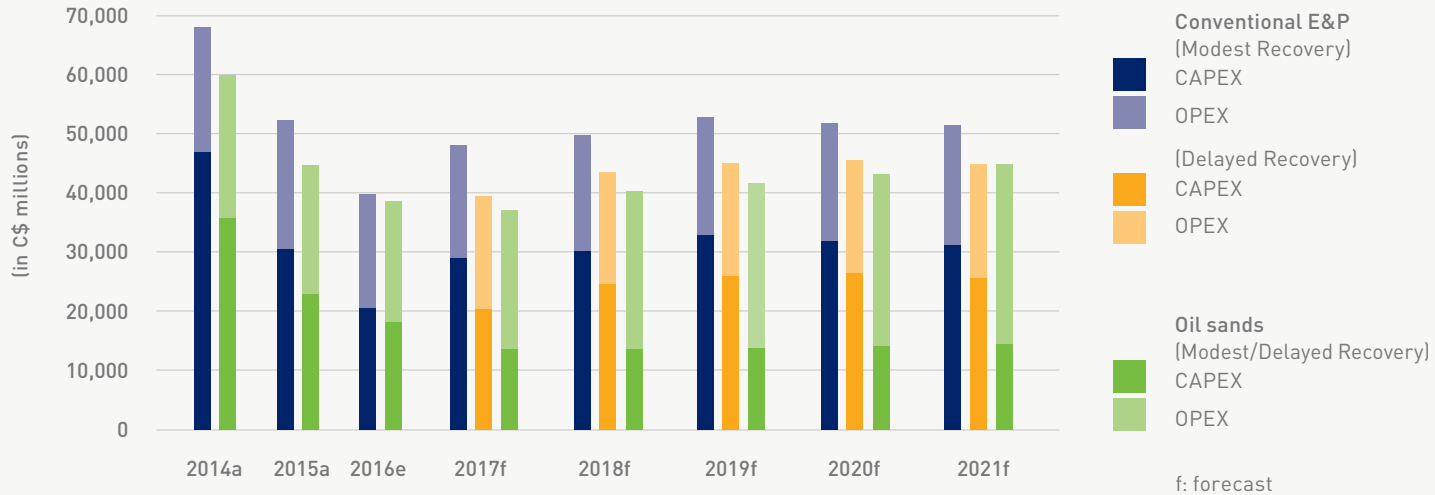


Figure 3 Sources: ARC Energy Research Institute for oil sands and conventional E&P spending projections (October 2016 and January 2017 respectively) and Statistics Canada and CAPP for actual spending numbers.

[3] The workforce required to construct and operate a small LNG (liquefied natural gas) facility is not included in PetroLMI's workforce projections. Refer to Exploring LNG in Canada report, published in April 2016 for LNG-specific workforce requirements.

Industry-wide Labour Market Outlook to 2021

Job cuts in 2015 and 2016 resulted in improved operational efficiency and increased workforce productivity.

The two scenarios presented in this report reflect the current market uncertainty for the Canadian oil and gas industry and as a result show diverging employment projections. If the **Delayed Recovery** scenario plays out, a third year of decline in industry investment is expected to result in further job cuts in 2017 followed by job gains in 2018. This scenario results in significantly less employment growth overall than anticipated in the **Modest Recovery** scenario, which reflects job gains beginning in 2017. Regardless of which scenario unfolds, however, overall growth in industry employment is not expected to fully recover or return to 2014 levels within the forecast period.[4]

Both scenario projections presented in this report trend below last year's **Labour Market Outlook 2016 to 2020's** Lower scenario (published in April 2016 and illustrated in the graph below), in part, due to a reset by industry on the level of productivity and lower forecasted spending. Companies are expected to continue to look for ways to create efficiencies, further improve productivity and make concerted efforts to maintain leaner workforces.

In the graph below, a slight decrease in employment during the latter portion of the forecast period in both scenarios is due to assumptions that:

- Labour productivity improvements will continue through to 2021; and,
- Companies will be hesitant to invest in additional production increases due to uncertainty in accessing new markets.

If the industry is able to sustain profitability through effective cost management and has greater access to markets within and beyond North America, the employment demand could increase from what is currently projected in the forecast period.

Oil and gas direct employment, 2014 to 2021

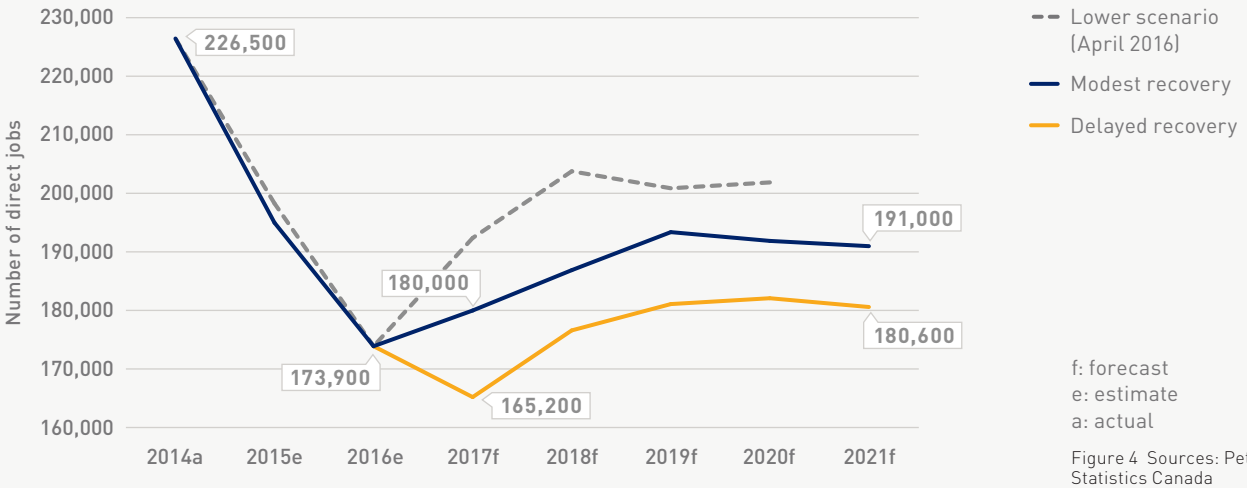


Figure 4 Sources: PetroLMI; Statistics Canada

[4] Although the oil and gas industry is not expected to regain the estimated 52,500 direct jobs lost in 2015/16 within the forecast period, from a sub-sector analysis, the oil sands and pipelines sectors are expected to fully recover and exceed their respective 2014 employment levels. Refer to pages 15 to 27 for the Sector Analysis section.

Expansion demand dependent on what happens in 2017

Whether the oil and gas industry's employment increases or declines in 2017, it will directly influence the labour supply/demand dynamics for the duration of the forecast period. These dynamics present a key planning consideration for workforce and career planners, job seekers and trainers. The following chart provides a summary of the estimated expansion demand to 2021 in both scenarios.

Oil and gas expansion demand summary

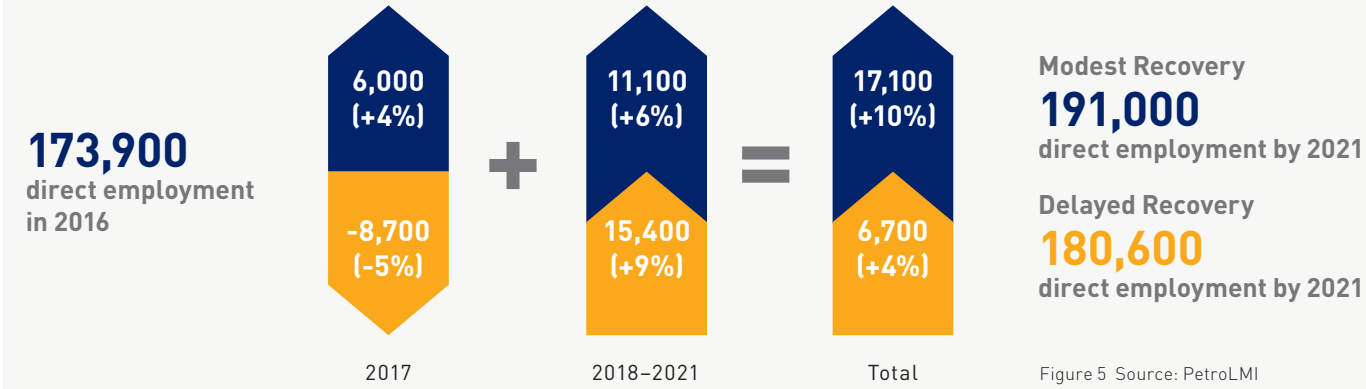


Figure 5 Source: PetroLMI

Modest Recovery scenario

In the **Modest Recovery** scenario, it is projected that a large proportion of new jobs will be added in the early years of the forecast period.

If oil prices continue to increase through 2017 and investment is encouraged, the industry will require about 6,000 additional workers in the year. It is anticipated that companies will implement a variety of talent strategies to address their hiring needs[5], while simultaneously mitigating risks related to cost and productivity, including:

- Recalling experienced workers
- Enhancing employee engagement and productivity
- Developing existing staff to take on additional responsibilities and/or new positions
- Using a flexible workforce that can ramp up and down as required and address peak activity levels
- Contracting workers until there is greater confidence that higher levels of industry activity can be sustained.

In this scenario, employment growth will continue from 2018 to 2021 and the industry would gain an additional 11,100 (+6%) new jobs. This results in a total employment gain of 17,100 new jobs between 2017 and 2021 and a stable annual growth rate of 3–4%, plateauing in 2020–2021.

Occupations with greatest job gains in 2017 (Modest Recovery scenario):

1. Supervisors and contractors, oil and gas drilling and services
2. Oil and gas well drillers, servicers, testers and related workers
3. Oil and gas well drilling workers and service operators
4. Oil and gas drilling, servicing and related labourers
5. Purchasing agents and officers, including landmen
6. Managers in natural resources production, drilling and well servicing
7. Heavy equipment operators (except crane)
8. Power engineers and power systems operators
9. Geologists and geophysicists
10. Geological, petroleum and mining technologists

[5] 2017 Industry HR Trends of 36 oil and gas companies representing close to 80,000 direct workers in Canada.

Delayed Recovery scenario

In a **Delayed Recovery** scenario, job growth would not commence until 2018. But when it does, it will occur at a higher rate than in the **Modest Recovery** scenario.

A third year of oil prices averaging well below US$50 is likely to result in another round of restructuring through divestitures, mergers and acquisitions and dissolutions. In this scenario, an additional 8,700 jobs could be lost in 2017. After three years of job cuts and workers seeking employment elsewhere or pursuing other opportunities it is expected there will be a smaller pool of available labour to hire from when activity picks up.

In this scenario it is assumed that oil supply/demand balance will be achieved in 2018, and the industry will restore investment and activity to meet demand. As production output increases, employment demand will also grow between 2018 and 2021, with 15,400 new jobs created. While a prolonged downturn would moderate overall job gains of 6,700 during the forecast period, the pace of growth from 2017 to 2018 would be about 7% – almost double the growth rate projected in the **Modest Recovery** scenario. Companies will not only need to hire for some occupations more quickly, they will also need to hire them in greater numbers.

Occupations with greatest job losses in 2017 (Delayed Recovery scenario):

1. Oil and gas well drillers, servicers, testers and related workers
2. Supervisors and contractors, oil and gas drilling and services
3. Managers in natural resources production, drilling and well servicing
4. Truck drivers
5. Petroleum engineers
6. Oil and gas well drilling workers and service operators
7. Geologists and geophysicists
8. Oil and gas drilling, servicing and related labourers
9. Purchasing agents and officers including landmen
10. Millwrights

Top 10 occupations with greatest expansion demand from 2017 to 2021, in both scenarios

Occupation (NOC 2011)	**2016 Estimated Employment**	**Scenario**	**Expansion Demand** (% growth/decline)		
			2017	**2018–2021**	**Total**
Total industry	**173,900**	**Modest**	**6,000** (+4%)	**11,100** (+6%)	**17,100** (+10%)
		Delayed	**-8,700** (-5%)	**15,400** (+9%)	**6,700** (+4%)
Supervisors and contractors, oil and gas drilling and services (8222)	7,940	Modest	860 (+11%)	625 (+7%)	1,480 (+19%)
		Delayed	-450 (-6%)	1,080 (+14%)	630 (+8%)
Oil and gas well drillers, servicers, testers and related workers (8232)	10,600	Modest	825 (+8%)	550 (+5%)	1,375 (+13%)
		Delayed	-475 (-4%)	980 (+10%)	505 (+5%)
Heavy equipment operators (except crane) (7521)	8,565	Modest	225 (+3%)	980 (+11%)	1,205 (+14%)
		Delayed	-120 (-1%)	1,075 (+13%)	955 (+11%)
Power engineers and power systems operators (9241)	6,735	Modest	175 (+3%)	750 (+11%)	925 (+14%)
		Delayed	75 (+1%)	770 (+11%)	845 (+13%)
Oil and gas well drilling workers and service operators (8412)	4,690	Modest	480 (+10%)	315 (+6%)	795 (+17%)
		Delayed	-250 (-5%)	570 (+13%)	320 (+7%)

Occupation (NOC 2011) **(cont.)**	**2016 Estimated Employment**	**Scenario**	**Expansion Demand** (% growth/decline)		
			2017	**2018–2021**	**Total**
Purchasing agents and officers including landmen (1225)	3,290	Modest	295 (+9%)	420 (+12%)	710 (+22%)
		Delayed	-215 (-7%)	565 (+18%)	350 (+11%)
Managers in natural resources production, drilling and well servicing (0811)	5,075	Modest	260 (+5%)	375 (+7%)	635 (+13%)
		Delayed	-410 (-8%)	590 (+13%)	180 (+4%)
Oil and gas drilling, servicing and related labourers (8615)	5,390	Modest	365 (+7%)	260 (+5%)	625 (+12%)
		Delayed	-220 (-4%)	450 (+9%)	230 (+4%)
Geologists and geophysicists (2113)	3,550	Modest	160 (+4%)	255 (+7%)	410 (+12%)
		Delayed	-245 (-7%)	380 (+12%)	135 (+4%)
Heavy-duty equipment mechanics (7312)	2,860	Modest	70 (+3%)	280 (+10%)	355 (+12%)
		Delayed	-80 (-3%)	325 (+12%)	245 (+9%)
Petroleum engineers (2145)	3,970	Modest	90 (+2%)	270 (+7%)	355 (+9%)
		Delayed	-255 (-6%)	375 (+10%)	120 (+3%)

Table 2 Source: PetroLMI

Notes: The top 10 occupations represent 36% of industry's workforce in 2016 and almost 50% of total expansion demand in the Modest Recovery scenario. Numbers may not add up due to rounding. Refer to Appendix 2 for the detailed list of occupational projections for the industry.

Age-related attrition impacted differently by two years of employment cuts

PetroLMI's model projects that about 22,000 to 23,000 direct oil and gas workers may retire between 2017 and 2021 if historical retirement rates and workforce demographics remain steady. In 2017 alone, the industry could experience over 4,000 retirements.

Retirement eligibility is relatively similar regardless of which scenario; however, the rate and timing of replacing retirees is expected to differ. Replacement would commence in 2017 and continue for the duration of the forecast period in the **Modest Recovery** while in the **Delayed Recovery** scenario, it is assumed the majority of the positions vacated by retirees in 2017 would be absorbed as the industry looks to survive a third year of low oil prices.

In previous PetroLMI outlooks when the industry was anticipating rapid growth, it was assumed that positions vacated by retirements would be filled and add to industry's hiring requirements. However, in the current climate this is not the case. In 2015 and 2016, many of the positions vacated by retirements were not filled as part of company strategy to reduce costs and create a leaner workforce. In a survey of oil and gas companies in early February 2017,[6] companies indicated that any decision to fill a job vacancy due to a retirement would be assessed based on the position, type of work involved and availability of other options to accomplish the work.[7] Some of these companies expressed concerns about the loss of experience resulting from two years of workforce reductions and a further loss of experience due to age-related attrition and that could be a consideration in deciding whether to replace a retiring worker.

Individual company consultations provided some insights into strategies to address retirements at an occupational level:

- **Supervisors and managers:** Over one-quarter of the positions that could be potentially impacted by age-related attrition during the forecast period are at the supervisory or managerial level. Companies indicated that if it is necessary to fill these positions, internal succession planning will play a key role. Further restructuring to maintain a lean organization may result in the elimination of some of these positions.

[6] **2017 HR Trends and Insights** survey of 36 oil and gas companies representing close to 80,000 direct workers.

[7] As a result and with the exception of the labour demand tables in the appendices, age-related attrition is not combined with expansion demand to present a net hiring requirement for the industry.

- **Operators:** About one-third of the positions impacted would be operators, including drillers, oil and gas services operators, and field, plant and pipeline operators. Since these positions tend to be directly related to a company's profitability, employers said they will carefully consider whether to fill the role or transfer the duties and responsibilities to other positions. The implementation of technology, such as automation and digitization, could decrease the need to backfill some of these positions.
- **Engineers:** Engineering roles are a relatively small percentage of the industry's overall age-related attrition projections. However, many engineers provide industry-specific technical knowledge and skills. Companies looking to implement innovation and efficiencies will closely monitor the impact any further loss of experienced engineers will have on productivity. This may drive some replacement of retiring engineers.
- **Trades:** Trade vacancies will also be carefully assessed due to their importance in maintaining and optimizing oil and gas operations. Companies may transfer duties and responsibilities to other positions when possible. The implementation of technology, such as automation and digitization, could reduce the need to fill some vacant positions.

Positions vacated within occupations from other job categories or groups will be considered on a case-by-case basis. The chart below illustrates year-over-year age-related attrition during the forecast period, broken down by occupational group.

Summary of potential age-related attrition by year and by occupational grouping in Modest Recovery scenario*

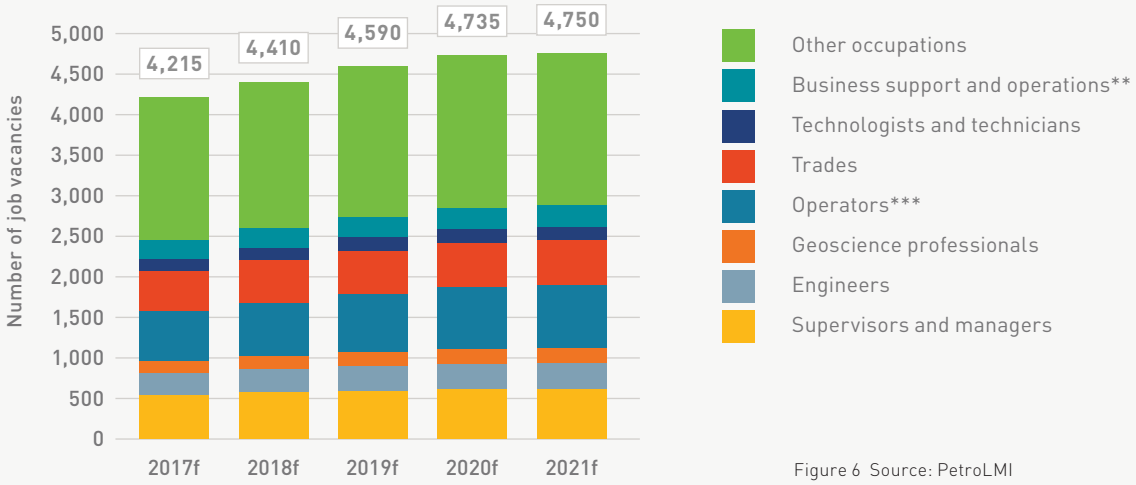


Figure 6 Source: PetroLMI

Notes:
* Based on core occupations included in PetroLMI's labour modeling system plus "other occupations" category, which is comprised of a number of occupations belonging to the different occupational groupings.
** Includes occupations such as supply chain, inspectors, environment, health & safety professionals, marketing and public relations.
*** Includes occupations such as drillers, well servicing, field, plant and pipeline operators.
Refer to Appendix 2 for projected age-related attrition by occupation.

Labour supply/demand gaps expected within the forecast period

Labour surpluses are expected to continue for the majority of oil and gas occupations throughout 2017. As projected in the industry-wide outlook report released in April 2016, however, the modest increase in activity levels experienced in the first quarter of 2017 has already created labour shortages for certain occupations. As activity levels intensify and growth is sustained year-over-year, labour gaps could deepen and become more widespread.

In the **Modest Recovery** scenario, hiring difficulties for some occupations begin in 2017 and continue for the duration of the forecast period. Labour shortages are not projected in the **Delayed Recovery** scenario until 2018, but the shortage could be more acute as the industry's labour force further shrinks as another year of workforce reductions forces displaced workers and potential new entrants to seek employment in other industries. In both scenarios, the industry's unemployment rate is projected to fall below 2014 levels for the duration of the forecast period.

Oil and gas unemployment rates to 2021

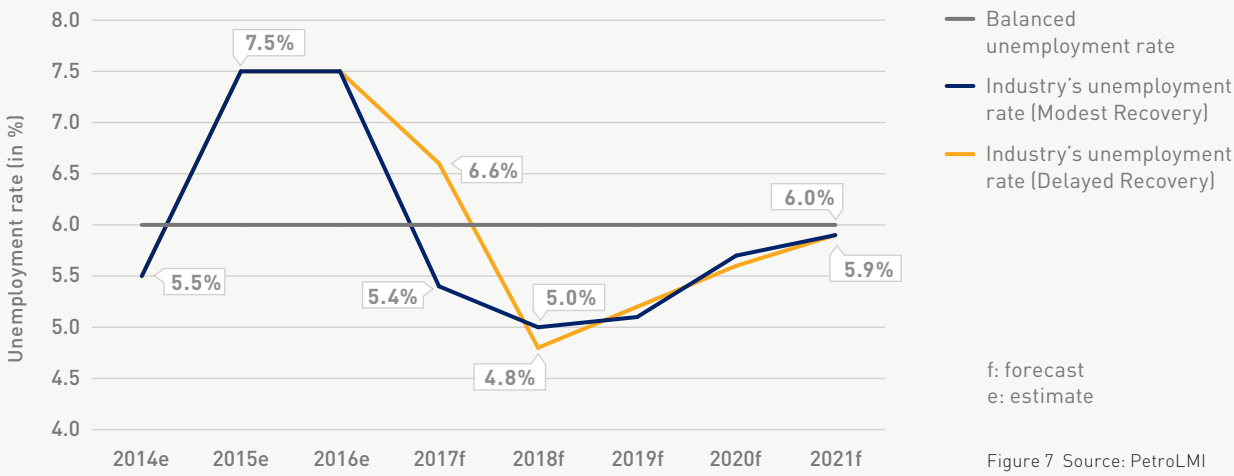


Figure 7 Source: PetroLMI

Note: Industry's labour supply/demand gaps are assessed by comparing the industry's projected unemployment rates with what is considered to be the balanced unemployment rate for the occupation or industry overall. For the total oil and gas industry, the balanced unemployment rate is determined to be 6%. A labour surplus is assumed if the projected unemployment rate is above the balanced unemployment rate. Conversely, a labour shortage is expected if the unemployment rate falls below the balanced rate.

Attracting workers may prove difficult

The magnitude of the layoffs in the oil and gas and related industries in the last two years has impacted the industry's ability to attract workers. Job seekers turned to industries perceived to have more employment stability. In addition, the attraction and retention strategies previously used, such as above-average compensation and benefits packages, have changed significantly due to cost-cutting measures.

Going forward, the oil and gas industry is at risk of experiencing attraction and retention issues for certain occupations due to a combination of: the addition of jobs for these occupations at a pace greater than the industry average and labour shortages.

In the **Modest Recovery** scenario, the labour supply/demand gaps begin almost immediately due to the 40% increase in capital spending projected for 2017 and significant growth for the occupations that saw higher numbers of workers leaving the workforce in 2015 and 2016.

In the **Delayed Recovery**, labour market tightness is expected to return for the majority of the industry's occupations in 2018. Steeper growth in activity levels and employment will occur, as the industry ramps up to address depleting oil and gas supplies.

"With the unemployment rates where they are now [and] with the downsizing that went on in our business, we anticipated that there would be a number of people champing at the bit to get back to work. [But] we're finding that there's not as big an appetite for a lot of those people to come back to the oil patch ... which is unfortunate."

Rob Cox, Vice President of Canadian Operations, Trican Well Service

The following table identifies those occupations that are projected to experience hiring challenges due to the combination of a greater than average employment growth rate and/or a tight labour market, particularly in 2018 and 2019, in both scenarios.

Occupation (NOC)	2017 in Modest Recovery scenario*		2018–2019 Both scenarios	
	Above average growth	Labour shortage	Above average growth	Labour shortage
Civil engineers (2131)				●
Engineering managers (0211)			●	
Facility operation and maintenance managers (0714)			●	
Geological, petroleum and mining technologists (2212)	●	●	●	●
Geologists and geophysicists (2113)			●	●
Heavy equipment operators (except crane) (7521)	●		●	●
Heavy-duty equipment mechanics (7312)			●	●
Industrial electricians (7242)	●		●	●
Inspectors in public and environmental health and safety (2263)	●	●		●
Instrumentation technicians (2243)		●	●	●
Managers in natural resources production, drilling and well servicing (0811)	●		●	●
Natural and applied science policy researchers, consultants and program officers (4161)			●	●
Oil and gas drilling, servicing and related labourers (8615)	●	●	●	●
Oil and gas well drillers, servicers, testers and related workers (8232)	●	●	●	●
Oil and gas well drilling workers and service operators (8412)	●	●	●	●
Petroleum engineers (2145)			●	●
Power engineers and power systems operators (9241)	●		●	●
Professional occupations in advertising, marketing and public relations (1123)			●	●
Industrial and manufacturing engineers (2141)			●	●
Purchasing agents and officers including landmen (1225)	●	●	●	●
Purchasing managers (0113)	●			●
Supervisors and contractors, oil and gas drilling and services (8222)	●	●	●	●

Table 3 Source: PetroLMI

*Also in 2018 for the Delayed Recovery scenario. Refer to Appendix 7 for projected unemployment rates by occupation.

Oil and Gas Sub-Sector Analysis

Oil and gas employment losses during 2015 and 2016 were deep and extended to indirect jobs including construction, manufacturing, transportation and professional consulting positions.

Overall, in terms of direct employment, the oil and gas services sector experienced the greatest number of job losses, while the conventional E&P sector experienced the greatest percentage decline in employment. Oil sands operations realized job losses for the first time in their history. The pipelines sector, meanwhile, which had ramped up employment in anticipation of major infrastructure expansions, also reduced their workforces as projects were delayed.

Due to the current uncertain market conditions, projections for the oil and gas services and the conventional E&P sectors show that neither is expected to return to 2014 employment levels during the forecast period. Job growth is projected for the oil sands and pipelines sectors starting in 2017, and employment for both of these is anticipated to surpass 2014 levels by 2021.

Oil and gas employment to 2021, by sub-sector

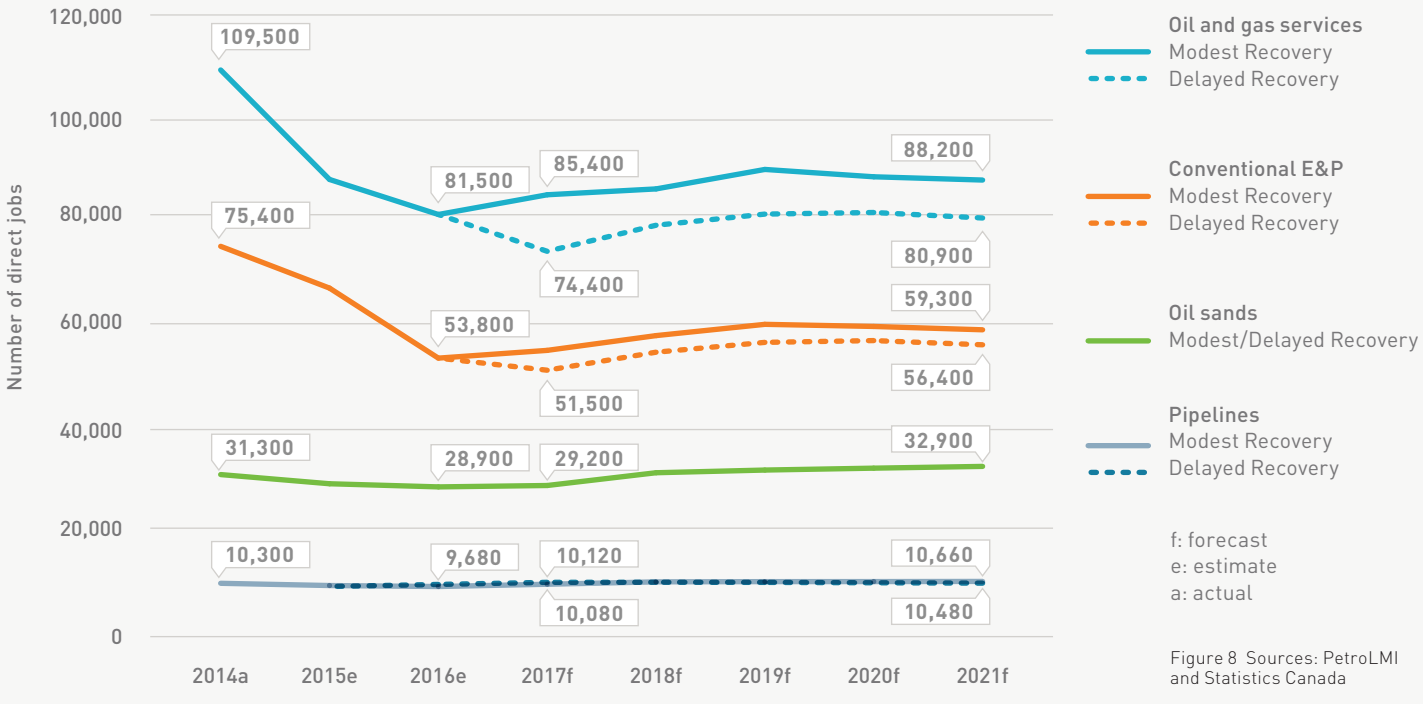


Figure 8 Sources: PetroLMI and Statistics Canada

Oil and gas services

By the end of 2016, the oil and gas services sector directly employed 81,500 workers. 2017 will be a challenging year regardless of the scenario for this sector, having lost 26% of its workforce in the two years prior. A number of occupations are forecast to experience labour shortages. In a survey of oil and gas companies in early February 2017, almost all service company respondents reported difficulties filling job vacancies. Companies indicated that some workers have been recalled and other positions have been filled through internal redeployments and transfers, but overall companies are challenged from an attraction and recruitment perspective. As a result, oil and gas services is the only sector contemplating compensation increases to address employee attraction and retention concerns.

"You'd think there are people looking for jobs now, but we struggle worse now than [we] ever did at our busiest point looking for people."

Abby Kradovill, Safety Co-ordinator, Miller Well Services

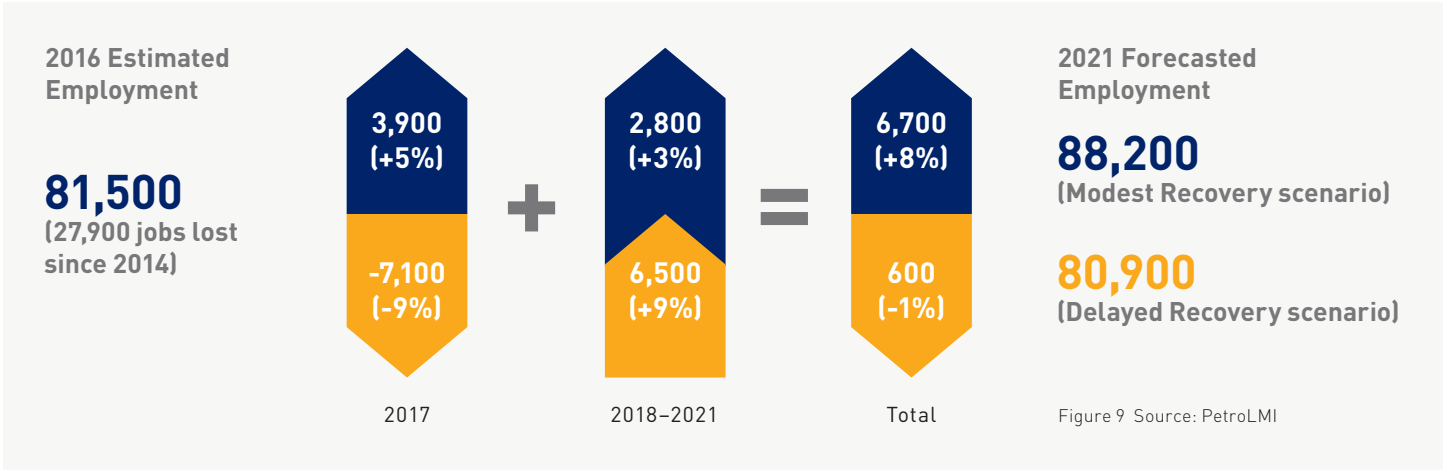


Figure 9 Source: PetroLMI

Modest Recovery scenario

In this scenario, the oil and gas services sector would add approximately 6,700 new jobs by the end of the forecast period, with more than half of the job gains in the early years.

In 2017 alone, the sector would create about 3,900 new jobs. The sector's employment growth rate flattens in the medium-term, but the sector still gains an additional 2,800 new jobs between 2018 and 2021.

Delayed Recovery scenario

In this scenario, the sector experiences additional job losses in 2017 and only partially regains these from 2018 to 2021. As a result, the sector loses 600 jobs overall within the forecast period.

As a result of a third year of low prices there is further restructuring through divestitures, mergers and acquisitions, and company dissolutions. Employment projections suggest about 7,100 additional job losses in 2017. Increased activity and investment between 2018 and 2021, will compel companies to ramp up quickly to address production demand and the sector's workforce could increase by over 6,500 new jobs. This is likely to intensify labour shortages.

Age-related attrition could contribute to additional hiring needs

Up to 10,000 oil and gas service workers could retire within the forecast period. With concerns about the loss of experienced workers due to the downturn, retirement vacancies directly related to generating revenue, such as operators and trades, are more likely to be filled. Companies may also view age-related attrition as an opportunity to recruit workers with the technology skills that will be necessary in digitized oil and gas fields.

Occupations with greatest job gains expected in 2017 (Modest Recovery):

1. Oil and gas well, servicers, testers and related workers
2. Supervisors and contractors, oil and gas drilling and services
3. Oil and gas drilling workers and service operators
4. Oil and gas drilling, servicing and related labourers
5. Geologists and geophysicists
6. Managers in natural resources production, drilling and well servicing
7. Geological, petroleum and mining technologists
8. Truck drivers
9. Heavy equipment operators (except crane)
10. Millwrights

Occupations with greatest job losses in 2017 (Delayed Recovery):

1. Oil and gas well, servicers, testers and related workers
2. Managers in natural resources production, drilling and well servicing
3. Supervisors and contractors, oil and gas drilling and services
4. Truck drivers
5. Heavy equipment operators
6. Millwrights
7. Oil and gas well drilling workers and service operators
8. Oil and gas drilling, servicing and related labourers
9. Welders
10. Petroleum engineers

Innovation, efficiencies and their impact on the services sector

The oil and gas industry overall has improved its profitability by imposing cost cuts and efficiency gains on the oil and gas services sector in the last two years. Further reduction of service sector fees is not sustainable. Any additional cost, efficiency and productivity improvements are likely to come from innovation and technological advancements.

Occupational demand closely aligns, therefore, with the implementation of oil and gas drilling and service technology. The use of multi-pad horizontal drilling, multi-stage hydraulic fracturing and data collection technologies that increase production, while decreasing time and costs, have been accelerated during this downturn. The impact of innovative technology on the oil and gas services workforce includes the following:

- Multi-pad horizontal drilling takes longer but requires fewer rigs and therefore fewer drillers. The decrease in well pad and road construction has the most impact on heavy equipment operators – fewer rig moves means fewer requirements for trucks and drivers.
- Hydraulic fracturing is both equipment and labour intensive, increasing the need for fracturing operators, and truck drivers hauling sand and fluid.
- Increased digitization of the industry to enhance drilling and completions accuracy and productivity drives the need for data analytics and interpretation roles.

Going forward, the oil and gas services sector could see additional hiring if conventional E&P and oil sands companies address increased capital-related activity with the use of third-party contractors. Geological, engineering and trades occupations would see the greatest increase from the implementation of this strategy.

"We do believe the next innovation is not a machine or a component innovation, but how one coordinates and interrelates a machine and downhole operational data, creating algorithms that think and help drillers replicate best wellbores on a continuous basis."

Bob Geddes, President and Chief Operation Office, Ensign Energy Services, February 6, 2017

Top 10 oil and gas services occupations with greatest expansion demand to 2021, both scenarios

Occupation (NOC 2011)	**2016 Estimated Employment**	**Scenario**	**Expansion Demand** (% growth/decline)		
			2017	**2018–2021**	**Total**
Total oil and gas services sector	**81,500**	**Modest**	**3,900 (+5%)**	**2,800 (+3%)**	**6,700 (+8%)**
		Delayed	**-7,100 (-9%)**	**6,500 (+9%)**	**-600 (-1%)**
Oil and gas well drillers, servicers, testers and related workers (8232)	6,305	Modest	1,035 (+16%)	505 (+8%)	1,545 (+25%)
		Delayed	-420 (-7%)	1,045 (+17%)	625 (+10%)
Supervisors and contractors, oil and gas drilling and services (8222)	4,530	Modest	745 (+16%)	365 (+8%)	1,110 (+24%)
		Delayed	-300 (-7%)	750 (+17%)	450 (+10%)
Oil and gas well drilling workers and service operators (8412)	2,980	Modest	490 (+16%)	240 (+8%)	730 (+25%)
		Delayed	-195 (-7%)	490 (+16%)	295 (+10%)
Oil and gas drilling, servicing and related labourers (8615)	2,910	Modest	480 (+17%)	235 (+8%)	710 (+24%)
		Delayed	-195 (-7%)	480 (+17%)	290 (+10%)
Millwrights (7311)	3,010	Modest	30 (+1%)	95 (+3%)	125 (+4%)
		Delayed	-225 (-7%)	165 (+5%)	-60 (-2%)
Truck drivers (7511)	2,925	Modest	45 (+2%)	70 (+2%)	110 (+4%)
		Delayed	-270 (-9%)	165 (+6%)	-105 (-4%)
Petroleum, gas, chemical process operators (no steam ticket required) (9232)	2,235	Modest	5 (0%)	100 (+4%)	105 (+5%)
		Delayed	-110 (-5%)	115 (+5%)	5 (0%)
Geologists and geophysicists (2113)	1,335	Modest	65 (+5%)	40 (+3%)	105 (+8%)
		Delayed	-120 (-9%)	105 (+8%)	-15 (-1%)
Geological, petroleum and mining technologists (2212)	1,275	Modest	65 (+5%)	40 (+3%)	100 (+8%)
		Delayed	-115 (-9%)	100 (+8%)	-15 (-1%)
Heavy equipment operators (except crane) (7521)	2,520	Modest	40 (+2%)	60 (+2%)	95 (+4%)
		Delayed	-235 (-9%)	140 (+6%)	-90 (-4%)

Table 4 Source: PetroLMI

Notes: The top 10 occupations make up almost 40% of the sector's 2016 employment and more than 70% of the sector's overall expansion demand to 2021 in the Modest Recovery scenario. Numbers may not add up due to rounding. Refer to Appendix 3 for full list of occupational projections for the sector including replacement demand.

Conventional exploration and production

Canada's conventional exploration and production (E&P) sector (excludes oil sands) employed about 53,800 direct employees at the end of 2016 having reduced close to 30% of its workforce in the last two years. While this sector could have additional job losses in 2017 in the Delayed Recovery scenario, overall workforce expansion is projected for both scenarios over the five-year forecast.

Until there is greater confidence that prices and investment have stabilized, some companies report a reluctance to add full-time employees and may instead rely on contractors to address increases in industry activity. If companies do hire contract workers, they may also negotiate for lower rates than in the past.

Like the oil and gas services sector, the conventional E&P sector will likely see greater demand for technical workers in order to optimize innovation and technology to further boost productivity and efficiencies. This sector's success in this area in the coming years will have a key impact on the industry's overall global competitiveness.

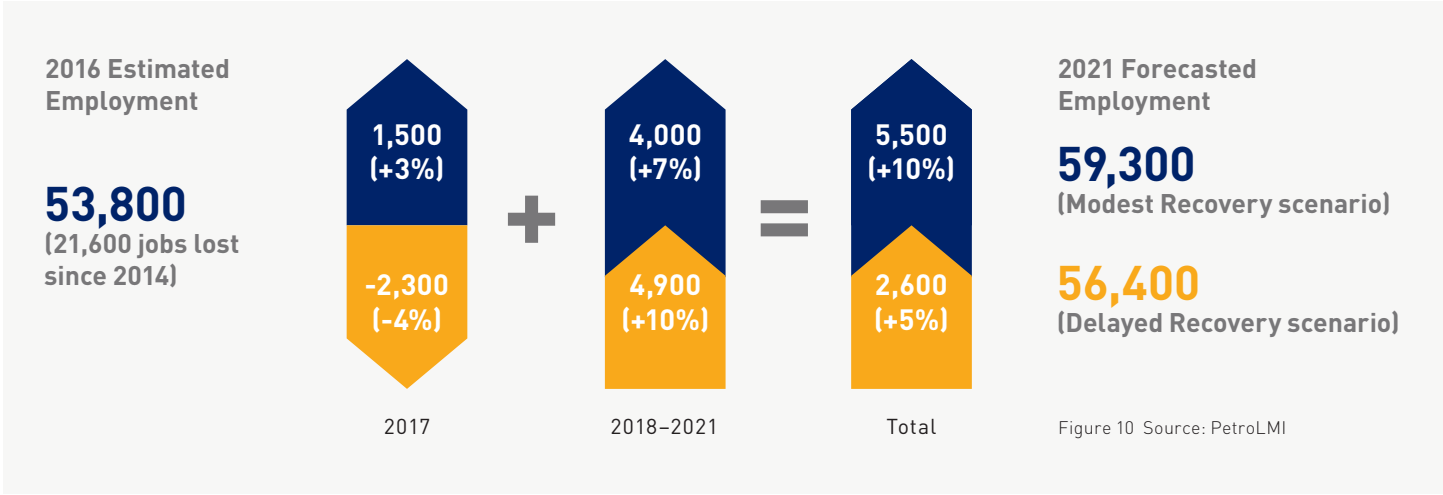


Figure 10 Source: PetroLMI

Modest Recovery scenario

In this scenario, the sector is expected to create 5,500 new jobs by 2021. Nearly 30% of this job growth, or 1,500 new workers, would need to be added in 2017.

The occupations expected to grow at a greater rate during the forecast period would be highly technical positions that support capital activity. These workers are also required to optimize drilling, completions and production technologies. Conventional E&P employment is not expected to recover to 2014 levels in the short-term and since these occupations do not transfer as easily into other industries, labour supply is expected to be more readily available when required.

In this scenario about 4,000 positions would be added between 2018 and 2021.

Innovation and technology to further boost productivity and efficiencies within the E&P sector will have a key impact on the industry's overall global competitiveness.

Occupations with greatest job gains expected in 2017 (Modest Recovery):

1. Purchasing agents and officers including landmen
2. Managers in natural resources production, drilling and well servicing
3. Geologists and geophysicists
4. Supervisors and contractors, oil and gas drilling and services
5. Petroleum engineers
6. Geological, petroleum and mining technologists
7. Inspectors in public and environmental health and safety
8. Power engineers and power systems operators
9. Industrial electricians
10. Chemical engineers

Delayed Recovery scenario

In this scenario, job growth does not occur until 2018 and limits overall growth to 2,600 new jobs from 2017 to 2021.

In 2017, the sector is forecast to cut approximately 2,300 jobs. But then, the industry quickly ramps up activity to realize production gains, resulting in 4,900 new jobs created between 2018 and 2021.

Similar occupations that would experience increased hiring in the Modest Recovery scenario are at risk for further job cuts if capital investment is delayed.

In this scenario, companies will likely try to maintain a lean workforce and sustain operational efficiency by focusing on their highest quality assets, stream lining operations and implementing process improvements.

"We have to be prepared for the possibility that oil prices are going to remain lower and more volatile for an extended period of time ... US$30 a barrel oil is barely in the rear view mirror. Companies will be relatively careful, certainly about taking on permanent staff. As activity ramps up, you are going to see more people employed in drilling and completing wells and work out in the field, but in the head office area, it's going to be slow to see numbers increase."

Robert Peabody, President and CEO, Husky Energy Inc. February 2, 2017

Occupations with greatest job losses in 2017 (Delayed Recovery):

1. Purchasing agents and officers including landmen
2. Supervisors and contractors, oil and gas drilling and services
3. Managers in natural resources production, drilling and well servicing
4. Geologists and geophysicists
5. Petroleum engineers
6. Petroleum, gas, chemical process operators (no steam ticket required)
7. Oil and gas well drillers, servicers, testers and related workers
8. Heavy equipment operators (except crane)
9. Power engineers and power systems operators
10. Oil and gas well drilling workers and service operators

Age-related attrition could contribute to additional hiring needs

About 7,000 conventional E&P workers could retire within the forecast period. Engineering, operations and geoscience roles are more likely to be filled as the sector looks for additional productivity in the field.

Top 10 conventional E&P occupations with greatest expansion demand to 2021, both scenarios

Occupation (NOC 2011)	**2016 Estimated Employment**	**Scenario**	**Expansion Demand** (% growth/decline)		
			2017	**2018–2021**	**Total**
Total conventional E&P sector	**53,800**	**Modest**	**1,500 (+3%)**	**4,000 (+7%)**	**5,500 (+10%)**
		Delayed	**-2,300 (-4%)**	**4,900 (+10%)**	**2,600 (+5%)**
Purchasing agents and officers including landmen (1225)	2,140	Modest	265 (+12%)	345 (+16%)	610 (+29%)
		Delayed	-165 (-8%)	470 (+22%)	305 (+14%)
Managers in natural resources production, drilling and well servicing (0811)	1,520	Modest	170 (+11%)	225 (+15%)	395 (+26%)
		Delayed	-110 (-7%)	305 (+20%)	195 (+13%)
Supervisors and contractors, oil and gas drilling and services (8222)	3,365	Modest	110 (+3%)	260 (+8%)	370 (+11%)
		Delayed	-155 (-5%)	330 (+10%)	175 (+5%)
Geologists and geophysicists (2113)	1,835	Modest	115 (+6%)	190 (+10%)	300 (+16%)
		Delayed	-105 (-6%)	255 (+14%)	150 (+8%)
Petroleum engineers (2145)	1,940	Modest	95 (+5%)	175 (+9%)	270 (+14%)
		Delayed	-100 (-5%)	230 (+12%)	130 (+7%)
Geological, petroleum and mining technologists (2212)	685	Modest	5 (+1%)	95 (+14%)	160 (+23%)
		Delayed	-50 (-7%)	130 (+19%)	80 (+12%)
Power engineers and power systems operators (9241)	1,295	Modest	30 (+2%)	90 (+7%)	115 (+9%)
		Delayed	-55 (-4%)	110 (+9%)	55 (+4%)
Heavy equipment operators (except crane) (7521)	1,505	Modest	15 (+1%)	95 (+6%)	105 (+7%)
		Delayed	-55 (-4%)	100 (+7%)	45 (+3%)
Inspectors in public and environmental health and safety (2263)	675	Modest	35 (+5%)	65 (+10%)	100 (+15%)
		Delayed	-35 (-5%)	85 (+13%)	50 (+7%)
Industrial electricians (7242)	420	Modest	25 (+6%)	45 (+11%)	70 (+17%)
		Delayed	-25 (-6%)	60 (+14%)	35 (+8%)

Table 5 Source: PetroLMI

Note: The top 10 occupations make up close to 30% of the sector's 2016 employment and about 45% of the sector's overall expansion demand to 2021 in the Modest Recovery scenario. Numbers may not add up due to rounding. Refer to Appendix 4 for full list of occupational projections for the sector including replacement demand.

Oil sands

Despite production increases, deeper than expected job losses in 2015 and 2016 (8% contraction) resulted in approximately 28,900 workers directly employed in Canada's oil sands sector at the end of 2016. (See PetroLMI's **Oil Sands Labour Demand Outlook to 2020 Update**, released December 2016).

For the oil sands sector, only one scenario is presented, because of one set of assumptions for oil sands investments and production. Total employment growth is expected to be 4,000 by 2021.

The oil sands sector is expected to fully recover the jobs lost in 2015 and 2016 and surpass 2014 employment levels within the forecast period.

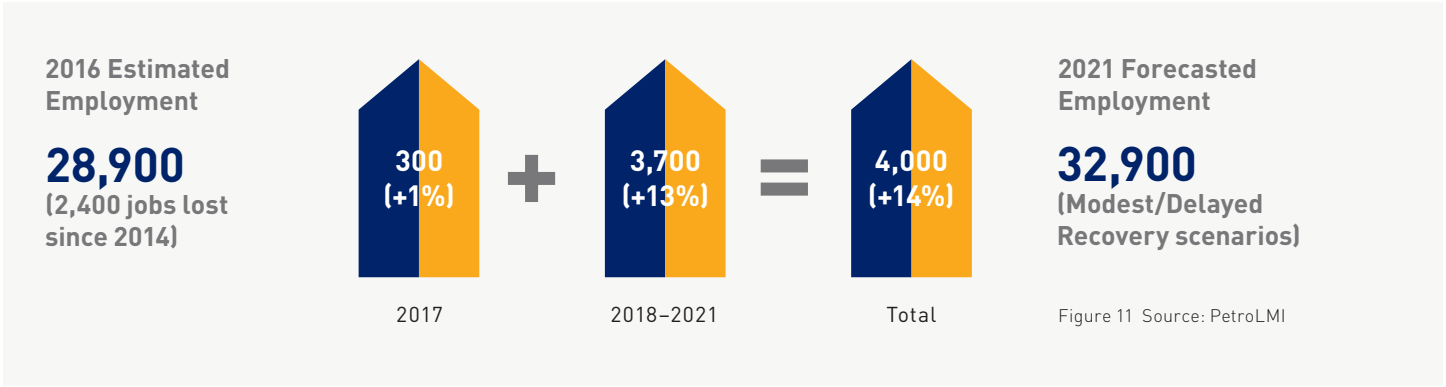


Figure 11 Source: PetroLMI

In 2017, the workforce requirements will reflect the transition of capital projects into operation. In oil sands mining operations the growth is expected to occur in production-related jobs. The addition of operations roles will be somewhat offset by the loss of capital-related jobs as major projects that were under construction prior to the downturn move into operation in 2017 and 2018. In situ operations will add workers as additional production comes on stream. Meanwhile, there will be a decrease in the number of upgrading jobs as investment in this sub-sector slows considerably following completion of projects currently under construction.

The continued focus on decreasing costs, increasing operational efficiencies and sustaining labour productivity gains will have an impact on oil sands workforce requirements between 2018 and 2021. Jobs added in the forecast period will be primarily in occupations that support production as well as the maintenance and optimization of existing operations. The sector is also expected to enhance operational productivity through technology, including additional automation.

Occupations with greatest job gains in 2017:

1. Heavy equipment operators (except crane)
2. Power engineers and power systems operators
3. Heavy-duty equipment mechanics
4. Managers in natural resources production, drilling and well servicing
5. Industrial electricians
6. Millwrights
7. Petroleum, gas, chemical process operators (no steam ticket required)
8. Welders
9. Facility operation and maintenance managers
10. Instrumentation technicians

Occupations with greatest job losses in 2017:

1. Construction managers
2. Petroleum engineers
3. Mechanical engineers
4. Electrical/instrumentation engineers
5. Chemical engineers
6. Geologists and geophysicists
7. Drafting technologists and technicians
8. Mining engineers
9. Civil engineering technologists and technicians
10. Mechanical engineering technologists and technicians

Hiring across all of the oil sands sub-sectors over the five-year period will be impacted by the decrease in growth-related capital spending and a shift towards sustaining and maintenance projects that drive operational reliability and efficiency. There will be concerted efforts to sustain labour productivity improvements realized in 2015 and 2016. All of the hiring is likely to undergo deeper scrutiny to determine if and how to fill open positions. There is also expected to be more reliance on independent and third-party contractors for operations and maintenance work and to address fluctuating workforce demand.

Future growth in oil sands is likely to be through smaller, phased-in production expansions that can be ramped up over a shorter time period if oil price and cost environments stabilize or improve.

"The maintenance capital is not insignificant for oilsands. I think that's the silver lining to the situation. We're not going to have the peak spending that we had in 2014 for the foreseeable future but we need to consider that there will be potentially as much as $13 billion per year sustaining capital spent."

Jackie Forrest, Vice President,
ARC Energy Research Institute

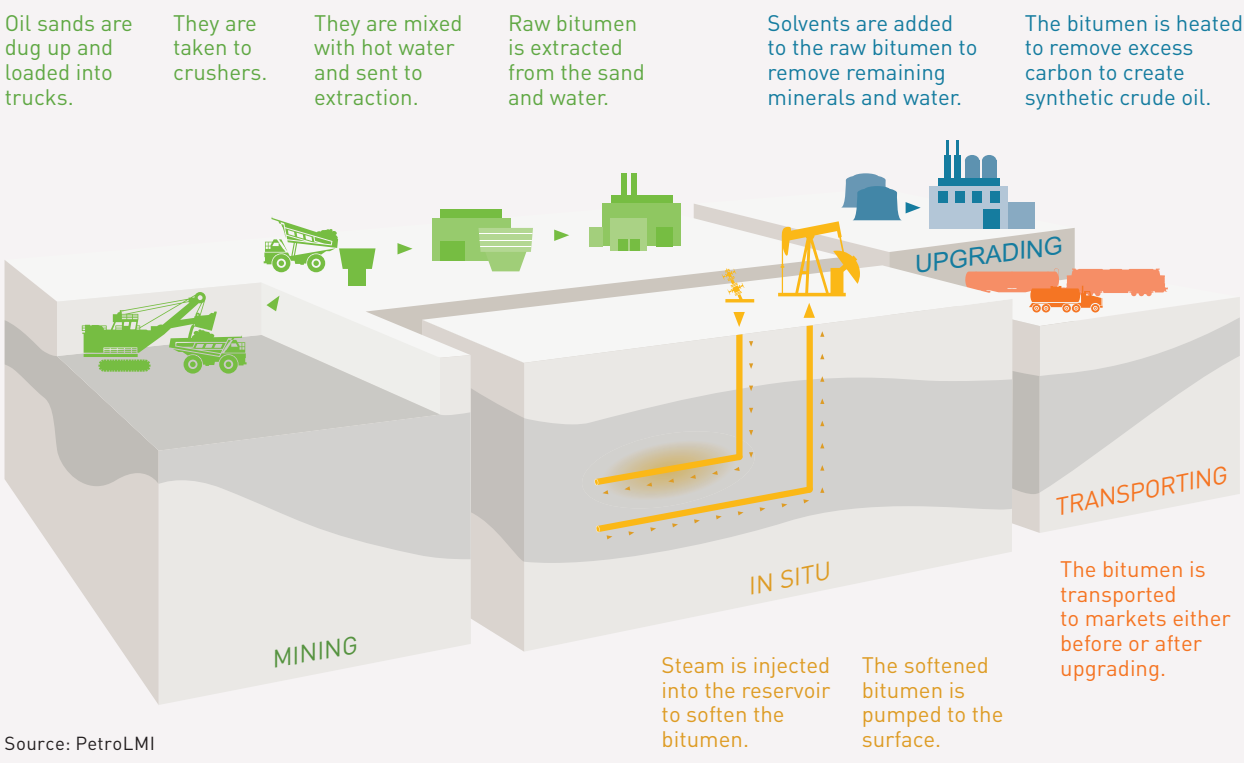
Oil sands expansion demand to 2021, by operations type

Operations type (sub-sector)	2016 Estimated Employment	2021 Projected Employment	2017–2021 Expansion Demand (% of 2016 Employment)
Total oil sands sector	**28,900**	**32,900**	**+4,000 (+14%)**
Mining	14,800	17,400	+2,600 (+18%)
In situ	9,200	11,200	+2,000 (+22%)
Upgrading	4,900	4,300	-600 (-12%)

Table 6 Source: PetroLMI

Note: Detailed labour demand projections to 2020 for oil sands by sub-sector and by occupation is located here.

Oil sands mining, in situ and upgrading operations



Source: PetroLMI

Top 10 oil sands occupations with greatest expansion demand to 2021 (one scenario)

Occupation (NOC 2011)	**2016 Estimated Employment**	**2017–2021 Expansion Demand** (% growth)
Total oil sands sector	**28,900**	**4,000 (+14%)**
Heavy equipment operators (except crane) (7521)	4,505	1,000 (+22%)
Power engineers and power systems operators (9241)	4,915	795 (+16%)
Heavy-duty equipment mechanics (7312)	1,400	290 (+21%)
Facility operation and maintenance managers (0714)	1,265	165 (+13%)
Managers in natural resources production, drilling and well servicing (0811)	780	150 (+19%)
Industrial electricians (7242)	765	145 (+19%)
Millwrights (7311)	715	135 (+19%)
Engineering managers (0211)	1,100	120 (+11%)
Petroleum, gas, chemical process operators (no steam ticket required) (9232)	520	110 (+22%)
Instrumentation technicians (2243)	725	95 (+13%)

Table 7 Source: PetroLMI

Note: The top 10 occupations make up close to 60% of the sector's 2016 employment and over 70% of the sector's overall expansion demand to 2021 in the Modest Recovery scenario. Refer to Appendix 5 for full list of occupational projections for the sector including replacement demand.

Age-related attrition could contribute to additional hiring needs

Approximately 4,000 oil sands employees could retire within the forecast period. Positions on the front line of production, such as operators, trades and engineers, are more likely to be filled than positions that have less direct impact on production.

Photo credit: Cenovus Energy Inc.

Pipelines

The pipelines sector entered 2017 with significant advancements in the approval of Canadian pipeline projects. Additionally, some pipeline companies made significant acquisitions in 2016, while others were awarded the construction and operation of pipeline projects in Mexico. All that bodes well for the sector.

Canada's pipeline operations[8] employed an estimated 9,700 direct workers at the end of 2016 after reducing 6% of its workforce in the last two years. In both the Moderate and Delayed Recovery scenarios, workforce levels are expected to recover the jobs lost during 2015 and 2016, with the majority of hiring occurring early in the forecast period.

At the same time, however, job growth will be tempered with the implementation of advanced technologies, including automation.

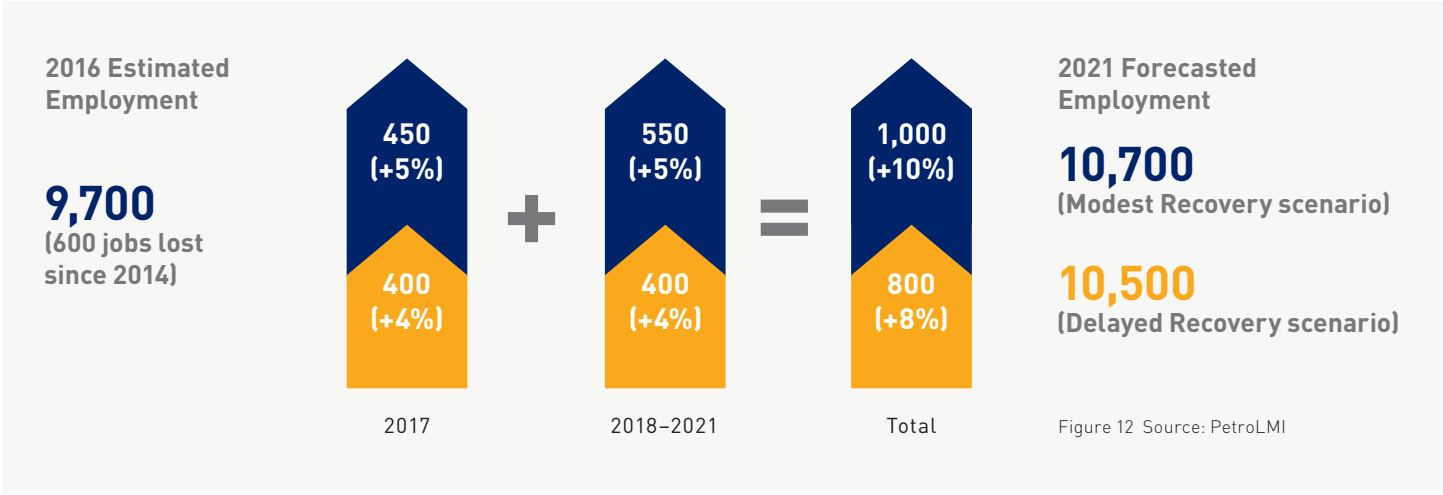


Figure 12 Source: PetroLMI

Modest Recovery scenario

In this scenario, pipeline operations employment is projected to grow in 2017 by more than 450 jobs. Hiring is expected to include a combination of field operations workers and those involved in capital-related work, including the planning for expansion projects.

After 2017, hiring is expected to increase for pipeline expansions that support additional natural gas production. Staffing up for expansions is expected to continue between 2018 and 2021 with close to 550 new jobs added, bringing overall employment growth to almost 1,000 new jobs within the five-year forecast.

Delayed Recovery scenario

In this scenario, the pipelines sector is expected to create a total of 800 new jobs from 2017 to 2021 with half of this growth, or 400 jobs created in 2017. In this scenario, the more moderate growth of natural gas production has an impact on employment after 2017.

Portions of Canadian pipelines could also be decommissioned. Shifts in pipeline transmission, along with implementation of automation and other technologies, would reduce job creation between 2018 and 2021 to about 400.

Occupations with greatest job gains in 2017 (similar in both scenarios):

1. Petroleum, gas, chemical process operators (no steam ticket required)
2. Millwrights
3. Supervisors, petroleum, gas and chemical processing and utilities
4. Chemical engineers
5. Mechanical engineers
6. Purchasing agents and officers including landmen
7. Engineering managers
8. Inspectors, testers and technicians (non-destructive)
9. Civil engineering technologists and technicians
10. Civil engineers

[8] The employment projections and analysis in this section refer only to the operation of large diameter oil and natural gas pipelines. Wind and nuclear electricity generation, natural gas processing, gas utilities, etc. that are the businesses of some Canadian pipeline companies are not included in the numbers. Nor do the projections capture the contingent workforce or U.S. operations. Some conventional E&P companies also hire for pipeline operations positions.

Top 10 pipeline occupations with greatest expansion demand to 2021, both scenarios

Occupation (NOC 2011)	**2016 Estimated Employment**	**Scenario**	**2017–2021 Expansion** (% growth)
Total pipelines sector	**9,700**	**Modest**	**1,000 (+10%)**
		Delayed	**800 (+8%)**
Petroleum, gas, chemical process operators (No steam ticket required) (9232)	1,060	Modest	107 (+10%)
		Delayed	87 (+8%)
Millwrights (7311)	275	Modest	27 (+10%)
		Delayed	23 (+8%)
Supervisors, petroleum, gas and chemical processing and utilities (9212)	235	Modest	24 (+10%)
		Delayed	19 (+8%)
Chemical engineers (2134)	210	Modest	22 (+10%)
		Delayed	18 (+8%)
Mechanical engineers (2132)	190	Modest	20 (+11%)
		Delayed	16 (+8%)
Purchasing agents and officers including landmen (1225)	185	Modest	19 (+10%)
		Delayed	16 (+9%)
Engineering managers (0211)	160	Modest	17 (+10%)
		Delayed	14 (+9%)
Petroleum engineers (2145)	155	Modest	15 (+10%)
		Delayed	12 (+8%)
Truck drivers (7511)	140	Modest	14 (+10%)
		Delayed	12 (+9%)
Inspectors, testers and technicians (non-destructive) (2261)	125	Modest	13 (+10%)
		Delayed	10 (+8%)

Table 8 Source: PetroLMI

Note: The top 10 occupations make up close to 30% of the sector's 2016 employment and overall expansion demand to 2021 in both the Modest and Delayed Recovery scenarios. Due to smaller labour demand numbers for the sector and to allow for differentiation within the table: occupational expansion demand numbers were not rounded but sector totals were rounded to the nearest hundred. Refer to Appendix 6 for full list of occupational projections for the sector including replacement demand.

Photo credit: Spectra Energy

Spotlight on pipeline construction labour demand

Canada's oil and gas industry achieved a key milestone towards market diversification in 2016 with the approval of two oil pipelines and one pipeline to transport natural gas to a proposed LNG plant on the west coast. Planning also continues for an oil pipeline to eastern Canada and there are a number of smaller pipeline construction projects underway. Additionally, there is potential for the Keystone XL pipeline to move ahead, transporting oil into the United States.

The workforce required to construct a pipeline is much greater than the number of workers required during the operations phase. The availability of skilled labour will be essential, especially if multiple projects move forward at the same time. Additionally, like other industry sectors, pipeline companies are evaluating their assets and there is potential for uneconomic, underutilized pipelines to be decommissioned. This would further increase demand for construction workers.

The CEPA Foundation commissioned a study to assess the workforce demand for critical occupations to construct Canada's pipelines. Recognizing that the timing of projects and workforce demand will be dependent on price, it was assumed that smaller projects would move forward on sustained oil price above US$60/bbl, while large capital projects are likely contingent on above US$70/bbl. Timing of regulatory approval will also be a factor.

Demand for critical occupations is expected to start increasing in 2017 as smaller construction projects move forward. Large capital project construction demand is expected to create a significant increase in demand starting in 2019 with 7,600 full-time equivalent (FTE) jobs. This number is projected to peak in 2021 with 15,950 FTE. Welders, heavy equipment operators (except crane) and construction trades and labourers are expected to comprise more than 66% of the critical occupation demand at peak.

Demand, combined with loss of construction labour supply and retirements, is expected to cause a labour demand-supply gap for the pipeline construction of almost 12,000 FTE in 2021. Occupations with the greatest gap (in FTE) include:

- Construction trades helpers and labourers (5,556)
- Heavy equipment operators (except crane) (2,245)
- Welders and related machine operators (1,949)
- Industrial painters, coaters and metal finishing process operators (931)
- Construction managers (720)
- Inspectors in public and environmental health and occupational health and safety (587)

Source: Industry-wide Pipeline Workers Supply and Demand Outlook to 2025, CEPA Foundation, July 2016.

Oil and Gas Activity Supports Jobs Across Canada

Oil and gas activity occurs in 12 of Canada's 13 provinces and territories. With oil prices trending around US$50 in the first quarter of 2017, new investment occurring in the industry is shifting to more traditional regions in the Western Canadian Sedimentary Basin (WCSB) that spans British Columbia, Alberta and Saskatchewan.

The oil and gas plays receiving the most attention are those offering producers the greatest profitability in a restructured price and cost environment, including:

- Reserves that respond to technology that enhances well efficiency and productivity, such as multi-pad horizontal drilling and multi-stage hydraulic fracturing,
- Reserves in regions that have established infrastructure including roads, pipelines and processing facilities.

Going forward, fiscal and regulatory environments will also continue to have an impact on attracting investment to certain jurisdictions.

Summary of industry activity by region

According to the Canadian Association of Petroleum Producers (CAPP), the Montney, Durvenay, Cardium and Viking plays of the WCSB have experienced the greatest increase in recent renewed activity. That said, activity forecasts provided by the Petroleum Services Association of Canada (PSAC) and Canadian Association of Oilwell Drilling Contractors (CAODC) continue to call for the number of wells to be drilled and rig operating days to be down by 54% and 62% respectively from 2014 levels.[9]

Provincially, activity in a Modest Recovery scenario is anticipated as follows:

British Columbia: a significant portion of the liquids-rich Montney lies in Northeast BC. Improved economics and investment in new processing facilities and pipelines to transport natural gas supply to markets is having a positive impact on natural gas activity in the region. For instance, single day land sales in early 2017 were greater than all auctions held in 2015 and 2016. PSAC's January 2017 Canadian Drilling Activity Forecast Update projects a 15% increase in the number of wells drilled in BC, from 320 wells in 2016 to 367 wells in 2017.

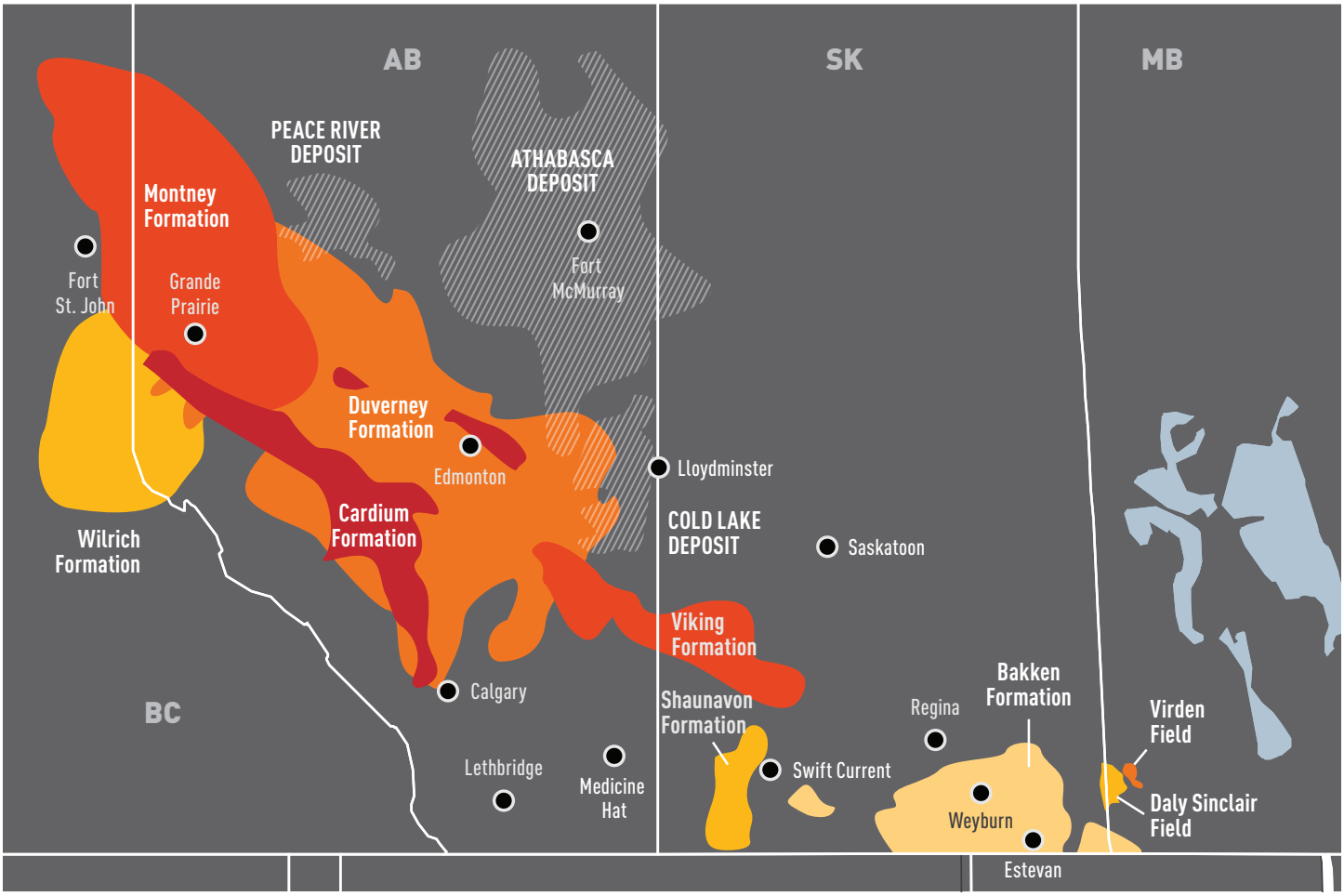
Alberta: all four of the oil and gas plays which have experienced an uptick in activity in early 2017 are located in Alberta. As a result, the province is projected to see the greatest rebound in drilling activity with 2,706 wells drilling – a 47% increase or 806 additional wells over 2016 levels. The west, central and northwest regions of the province are expected to be the busiest through 2017.

Despite an anticipated decrease in spending during the forecast period, the oil sands sector is expected to generate activity and employment to 2021 due to increased maintenance and production requirements – especially if cost structures remain low and oil prices stabilize above US$50. Planned expansion projects that were suspended in 2015 and 2016 could resume before 2021 if economics are determined to be favourable.

Saskatchewan: the Viking light oil play stretches into Saskatchewan. With an industry-friendly regulatory environment, its light oil reserves are attractive to capital investment; however, the province does not have the scale of reserves found elsewhere. Still, Saskatchewan is expected to experience a 17% increase in the number of wells drilled in 2017, 1,985 wells compared to 1,700 in 2016.

[9] Petroleum Services Association of Canada. 2017 Canadian Drilling Activity Forecast update. Released January 30, 2017 (note: a mid-year update is planned for release in late-April 2017) and Canadian Association of Oilwell Drilling Contractors. State of the Industry 2016 Review & 2017 Forecast. Released November 22, 2016.

Western Canada Oil & Gas plays



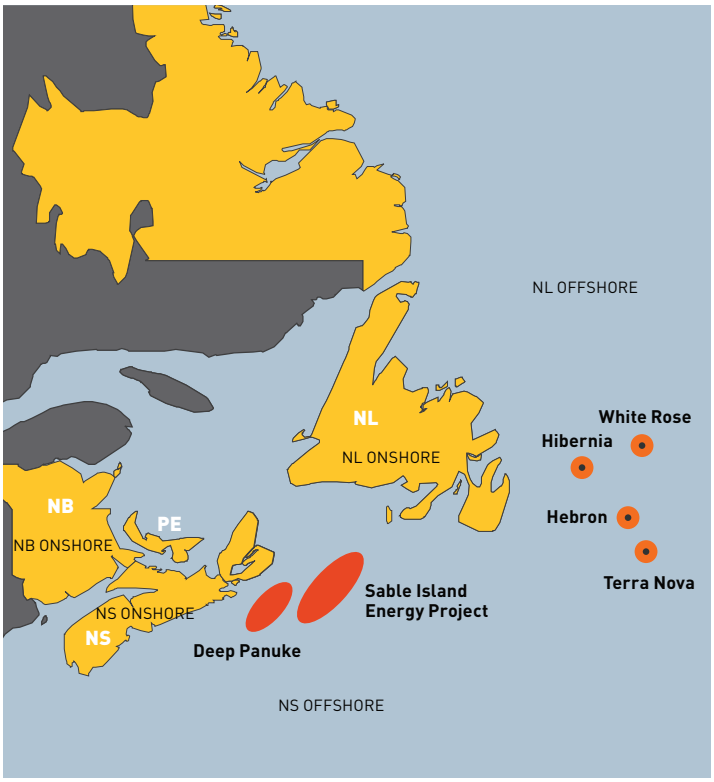
Rest of Canada

The majority of Canadian oil and gas activity outside of the WCSB takes place offshore in Eastern Canada, including three offshore oil producing fields in Newfoundland and Labrador and two offshore natural gas producing fields in Nova Scotia.

Hebron, a fourth offshore oil project in Newfoundland and Labrador, which has provided a massive injection of construction jobs into the province, is near completion and expected to move into production in 2017. Conversely, the Sable Offshore Energy Project, is nearing the end of its natural gas production cycle and decommissioning could begin as early as 2017.

Like the oil sands, Canada's offshore experienced the deferral of expansion projects during the last two years but offshore operators are undertaking some exploration drilling and are reviewing their options for cost-effective expansions. No final investment decisions were made by the end of first quarter 2017.

Eastern Canada Oil & Gas plays



Employment impacts on oil and gas activity across Canada (Delayed – Modest Recovery scenario)

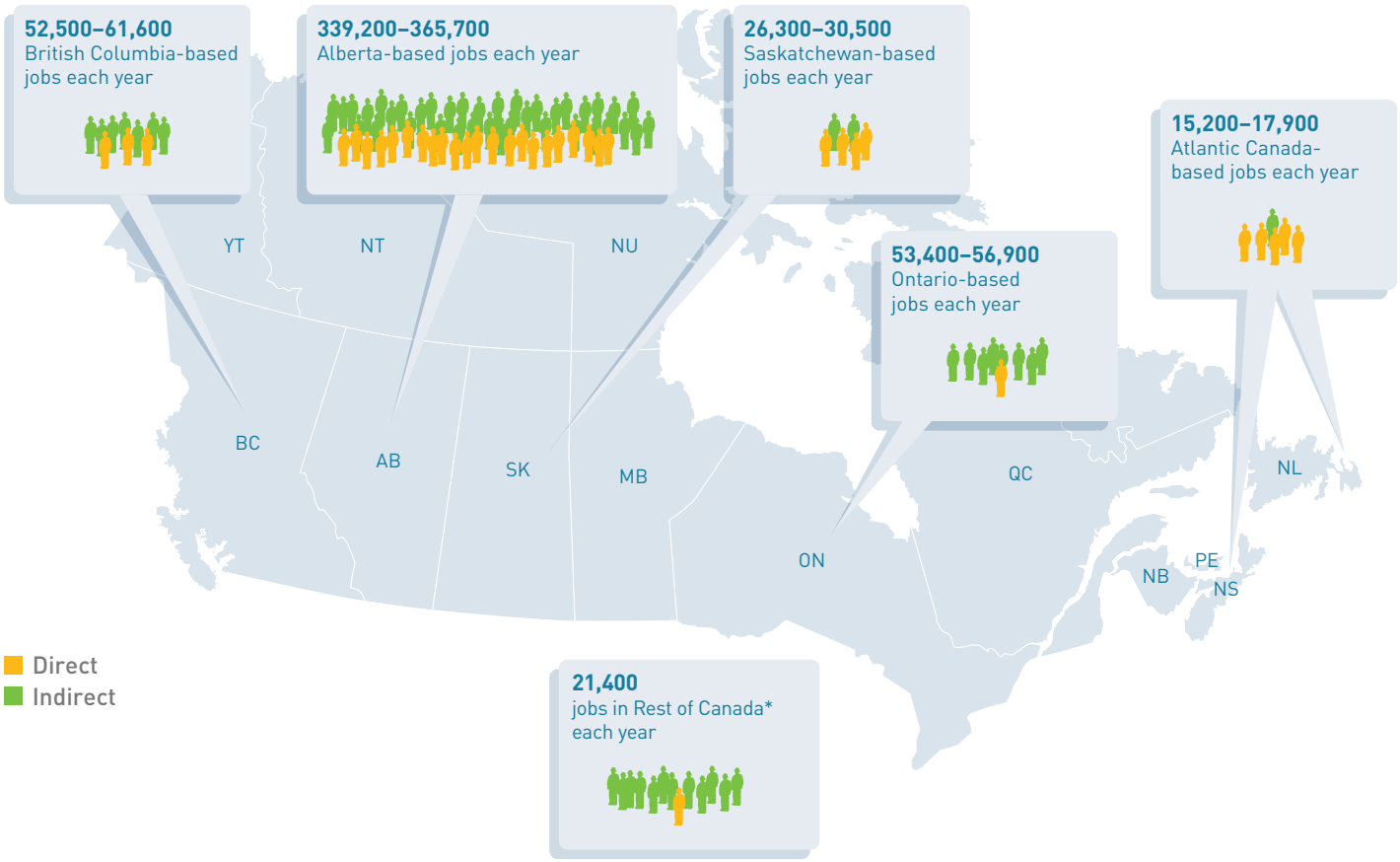


Figure 14 Source: PetroLMI using Statistics Canada's Input-Output tables

Notes: The methodology used to determine the indirect and induced employment generated by investment in Canada's oil and gas industry is separate from PetroLMI's modelling system used to determine direct employment within the oil and gas services, conventional E&P, oil sands and pipelines sectors. The economic impact analysis presented uses interprovincial, inter-industry input-output tables of the economy published by Statistics Canada to estimate the economic impacts (including employment impacts) of specific industry expenditures on other industries and across provinces.

*Rest of Canada includes Manitoba, Quebec, the Northwest Territories, Yukon and Nunavut, for both scenarios.

Indirect and induced job creation from oil and gas activity

While direct industry employment is concentrated in regions with the greatest oil and gas production, indirect employment is widespread as the industry sources goods and services from across Canada.

Based on production and investment projections for both scenarios, an estimated annual average of 508,000 to 554,000 direct and indirect jobs respectively will be supported by the oil and gas industry throughout Canada between 2017 and 2021.

A third category is referred to as induced employment and includes employment generated due to consumer spending by direct and indirect workers. Oil and gas-related induced employment accounts for another 208,000 to 226,400 jobs per year to 2021.

In total, oil and gas capital and operating spending will sustain between 716,100 and 780,800 Canadian jobs annually between 2017 and 2021.

Indirect jobs supported by oil and gas activity from 2017 to 2021, by sub-sector

331,000 to 365,800 Total annual jobs

- **30%** Oil and gas engineering and other construction
- **11%** Wholesale and retail trade
- **10%** Engineering, architectural, legal and accounting and related services
- **8%** Finance, insurance and real estate services
- **8%** Administrative and support services
- **6%** Computer systems design and other professional, scientific and technical services
- **4%** Fabricated metal and machinery manufacturing
- **3%** Accommodation, food services and transportation
- **2%** Truck transportation
- **18%** Other

Source: PetroLMI using StatsCan I/O tables.

Conclusion

Over the next five years the exact timing and level of expansion in Canada's oil and gas industry is dependent on a number of factors, with 2017 being the pivotal year to set the stage for oil prices, investment and employment growth.

2017 started out promising with oil prices trending around US$50/bbl. If a balanced global oil supply/demand and $55 average oil price is achieved in 2017, there will be increased spending and employment. Should oil prices stay below $50, industry will resume cost-cutting measures and recovery and growth will be delayed until 2018.

Should oil prices land more favourably and rise steadily in the next five years, the industry is expected to create 17,100 new jobs by 2021. If lower oil prices continue in 2017 and growth is delayed until 2018, the industry will only gain about 6,700 net new jobs in the same time period.

Some portion of the estimated 22,000 to 23,000 job vacancies that will occur due to age-related attrition during the five-year period will also contribute to increased hiring activity, but the number and types of occupations remain less certain.

The assumption that the deep employment cuts in 2015 and 2016 will leave the oil and gas industry with readily available workers is not the case. Already, labour shortages are occurring. Going forward, the industry's unemployment rate is projected to fall below 2014 levels, mainly due to a shrinking labour force. This will further escalate a third year of contraction, pushing even more unemployed oil and gas workers and potential new entrants, including new graduates into other industries.

Regardless of the pace of job creation, growth is projected to plateau in 2020–2021 because of productivity improvements and Canada's limited ability to compete in the global energy market – at least within the five-year forecast.

To sustain growth beyond 2021, market diversification is required. The United States, traditionally Canada's primary consumer, has fast emerged as a key competitor – for both market share and industry investments. Maintaining a lean and productive workforce, as well as operational efficiencies through innovation and technology, will be key to remaining competitive. Canada's industry will also need to focus on effectively managing the labour and skill shortages that have impacted costs and productivity in the past.

At the same time the industry's workforce will play a key role in its ability to compete globally. Their technical skills and knowledge will lead to further innovation and the development of technology to facilitate the industry's transition to a global energy supplier while managing widening competitive pressures and new carbon regulations.

Photo credit: Nexen

"The Canadian oilfield service, supply and manufacturing sector is a leader in providing innovation and technological support for Canada's responsibly-developed oil and gas resources and like our customers, the producers, we are limited in our growth here in Canada as long as we only have one customer, the U.S., a customer that has quickly become our biggest competitor."

Mark Salkeld, President,
Petroleum Services Association of Canada

Appendices

Appendix 1: National Occupational Classification (NOC) and Sample Industry Job Titles

The following table provides sample job titles for the 48 and other occupations mapped to NOC 2011 version.

NOC Title and Code	Sample Job Titles per Sector			
	Oil and gas services	Conventional E&P	Oil sands	Pipelines
Chemical engineers (2134)	Field engineer, drilling engineer, well engineer, measurement while drilling specialist, technical engineer	Production engineer, reservoir engineer, reliability engineer, drilling and completions engineer, exploitation engineer	Chemical engineer, process engineer	Pipeline engineer, inspection engineer, pipeline integrity engineer, corrosion engineer
Chemical technologists and technicians (2211)	Field technician, field operations technologist	Chemical engineering technologist, production technologist, reservoir technologist, quality assurance analyst	Process technician, chemical engineering technologist, quality assurance analyst, lab technician	Pipeline integrity technician, corrosion specialist
Civil engineers (2131)	Civil engineer, project engineer	Civil engineer, project engineer	Civil engineer, geotechnical engineer, piping engineer, project engineer	Pipeline engineer, inspection engineer, pipeline integrity engineer, project engineer
Construction managers (0711)	Construction manager, project manager, site superintendent	Construction manager, project manager, site superintendent	Construction manager, project manager, site superintendent	Construction manager, project manager, site superintendent, pipeline construction manager
Crane operators (7371)	Crane operator	Crane operator	Crane operator, mobile crane operator	Crane operator
Drafting technologists and technicians (2253)	Drafting technologist, CAD technologist	Drafting technologist, CAD technologist	Drafting technologist, CAD technologist	Pipeline design technologist, piping technologist, drafting technologist, CAD technologist
Electrical/ instrumentation engineers (2133)	Electrical engineer, instrumentation engineer	Electrical/ instrumentation engineer, project engineer	Electrical/ instrumentation engineer, project engineer, electrical/ instrumentation reliability engineer, control systems specialist	Electrical/ instrumentation engineer, project engineer

NOC Title and Code (cont.)	Sample Job Titles per Sector			
	Oil and gas services	Conventional E&P	Oil sands	Pipelines
Engineering managers (0211)	Manager quality assurance, manager civil engineering, manager mechanical engineering, manager electrical engineering, manager quality control	Manager quality assurance, manager civil engineering, manager mechanical engineering, manager electrical engineering, manager quality control	Manager quality assurance, manager civil engineering, manager mechanical engineering, manager electrical engineering, manager quality control	Manager quality assurance, manager civil engineering, manager mechanical engineering, manager electrical engineering, manager quality control
Facility operation and maintenance managers (0714)	Maintenance manager, facility manager, operations manager, plant maintenance superintendent	Maintenance manager, facility manager, operations manager, plant maintenance superintendent	Maintenance manager, facility manager, operations manager, plant maintenance superintendent	Maintenance manager, pipeline operations manager, maintenance superintendent
Geological, petroleum and mining technologists (2212)	Petroleum engineering technologist, technical specialists (fracturing, coil tubing, etc.), engineering technician, measurement while drilling or field specialist	Petroleum engineering technologist, reservoir technologist, geological technologist, production technician	Mining engineering technologist, petroleum engineering technologist	n/a
Geologists and geophysicists (2113)	Geologist, geophysicist	Geologist, geophysicist	Geologist, geophysicist	Geologist, geophysicist
Heavy equipment operators (except crane) (7421)	Heavy equipment operator	Heavy equipment operator	Heavy equipment operator	Heavy equipment operator
Heavy-duty equipment mechanics (7312)	Heavy-duty mechanic, heavy-duty technician	Heavy-duty mechanic, heavy-duty technician	Heavy-duty mechanic	Heavy-duty mechanic
Industrial and manufacturing engineers (2141)	Project engineer, quality control engineer	Industrial technician, engineering technologist, quality control engineer, optimization engineer	Project engineer, quality control engineer, optimization engineer	Project engineer, quality control engineer, optimization engineer
Industrial electricians (7242)	Industrial electrician, electrician, electrical technician	Industrial electrician, electrician, electrical technician	Industrial electrician, electrician, electrical technician	Industrial electrician, electrician, electrical technician
Industrial engineering and manufacturing technologists and technicians (2233)	Industrial engineering technologist, engineering technologist	Industrial technician, engineering technologist	Rotating equipment technician, industrial technician	SCADA technician
Inspectors in public and environmental health and safety (2263)	Health & safety inspector, EH&S specialist, OHSE field advisor	Health & safety inspector, EH&S specialist	Health & safety inspector, EH&S specialist	Health & safety inspector, EH&S specialist
Inspectors, testers and technicians (non-destructive) (2261)	Quality assurance analyst, mechanical QA, QA /QC inspector, coordinator	Quality assurance analyst, NDT technician, NDT analyst	Quality assurance analyst, NDT technician, NDT analyst	Quality assurance analyst, measurement integrity analyst

NOC Title and Code (cont.)	Sample Job Titles per Sector			
	Oil and gas services	Conventional E&P	Oil sands	Pipelines
Instrumentation engineering technologists (2241)	Instrumentation technologist, instrumentation technician	Distributed control system (DCS) specialist, DCS technician, instrumentation technologist/ technician	Distributed control system (DCS) specialist, DCS technician, instrumentation technologist/ technician, instrumentation reliability technician	SCADA design technologist, SCADA technologist
Instrumentation technicians (2243)	Instrumentation technician, instrumentation mechanic, service technician, field services technician	DCS specialist, DCS technician, instrumentation technologist, instrumentation technician	DCS specialist, DCS technician, instrumentation technologist/ technician, instrumentation reliability technician	SCADA technician
Insulators (7293)	Insulator	Insulator	n/a	Insulator
Machinists and machining and tooling inspectors (7231)	Machinist, CNC machinist	Machinist	Machinist	Machinist
Managers in natural resources production, drilling and well servicing (0811)	Drilling coordinator, production engineer, production manager	Drilling coordinator, production engineer, production manager, field manager	Production manager, drilling manager, operations manager	Pipeline operations manager
Mechanical engineering technologists (2232)	Engineering technician, hydraulic technician, field operations technologist	Reservoir engineering technologist, reservoir technician, mechanical engineering technologist	Mechanical engineering technologist, rotating equipment technician/ technologist	Mechanical design technologist
Mechanical engineers (2132)	Technical engineer, mechanical engineer	Mechanical engineer, facilities engineer, production engineer, reservoir engineer, drilling and completions engineer, exploitation engineer, project engineer, rotating equipment engineer	Plant engineer, facilities engineer, rotating equipment engineer, mechanical reliability engineer	Pipeline engineer, inspection engineer, pipeline integrity engineer, facilities engineer, measurement engineer, project engineer
Millwrights (7311)	Millwright, maintenance mechanic	Millwright, rotating equipment mechanic	Millwright, mechanical reliability technician, rotating equipment mechanic	Millwright, maintenance technician
Mining engineers (2143)	Mining engineer	Mining engineer	Mining engineer	n/a
Natural and applied science policy researchers, consultants and program officers (4161)	Environmental technician, emergency preparedness analyst, waste management coordinator, environmental advisor	Environmental technician, emergency preparedness analyst, policy analyst, environmental analyst, environmental advisor	Environmental technician, emergency preparedness analyst, policy analyst, environmental analyst, environmental advisor	Environmental technician, emergency preparedness analyst, policy analyst, environmental analyst, environmental advisor

NOC Title and Code (cont.)	Sample Job Titles per Sector			
	Oil and gas services	Conventional E&P	Oil sands	Pipelines
Oil and gas drilling, servicing and related labourers (8615)	Labourer, floorhand, leasehand, roustabout, seismic surveyor, vibrator operator, observor	Field labourer	Labourer	Field labourer, tank farm labourer
Oil and gas well drillers, servicers, testers and related workers (8232)	Rig technician, cementer helper, fracturing operator trainee, tubing helper, production testing trainee, perforator helper, rigger, snubbing assistant operator, well puller helper, well testing helper, wireline helper/ operator trainee, logger, tester	Production tester	n/a	Field worker
Oil and gas well drilling workers and service operators (8412)	Driller, derrickhand, motorhand, production well test operator, snubbing services operator, wireline operator, acidizing operator, pump servicer, power tong/ casing operator, cementing operator, coil tubing operator, completion/service tool operator, drill stem test (DST) operator, fishing tool operator, fracturing equipment operator, logging & coring operator, nitrogen operator, swabbing unit operator, fracturing operator, directional driller, measurement while drilling (MWD) specialist/operator, driller, rig technician	Field operator, production operator, well operator, battery operator	n/a	Tank operator, pipeline locator
Petroleum engineers (2145)	Petroleum engineer, field engineer, production operations engineer, field operations engineer, technical engineer	Petroleum engineer, production engineer, reservoir engineer, drilling and completions engineer, exploitation engineer	Petroleum engineer, reservoir engineer, drilling and completions engineer	Petroleum engineer, reservoir engineer
Petroleum, gas, chemical process operators (no steam-ticket required) (9232)	Cementing plant operator, drilling fluids plant operator, bulk plant operator, plant operator	Plant operator, gas plant operator, field operator, production technician, battery operator	Process operator, plant operator, unit operator, bitumen operator	Control room operator, gas control operator, compressor operator, facilities operator, pipeline operator

NOC Title and Code (cont.)	Sample Job Titles per Sector			
	Oil and gas services	Conventional E&P	Oil sands	Pipelines
Petroleum/mining/ geological engineering technologists (2212)	Petroleum engineering technologist, technical specialist (fracturing, coil tubing, etc.), engineering technician, measurement while drilling specialist, field specialist	Petroleum engineering technologist, reservoir technologist, geological technologist, production technician	Mining engineering technologist, petroleum engineering technologist	Geological technician, geological surveyor, welding technologist, metallurgical technologist
Power engineers and power systems operators (9241)	Process operator, power engineer, steam-ticketed operator, cementing plant operator, drilling fluids plant operator, 5th class power engineer	Plant operator, gas plant operator, field operator, production technician, 1st, 2nd, 3rd and 4th class power engineer	Control room operator, process operator, bitumen plant operator, SAGD operator, in situ operator, production technician, unit operator, 1st, 2nd, 3rd and 4th class power engineer	n/a
Production logistics co-ordinators (1523)	Production clerk	Production accountant, production clerk	Production accountant, production technician	Production accountant, oil/ gas scheduler, pipeline scheduler, measurement technician
Professional occupations in advertising, marketing and public relations (1123)	Communications specialist, community relations advisor, Aboriginal relationship specialist, stakeholder relationship specialist, public relations coordinator	Communications specialist, community relations advisor, Aboriginal relationship specialist, stakeholder relationship specialist, public relations coordinator	Communications specialist, community relations advisor, Aboriginal relationship specialist, stakeholder relationship specialist, public relations coordinator	Communications specialist, community relations advisor, Aboriginal relationship specialist, stakeholder relationship specialist, public relations coordinator
Purchasing agents and officers, including landmen (1225)	Purchaser, materials coordinator, buyer, procurement	Landman, contract administrator, contract manager, contract specialist, procurement specialist, buyer	Contract administrator, contract manager, contract specialist, procurement specialist, buyer, purchaser	Contract administrator, contract manager, contract specialist, buyer, procurement specialist
Purchasing and inventory control workers (1524)	Inventory planner, invoice control clerk, procurement coordinator	Inventory planner, invoice control clerk, procurement coordinator	Inventory planner, invoice control clerk, procurement coordinator	Inventory planner, invoice control clerk, procurement coordinator
Purchasing managers (0113)	Contract manager, supply manager, procurement manager, material manager, supply chain manager, logistics manager	Contract manager, supply manager, procurement manager, material manager, supply chain manager, logistics manager	Contract manager, supply manager, procurement manager, material manager, supply chain manager, logistics manager	Contract manager, supply manager, procurement manager, material manager, supply chain manager, logistics manager
Shippers and receivers (1521)	Shipping agent, warehouse clerk, supply chain assistant	Shipping agent, warehouse clerk, supply chain assistant	Shipping agent, warehouse clerk, supply chain assistant	Shipping agent, warehouse clerk, supply chain assistant

NOC Title and Code (cont.)	Sample Job Titles per Sector			
	Oil and gas services	Conventional E&P	Oil sands	Pipelines
Steamfitters and pipefitters (7252)	Steamfitter, pipefitter	Steamfitter, pipefitter	Steamfitter, pipefitter	Steamfitter, pipefitter
Supervisors and contractors, heavy equipment operator crews (7302)	Oilfield construction supervisor, foreman, heavy construction, road construction supervisor	n/a	Surface mining supervisor	Pipeline construction supervisor
Supervisors, oil and gas drilling and services (8222)	Rig manager, service rig manager, field supervisor, fracturing supervisor, drilling rig manager, seismic field operations supervisor	Drilling superintendent, completions supervisor	n/a	n/a
Supervisors, petroleum, gas and chemical processing and utilities (9212)	Petroleum field supervisor, blending plant supervisor, water treatment supervisor, pumping and blending supervisor	Gas plant facilities manager, operations manager or supervisor	n/a	Pipeline supervisor, pipeline operations supervisor, transmission supervisor
Supervisors, supply chain, tracking and scheduling coordination occupations (1215)	Crew scheduler, transportation logistics coordinator, transportation planning coordinator	Supply chain supervisor, shift and transportation logistics coordinator, transportation planning coordinator	Supply chain supervisor, shift and transportation logistics coordinator, transportation planning coordinator	Pipeline scheduling lead, nominations supervisor
Truck drivers (7411)	Transportation operator, Class 1 truck driver, Class 3 truck driver	Truck driver	n/a	Truck driver, transport operator
Welders (7265)	Welder, B-pressure welder	Welder	Welder	Welder
Other occupations	Includes occupations in human resources, accounting and finance, IT, administrative assistance, legal and other corporate services.	Includes occupations in human resources, accounting and finance, IT, administrative assistance, legal and other corporate services.	Includes occupations in human resources, accounting and finance, IT, administrative assistance, legal and other corporate services.	Includes occupations in human resources, accounting and finance, IT, administrative assistance, legal and other corporate services.

Appendix 2: Total Industry Labour Demand to 2021, by Occupation

Occupation (NOC)	**2016 Estimated Employment**	**Scenario**	**Expansion Demand**			**Replacement Demand**	**Net Hiring Requirements**
			2017 (a)	**2018–2021** (b)	**Total** (a+b)	**2017–2021** (c)	**2017–2021** (a+b+c)
Total industry	**173,945**	**Modest**	**6,000**	**11,100**	**17,100**	**22,700**	**39,800**
		Delayed	**-8,700**	**15,400**	**6,700**	**22,000**	**28,700**
Chemical engineers (2134)	1,402	Modest	10	80	90	155	240
		Delayed	-60	95	35	150	185
Chemical technologists and technicians (2211)	711	Modest	10	40	50	70	120
		Delayed	-40	55	10	65	80
Civil engineering technologists and technicians (2231)	386	Modest	-5	15	10	50	60
		Delayed	-15	15	5	50	55
Civil engineers (2131)	587	Modest	20	40	55	65	120
		Delayed	-30	50	25	60	85
Construction managers (0711)	706	Modest	-25	15	-5	70	65
		Delayed	-65	30	-35	70	35
Crane operators (7371)	467	Modest	5	20	20	55	75
		Delayed	-30	30	-5	55	50
Drafting technologists and technicians (2253)	439	Modest	-5	15	10	55	65
		Delayed	-40	25	-15	55	40
Electrical/instrumentation engineers (2133)	1,027	Modest	-25	45	20	110	130
		Delayed	-55	50	-5	110	105
Engineering managers (0211)	1,662	Modest	20	155	175	325	500
		Delayed	-15	160	145	335	480
Facility operation and maintenance managers (0714)	2,049	Modest	30	205	235	405	640
		Delayed	-20	215	195	415	610
Geological, petroleum and mining technologists (2212)	2,254	Modest	135	180	315	305	620
		Delayed	-160	270	110	290	400
Geologists and geophysicists (2113)	3,548	Modest	160	255	410	590	1,000
		Delayed	-245	380	135	570	700

Occupation (NOC) (cont.)	**2016 Estimated Employment**	**Scenario**	**Expansion Demand**			**Replacement Demand**	**Net Hiring Requirements**
			2017 (a)	**2018–2021** (b)	**Total** (a+b)	**2017–2021** (c)	**2017–2021** (a+b+c)
Heavy equipment operators (except crane) (7521)	8,563	Modest	225	980	1,205	865	2,070
		Delayed	-120	1,075	955	850	1,805
Heavy-duty equipment mechanics (7312)	2,860	Modest	70	280	355	310	665
		Delayed	-80	325	245	305	550
Industrial electricians (7242)	2,121	Modest	65	190	250	255	505
		Delayed	-80	230	150	250	395
Industrial engineering and manufacturing technologists and technicians (2233)	294	Modest	5	15	20	25	45
		Delayed	-10	20	10	25	35
Inspectors in public and environmental health and safety (2263)	1,880	Modest	55	115	165	315	480
		Delayed	-115	160	50	305	350
Inspectors, testers and technicians (non-destructive) (2261)	969	Modest	5	45	50	105	155
		Delayed	-45	55	10	100	110
Instrumentation engineering technologists (2241)	804	Modest	1	40	40	80	125
		Delayed	-30	45	10	80	90
Instrumentation technicians (2243)	1,711	Modest	20	140	160	185	345
		Delayed	-30	145	120	180	300
Insulators (7293)	360	Modest	5	15	15	30	45
		Delayed	-20	20	+0	25	25
Machinists and machining and tooling inspectors (7231)	644	Modest	5	25	30	65	95
		Delayed	-45	35	-5	65	60
Managers in natural resources production, drilling and well servicing (0811)	5,074	Modest	260	375	635	1,025	1,660
		Delayed	-410	590	180	985	1,160
Mechanical engineering technologists and technicians (2232)	656	Modest	1	30	35	65	95
		Delayed	-30	40	10	60	70
Mechanical engineers (2132)	1,798	Modest	+0	95	95	180	275
		Delayed	-90	115	25	175	200
Millwrights (7311)	4,463	Modest	55	240	295	510	805
		Delayed	-200	295	95	500	595

Occupation (NOC) (cont.)	**2016 Estimated Employment**	**Scenario**	**Expansion Demand**			**Replacement Demand**	**Net Hiring Requirements**
			2017 (a)	**2018–2021** (b)	**Total** (a+b)	**2017–2021** (c)	**2017–2021** (a+b+c)
Mining engineers (2143)	348	Modest	-15	10	-5	30	25
		Delayed	-25	15	-10	30	15
Natural and applied science policy researchers, consultants and program officers (4161)	733	Modest	15	50	65	85	145
		Delayed	-35	65	25	80	105
Oil and gas drilling, servicing and related labourers (8615)	5,389	Modest	365	260	625	340	965
		Delayed	-220	450	230	315	540
Oil and gas well drillers, servicers, testers and related workers (8232)	10,600	Modest	825	550	1,375	815	2,195
		Delayed	-475	980	505	760	1,270
Oil and gas well drilling workers and service operators (8412)	4,692	Modest	480	315	795	340	1,140
		Delayed	-250	570	320	310	630
Petroleum engineers (2145)	3,969	Modest	90	270	355	425	785
		Delayed	-255	375	120	410	530
Petroleum, gas, chemical process operators (no steam ticket required) (9232)	6,569	Modest	-5	325	320	770	1,090
		Delayed	-105	295	185	760	950
Power engineers and power systems operators (9241)	6,737	Modest	175	750	925	795	1,725
		Delayed	75	770	845	790	1,635
Production logistics co-ordinators (1523)	565	Modest	2	25	25	80	110
		Delayed	-15	25	10	80	90
Professional occupations in advertising, marketing and public relations (1123)	538	Modest	20	40	60	75	130
		Delayed	-25	50	30	70	100
Project/cost control engineers (2141)	553	Modest	15	70	85	45	125
		Delayed	-1	75	70	40	115
Purchasing agents and officers including landmen (1225)	3,288	Modest	295	420	710	560	1,270
		Delayed	-215	565	350	530	880
Purchasing and inventory control workers (1524)	344	Modest	5	20	25	55	80
		Delayed	-15	25	5	55	60
Purchasing managers (0113)	371	Modest	10	25	35	60	95
		Delayed	-20	30	10	60	70

Occupation (NOC) (cont.)	**2016 Estimated Employment**	**Scenario**	**Expansion Demand**			**Replacement Demand**	**Net Hiring Requirements**
			2017 (a)	**2018–2021** (b)	**Total** (a+b)	**2017–2021** (c)	**2017–2021** (a+b+c)
Shippers and receivers (1521)	554	Modest	10	25	35	85	120
		Delayed	-40	40	+0	85	85
Steamfitters and pipefitters (7252)	2,239	Modest	15	90	105	215	325
		Delayed	-135	130	-5	210	205
Supervisors and contractors, heavy equipment operator crews (0732)	1,206	Modest	25	55	80	120	195
		Delayed	-90	85	-5	110	105
Supervisors and contractors, oil and gas drilling and services (8222)	7,940	Modest	860	625	1,480	1,250	2,730
		Delayed	-450	1,080	630	1,185	1,815
Supervisors, petroleum, gas and chemical processing and utilities (9212)	1,521	Modest	10	70	80	260	335
		Delayed	-40	70	30	255	290
Supervisors, supply chain, tracking and scheduling co-ordination occupations (1215)	368	Modest	5	15	20	55	75
		Delayed	-25	25	–	55	55
Truck drivers (7511)	3,948	Modest	65	130	200	505	700
		Delayed	-300	240	-60	485	425
Welders (7237)	2,817	Modest	40	170	210	280	490
		Delayed	-135	210	75	275	350
Other occupations	61,222	Modest	1,610	3,120	4,730	9,195	13,925
		Delayed	-3,885	4,720	835	8,920	9,755

Notes: Numbers may not add up due to rounding. As noted in the report, not all replacement demand will be filled and may be dependent on the occupation or the circumstance. Refer to detailed spreadsheets for year-over-year numbers.

Appendix 3: Oil and Gas Services Labour Demand to 2021, by Occupation

Occupation (NOC)	2016 Estimated Employment	Scenario	Expansion Demand			Replacement Demand	Net Hiring Requirements
			2017 (a)	2018–2021 (b)	Total (a+b)	2017–2021 (c)	2017–2021 (a+b+c)
Total oil and gas services sector	**81,500**	**Modest**	**3,800**	**2,800**	**6,700**	**10,200**	**16,800**
		Delayed	**-7,100**	**6,400**	**-700**	**9,600**	**8,900**
Chemical engineers (2134)	295	Modest	5	10	10	30	40
		Delayed	-25	15	-10	25	20
Chemical technologists and technicians (2211)	250	Modest	5	5	10	25	40
		Delayed	-20	15	-5	25	20
Civil engineering technologists and technicians (2231)	30	Modest	0	0	0	5	5
		Delayed	-5	0	0	5	0
Civil engineers (2131)	95	Modest	5	0	5	10	15
		Delayed	-10	5	-5	10	5
Construction managers (0711)	190	Modest	5	0	5	20	25
		Delayed	-25	10	-10	20	5
Crane operators (7371)	295	Modest	5	10	10	35	45
		Delayed	-25	15	-10	30	25
Drafting technologists and technicians (2253)	170	Modest	5	0	5	20	30
		Delayed	-20	10	-10	20	10
Electrical/instrumentation engineers (2133)	2,730	Modest	65	25	90	525	610
		Delayed	-330	160	-170	500	330
Engineering managers (0211)	345	Modest	0	15	15	40	55
		Delayed	-15	20	0	35	40
Facility operation and maintenance managers (0714)	140	Modest	0	5	5	25	35
		Delayed	-10	10	-5	25	20
Geological, petroleum and mining technologists (2212)	195	Modest	5	5	5	20	30
		Delayed	-20	10	-10	20	10

Occupation (NOC) (cont.)	**2016 Estimated Employment**	**Scenario**	**Expansion Demand**			**Replacement Demand**	**Net Hiring Requirements**
			2017 (a)	**2018–2021** (b)	**Total** (a+b)	**2017–2021** (c)	**2017–2021** (a+b+c)
Geologists and geophysicists (2113)	305	Modest	0	15	15	60	70
		Delayed	-15	15	0	60	60
Heavy equipment operators (except crane) (7521)	1,335	Modest	65	40	105	220	325
		Delayed	-120	105	-15	210	190
Heavy-duty equipment mechanics (7312)	2,520	Modest	40	60	95	240	340
		Delayed	-235	140	-90	230	135
Industrial electricians (7242)	1,310	Modest	20	30	50	135	185
		Delayed	-120	75	-45	125	80
Industrial engineering and manufacturing technologists and technicians (2233)	930	Modest	15	25	40	105	145
		Delayed	-80	50	-30	100	75
Inspectors in public and environmental health and safety (2263)	95	Modest	0	5	5	10	10
		Delayed	-10	5	-5	5	5
Inspectors, testers and technicians (non-destructive) (2261)	825	Modest	15	15	30	135	165
		Delayed	-80	45	-35	130	90
Instrumentation engineering technologists (2241)	520	Modest	0	25	25	55	75
		Delayed	-25	25	0	50	55
Instrumentation technicians (2243)	535	Modest	0	25	25	55	80
		Delayed	-25	30	0	55	55
Insulators (7293)	240	Modest	0	10	10	20	30
		Delayed	-20	10	-5	20	15
Machinists and machining and tooling inspectors (7231)	670	Modest	10	15	25	105	125
		Delayed	-65	40	-30	100	70
Managers in natural resources production, drilling and well servicing (0811)	525	Modest	5	15	20	55	80
		Delayed	-40	30	-10	55	40
Mechanical engineering technologists and technicians (2232)	200	Modest	5	5	10	20	25
		Delayed	-15	10	-5	20	10

Occupation (NOC) (cont.)	**2016 Estimated Employment**	**Scenario**	**Expansion Demand**			**Replacement Demand**	**Net Hiring Requirements**
			2017 (a)	**2018–2021** (b)	**Total** (a+b)	**2017–2021** (c)	**2017–2021** (a+b+c)
Mechanical engineers (2132)	455	Modest	5	10	20	45	65
		Delayed	-40	25	-15	40	30
Millwrights (7311)	3,010	Modest	30	95	125	340	470
		Delayed	-225	165	-60	325	265
Mining engineers (2143)	70	Modest	-10	-5	-15	5	-5
		Delayed	-10	-5	-15	5	-5
Natural and applied science policy researchers, consultants and program officers (4161)	1,275	Modest	65	40	100	170	270
		Delayed	-115	100	-15	160	140
Oil and gas drilling, servicing and related labourers (8615)	2,910	Modest	480	235	710	200	910
		Delayed	-195	480	290	175	460
Oil and gas well drillers, servicers, testers and related workers (8232)	6,305	Modest	1,035	505	1,545	525	2,070
		Delayed	-420	1,045	625	460	1,085
Oil and gas well drilling workers and service operators (8412)	2,980	Modest	490	240	730	230	960
		Delayed	-195	490	295	200	495
Petroleum engineers (2145)	460	Modest	-5	10	5	50	55
		Delayed	-20	10	-15	50	35
Petroleum, gas, chemical process operators (no steam ticket required) (9232)	2,235	Modest	5	100	105	260	365
		Delayed	-110	115	5	250	260
Power engineers and power systems operators (9241)	1,020	Modest	25	10	35	105	140
		Delayed	-125	60	-65	100	35
Production logistics co-ordinators (1523)	110	Modest	0	5	5	15	20
		Delayed	-10	5	-5	15	10
Professional occupations in advertising, marketing and public relations (1123)	115	Modest	0	0	5	15	20
		Delayed	-10	5	-5	15	10
Project/cost control engineers (2141)	70	Modest	0	0	5	5	5
		Delayed	-10	5	-5	5	0

Occupation (NOC) (cont.)	**2016 Estimated Employment**	**Scenario**	**Expansion Demand**			**Replacement Demand**	**Net Hiring Requirements**
			2017 (a)	**2018–2021** (b)	**Total** (a+b)	**2017–2021** (c)	**2017–2021** (a+b+c)
Purchasing agents and officers including landmen (1225)	150	Modest	5	5	5	25	30
		Delayed	-15	10	-5	20	15
Purchasing and inventory control workers (1524)	125	Modest	0	0	5	20	25
		Delayed	-10	5	-5	20	15
Purchasing managers (0113)	490	Modest	5	15	20	55	75
		Delayed	-35	25	-10	50	40
Shippers and receivers (1521)	380	Modest	5	5	15	60	70
		Delayed	-40	20	-15	55	40
Steamfitters and pipefitters (7252)	1,540	Modest	15	50	65	150	210
		Delayed	-115	85	-30	140	110
Supervisors and contractors, heavy equipment operator crews (0732)	925	Modest	15	20	35	90	125
		Delayed	-85	50	-35	85	50
Supervisors and contractors, oil and gas drilling and services (8222)	4,530	Modest	745	365	1,110	740	1,850
		Delayed	-300	750	450	680	1,130
Supervisors, petroleum, gas and chemical processing and utilities (9212)	520	Modest	0	25	25	90	110
		Delayed	-25	25	0	85	85
Supervisors, supply chain, tracking and scheduling co-ordination occupations (1215)	200	Modest	5	5	5	30	40
		Delayed	-20	10	-10	30	20
Truck drivers (7511)	2,925	Modest	45	70	110	370	480
		Delayed	-270	165	-105	355	245
Welders (7237)	1,760	Modest	15	55	75	175	250
		Delayed	-130	95	-35	165	130
Other occupations	32,250	Modest	555	635	1,190	4,455	5,645
		Delayed	-3,220	1,835	-1,385	4,230	2,850

Notes: Numbers may not add up due to rounding. As noted in the report, not all replacement demand will be filled and may be dependent on the occupation or the circumstance. Refer to detailed spreadsheets for year-over-year numbers.

Appendix 4: Conventional E&P Labour Demand to 2021, by Occupation

Occupation (NOC)	**2016 Estimated Employment**	**Scenario**	**Expansion Demand**			**Replacement Demand**	**Net Hiring Requirements**
			2017 (a)	**2018–2021** (b)	**Total** (a+b)	**2017–2021** (c)	**2017–2021** (a+b+c)
Total conventional E&P sector	**53,800**	**Modest**	**1,500**	**4,000**	**5,500**	**7,000**	**12,500**
		Delayed	**-2,300**	**4,900**	**2,600**	**6,700**	**9,300**
Chemical engineers (2134)	215	Modest	10	20	30	20	50
		Delayed	-10	25	15	20	35
Chemical technologists and technicians (2211)	430	Modest	25	40	65	50	115
		Delayed	-25	55	30	50	80
Civil engineering technologists and technicians (2231)	55	Modest	0	5	5	10	15
		Delayed	-5	5	5	5	10
Civil engineers (2131)	300	Modest	15	30	45	35	80
		Delayed	-15	40	20	30	55
Construction managers (0711)	155	Modest	5	15	20	15	35
		Delayed	-10	15	10	15	25
Crane operators (7371)	125	Modest	0	10	10	15	25
		Delayed	-5	10	5	15	20
Drafting technologists and technicians (2253)	80	Modest	5	10	15	10	25
		Delayed	-5	10	10	10	20
Electrical/instrumentation engineers (2133)	1,520	Modest	170	225	395	35	725
		Delayed	-110	305	195	310	505
Engineering managers (0211)	105	Modest	5	10	15	15	30
		Delayed	-5	15	5	10	20
Facility operation and maintenance managers (0714)	260	Modest	10	20	30	55	85
		Delayed	-15	30	15	50	65
Geological, petroleum and mining technologists (2212)	305	Modest	10	25	35	35	75
		Delayed	-15	35	20	35	50

Occupation (NOC) (cont.)	**2016 Estimated Employment**	**Scenario**	**Expansion Demand**			**Replacement Demand**	**Net Hiring Requirements**
			2017 (a)	**2018–2021** (b)	**Total** (a+b)	**2017–2021** (c)	**2017–2021** (a+b+c)
Geologists and geophysicists (2113)	395	Modest	15	35	50	80	130
		Delayed	-20	45	25	80	105
Heavy equipment operators (except crane) (7521)	1,835	Modest	115	190	300	315	615
		Delayed	-105	255	150	300	450
Heavy-duty equipment mechanics (7312)	1,505	Modest	15	95	105	145	250
		Delayed	-55	100	45	145	190
Industrial electricians (7242)	150	Modest	5	10	15	15	30
		Delayed	-5	10	5	15	20
Industrial engineering and manufacturing technologists and technicians (2233)	420	Modest	25	45	70	50	125
		Delayed	-25	60	35	50	85
Inspectors in public and environmental health and safety (2263)	120	Modest	0	5	10	10	20
		Delayed	-5	10	5	10	15
Inspectors, testers and technicians (non-destructive) (2261)	675	Modest	35	65	100	115	215
		Delayed	-35	85	50	110	160
Instrumentation engineering technologists (2241)	45	Modest	0	5	5	5	10
		Delayed	0	5	5	5	5
Instrumentation technicians (2243)	390	Modest	5	25	30	40	75
		Delayed	-15	30	15	40	55
Insulators (7293)	125	Modest	0	5	5	10	20
		Delayed	-5	10	5	10	10
Machinists and machining and tooling inspectors (7231)	2,140	Modest	0	345	610	380	990
		Delayed	-165	470	305	350	655
Managers in natural resources production, drilling and well servicing (0811)	110	Modest	265	5	5	10	20
		Delayed	-5	70	5	10	15
Mechanical engineering technologists and technicians (2232)	115	Modest	0	10	15	10	25
		Delayed	-5	10	5	10	20

Occupation (NOC) (cont.)	**2016 Estimated Employment**	**Scenario**	**Expansion Demand**			**Replacement Demand**	**Net Hiring Requirements**
			2017 (a)	**2018–2021** (b)	**Total** (a+b)	**2017–2021** (c)	**2017–2021** (a+b+c)
Mechanical engineers (2132)	450	Modest	5	40	60	50	110
		Delayed	-25	55	30	45	75
Millwrights (7311)	465	Modest	20	15	0	50	55
		Delayed	-10	10	0	50	50
Mining engineers (2143)	70	Modest	-10	10	15	5	25
		Delayed	-5	15	10	5	15
Natural and applied science policy researchers, consultants and program officers (4161)	685	Modest	5	95	160	100	260
		Delayed	-50	130	80	90	170
Oil and gas drilling, servicing and related labourers (8615)	2,400	Modest	-120	25	-95	135	40
		Delayed	-30	-35	-65	135	70
Oil and gas well drillers, servicers, testers and related workers (8232)	4,295	Modest	-210	45	-165	290	125
		Delayed	-55	-60	-120	300	180
Oil and gas well drilling workers and service operators (8412)	1,715	Modest	-10	75	65	115	180
		Delayed	-55	80	25	110	135
Petroleum engineers (2145)	1,295	Modest	30	90	115	150	270
		Delayed	-55	110	55	145	200
Petroleum, gas, chemical process operators (no steam ticket required) (9232)	2,755	Modest	75	75	-5	315	310
		Delayed	-60	40	-20	315	295
Power engineers and power systems operators (9241)	1,940	Modest	95	175	270	215	485
		Delayed	-100	230	130	205	340
Production logistics co-ordinators (1523)	380	Modest	0	15	15	55	70
		Delayed	-10	15	5	55	60
Professional occupations in advertising, marketing and public relations (1123)	320	Modest	15	25	40	45	85
		Delayed	-15	35	20	45	60
Project/cost control engineers (2141)	35	Modest	5	5	10	5	10
		Delayed	0	5	5	5	5

Occupation (NOC) (cont.)	**2016 Estimated Employment**	**Scenario**	**Expansion Demand**			**Replacement Demand**	**Net Hiring Requirements**
			2017 (a)	**2018–2021** (b)	**Total** (a+b)	**2017–2021** (c)	**2017–2021** (a+b+c)
Purchasing agents and officers including landmen (1225)	50	Modest	0	5	5	10	15
		Delayed	-5	5	5	10	10
Purchasing and inventory control workers (1524)	200	Modest	10	15	25	35	55
		Delayed	-10	20	10	30	45
Purchasing managers (0113)	125	Modest	5	10	10	15	25
		Delayed	-5	10	5	15	20
Shippers and receivers (1521)	70	Modest	5	5	10	10	20
		Delayed	-5	10	5	10	15
Steamfitters and pipefitters (7252)	485	Modest	5	25	30	50	80
		Delayed	-20	30	15	45	60
Supervisors and contractors, heavy equipment operator crews (0732)	190	Modest	10	15	25	20	45
		Delayed	-10	20	10	20	30
Supervisors and contractors, oil and gas drilling and services (8222)	3,365	Modest	110	260	370	500	870
		Delayed	-155	330	175	495	675
Supervisors, petroleum, gas and chemical processing and utilities (9212)	770	Modest	-5	35	30	130	160
		Delayed	-25	35	10	130	140
Supervisors, supply chain, tracking and scheduling co-ordination occupations (1215)	70	Modest	5	5	10	10	20
		Delayed	-5	10	5	10	15
Truck drivers (7511)	880	Modest	15	55	70	115	185
		Delayed	-35	70	35	110	145
Welders (7237)	540	Modest	5	30	35	55	90
		Delayed	-20	35	15	55	70
Other occupations	18,675	Modest	785	1,590	2,370	2,725	5,095
		Delayed	-920	2,070	1,155	2,625	3,780

Notes: Numbers may not add up due to rounding. As noted in the report, not all replacement demand will be filled and may be dependent on the occupation or the circumstance. Refer to detailed spreadsheets for year-over-year numbers.

Appendix 5: Oil Sands Labour Demand to 2021, by Occupation

Occupation (NOC)	2016 Estimated Employment	Expansion Demand			Replacement Demand	Net Hiring Requirements
		2017 (a)	2018–2021 (b)	Total (a+b)	2017–2021 (c)	2017–2021 (a+b+c)
Total oil sands sector	**28,900**	**300**	**3,700**	**4,000**	**4,200**	**8,200**
Chemical technologists and technicians (2211)	170	-5	10	5	15	20
Chemical engineers (2134)	510	-25	20	-5	55	45
Civil engineering technologists and technicians (2231)	190	-10	5	-5	25	20
Civil engineers (2131)	80	-5	5	0	10	5
Construction managers (0711)	320	-35	0	-40	30	-5
Crane operators (7371)	45	0	5	0	5	5
Drafting technologists and technicians (2253)	140	-15	0	-15	15	5
Managers in natural resources production, drilling and well servicing (0811)	780	30	120	150	160	310
Electrical/instrumentation engineers (2133)	520	-35	15	-20	55	35
Engineering managers (0211)	1,100	0	120	120	215	335
Natural and applied science policy researchers, consultants and program officers (4161)	165	-5	15	10	20	30
Facility operation and maintenance managers (0714)	1,265	10	155	165	250	415
Geologists and geophysicists (2113)	380	-20	25	5	55	60
Heavy equipment operators (except crane) (7521)	4,505	170	830	1,000	475	1,475
Heavy-duty equipment mechanics (7312)	1,400	50	240	290	155	445
Industrial electricians (7242)	765	25	120	145	95	235
Industrial engineering and manufacturing technologists and technicians (2233)	45	0	5	5	5	10
Inspectors in public and environmental health and safety (2263)	275	0	30	30	45	75
Instrumentation engineering technologists (2241)	150	-5	5	0	15	15
Instrumentation technicians (2243)	725	10	85	95	80	180

Occupation (NOC) (cont.)	**2016 Estimated Employment**	**Expansion Demand** (% growth/decline)			**Replacement Demand**	**Net Hiring Requirements**
		2017 (a)	**2018–2021** (b)	**Total** (a+b)	**2017–2021** (c)	**2017–2021** (a+b+c)
Insulators (7293)	0	0	0	0	0	0
Machinists and machining and tooling inspectors (7231)	10	0	0	0	0	0
Mechanical engineering technologists and technicians (2232)	235	-10	10	0	20	20
Mechanical engineers (2132)	700	-35	30	-5	65	60
Millwrights (7311)	715	25	110	135	85	220
Mining engineers (2143)	210	-15	5	-5	15	10
Geological, petroleum and mining technologists (2212)	250	0	40	45	35	80
Oil and gas drilling, servicing and related labourers (8615)	5	0	0	0	0	0
Oil and gas well drillers, servicers, testers and related workers (8232)	0	0	0	0	0	0
Oil and gas well drilling workers and service operators (8412)	0	0	0	0	0	0
Power engineers and power systems operators (9241)	4,915	150	650	795	585	1,385
Petroleum, gas, chemical process operators (no steam ticket required) (9232)	520	20	95	110	65	180
Petroleum engineers (2145)	850	-35	75	40	85	125
Production logistics co-ordinators (1523)	5	0	0	0	0	0
Professional occupations in advertising, marketing and public relations (1123)	55	0	10	10	10	15
Project/cost control engineers (2141)	405	10	60	70	30	100
Purchasing agents and officers including landmen (1225)	295	10	50	60	50	105
Purchasing and inventory control workers (1524)	80	0	5	5	10	15
Purchasing managers (0113)	20	0	0	0	5	5
Inspectors, testers and technicians (non-destructive) (2261)	225	-10	15	5	25	30
Shippers and receivers (1521)	100	0	10	10	15	25

Occupation (NOC) (cont.)	**2016 Estimated Employment**	**Expansion Demand**			**Replacement Demand**	**Net Hiring Requirements**
		2017 (a)	**2018–2021** (b)	**Total** (a+b)	**2017–2021** (c)	**2017–2021** (a+b+c)
Steamfitters and pipefitters (7252)	180	-5	10	5	20	25
Supervisors and contractors, heavy equipment operator crews (0732)	90	5	15	20	10	30
Supervisors and contractors, oil and gas drilling and services (8222)	0	0	0	0	0	0
Supervisors, petroleum, gas and chemical processing and utilities (9212)	0	0	0	0	0	0
Supervisors, supply chain, tracking and scheduling co-ordination occupations (1215)	55	0	5	0	10	10
Truck drivers (7511)	0	0	0	0	0	0
Welders (7237)	450	15	75	90	50	140
Other occupations	5,030	30	600	630	1,260	1,890

Notes: Numbers may not add up due to rounding. As noted in the report, not all replacement demand will be filled and may be dependent on the occupation or the circumstance. Refer to detailed spreadsheets for year-over-year numbers.

Appendix 6: Pipelines Labour Demand to 2021, by Occupation

Occupation (NOC)	**2016 Estimated Employment**	**Scenario**	**Expansion Demand**			**Replacement Demand**	**Net Hiring Requirements**
			2017 (a)	**2018–2021** (b)	**Total** (a+b)	**2017–2021** (c)	**2017–2021** (a+b+c)
Total industry pipelines sector	**9,700**	**Modest**	**450**	**550**	**1,000**	**1,300**	**2,300**
		Delayed	**400**	**400**	**800**	**1,350**	**2,150**
Chemical engineers (2134)	35	Modest	0	0	5	5	5
		Delayed	0	0	0	5	5
Chemical technologists and technicians (2211)	210	Modest	10	10	20	25	45
		Delayed	10	10	20	25	40
Civil engineering technologists and technicians (2231)	115	Modest	5	5	10	15	25
		Delayed	5	5	10	15	25
Civil engineers (2131)	115	Modest	5	5	10	10	25
		Delayed	5	5	10	15	20
Construction managers (0711)	40	Modest	0	0	5	5	10
		Delayed	0	0	5	5	10
Crane operators (7371)	0	Modest	0	0	0	0	0
		Delayed	0	0	0	0	0
Drafting technologists and technicians (2253)	50	Modest	0	0	5	5	10
		Delayed	0	0	5	5	10
Electrical/instrumentation engineers (2133)	40	Modest	0	0	5	10	15
		Delayed	0	0	5	10	15
Engineering managers (0211)	55	Modest	5	5	5	5	15
		Delayed	0	0	5	5	10
Facility operation and maintenance managers (0714)	160	Modest	5	10	15	30	50
		Delayed	5	5	15	35	45
Geological, petroleum and mining technologists (2212)	65	Modest	5	5	5	10	15
		Delayed	5	5	5	10	15

Occupation (NOC) (cont.)	**2016 Estimated Employment**	**Scenario**	**Expansion Demand**			**Replacement Demand**	**Net Hiring Requirements**
			2017 (a)	**2018–2021** (b)	**Total** (a+b)	**2017–2021** (c)	**2017–2021** (a+b+c)
Geologists and geophysicists (2113)	85	Modest	5	5	10	15	25
		Delayed	5	5	10	20	25
Heavy equipment operators (except crane) (7521)	0	Modest	0	0	0	0	0
		Delayed	0	0	0	0	0
Heavy-duty equipment mechanics (7312)	35	Modest	0	0	5	5	5
		Delayed	0	0	0	5	5
Industrial electricians (7242)	0	Modest	0	0	0	0	0
		Delayed	0	0	0	0	0
Industrial engineering and manufacturing technologists and technicians (2233)	0	Modest	0	0	0	0	0
		Delayed	0	0	0	0	0
Inspectors in public and environmental health and safety (2263)	35	Modest	0	0	5	5	5
		Delayed	0	0	0	5	5
Inspectors, testers and technicians (non-destructive) (2261)	105	Modest	5	5	10	20	30
		Delayed	5	5	10	20	25
Instrumentation engineering technologists (2241)	90	Modest	5	5	10	10	20
		Delayed	5	5	10	10	15
Instrumentation technicians (2243)	65	Modest	5	5	5	5	15
		Delayed	5	5	5	5	10
Insulators (7293)	0	Modest	0	0	0	0	0
		Delayed	0	0	0	0	0
Machinists and machining and tooling inspectors (7231)	185	Modest	10	10	20	30	50
		Delayed	10	10	15	30	45
Managers in natural resources production, drilling and well servicing (0811)	0	Modest	0	0	0	0	0
		Delayed	0	0	0	0	0
Mechanical engineering technologists and technicians (2232)	105	Modest	5	5	10	10	20
		Delayed	5	5	10	10	20

Occupation (NOC) (cont.)	**2016 Estimated Employment**	**Scenario**	**Expansion Demand**			**Replacement Demand**	**Net Hiring Requirements**
			2017 (a)	**2018–2021** (b)	**Total** (a+b)	**2017–2021** (c)	**2017–2021** (a+b+c)
Mechanical engineers (2132)	190	Modest	10	10	20	20	40
		Delayed	10	10	15	20	35
Millwrights (7311)	275	Modest	10	15	25	35	60
		Delayed	10	10	25	35	55
Mining engineers (2143)	0	Modest	0	0	0	0	0
		Delayed	0	0	0	0	0
Natural and applied science policy researchers, consultants and program officers (4161)	50	Modest	0	0	5	5	10
		Delayed	0	0	5	5	10
Oil and gas drilling, servicing and related labourers (8615)	80	Modest	5	5	10	5	10
		Delayed	5	5	5	5	10
Oil and gas well drillers, servicers, testers and related workers (8232)	0	Modest	0	0	0	0	0
		Delayed	0	0	0	0	0
Oil and gas well drilling workers and service operators (8412)	0	Modest	0	0	0	0	0
		Delayed	0	0	0	0	0
Petroleum engineers (2145)	70	Modest	5	5	5	10	15
		Delayed	5	5	5	10	15
Petroleum, gas, chemical process operators (no steam ticket required) (9232)	1,060	Modest	50	60	105	130	235
		Delayed	45	45	85	130	215
Power engineers and power systems operators (9241)	155	Modest	5	10	15	15	35
		Delayed	5	5	10	15	30
Production logistics co-ordinators (1523)	70	Modest	5	5	5	10	15
		Delayed	5	5	5	10	15
Professional occupations in advertising, marketing and public relations (1123)	50	Modest	0	0	5	5	10
		Delayed	0	0	5	5	10
Project/cost control engineers (2141)	40	Modest	0	0	5	5	10
		Delayed	0	0	5	5	5

Occupation (NOC) (cont.)	**2016 Estimated Employment**	**Scenario**	**Expansion Demand**			**Replacement Demand**	**Net Hiring Requirements**
			2017 (a)	**2018–2021** (b)	**Total** (a+b)	**2017–2021** (c)	**2017–2021** (a+b+c)
Purchasing agents and officers including landmen (1225)	65	Modest	5	5	5	10	0
		Delayed	5	5	5	10	15
Purchasing and inventory control workers (1524)	30	Modest	0	0	0	5	5
		Delayed	0	0	0	5	5
Purchasing managers (0113)	125	Modest	5	5	15	15	25
		Delayed	5	5	10	15	25
Shippers and receivers (1521)	0	Modest	0	0	0	0	0
		Delayed	0	0	0	0	0
Steamfitters and pipefitters (7252)	35	Modest	0	0	5	5	5
		Delayed	0	0	0	5	5
Supervisors and contractors, heavy equipment operator crews (0732)	0	Modest	0	0	0	0	0
		Delayed	0	0	0	0	0
Supervisors and contractors, oil and gas drilling and services (8222)	40	Modest	0	0	5	5	10
		Delayed	0	0	5	5	10
Supervisors, petroleum, gas and chemical processing and utilities (9212)	235	Modest	10	15	25	40	65
		Delayed	10	10	20	40	60
Supervisors, supply chain, tracking and scheduling co-ordination occupations (1215)	40	Modest	0	0	5	5	10
		Delayed	0	0	5	5	10
Truck drivers (7511)	140	Modest	5	10	15	20	30
		Delayed	5	5	10	20	30
Welders (7237)	65	Modest	5	5	5	5	15
		Delayed	5	5	5	5	10
Other occupations	5,270	Modest	240	295	535	755	1,290
		Delayed	220	215	435	765	1,200

Notes: Numbers may not add up due to rounding. As noted in the report, not all replacement demand will be filled and may be dependent on the occupation or the circumstance. Refer to detailed spreadsheets for year-over-year numbers.

Appendix 7: Projected Unemployment Rates to 2021, Total Industry and by Occupation

Occupation (NOC)	**Balanced Unemployment Rate (%)**	**Scenario**	**Projected Unemployment Rate (%)**				
			2017	**2018**	**2019**	**2020**	**2021**
Total Industry	**6.0**	**Modest**	**5.4**	**5.0**	**5.1**	**5.7**	**5.9**
		Delayed	**6.6**	**4.8**	**5.2**	**5.6**	**5.9**
Chemical technologists and technicians (2211)	3.5	Modest	3.8	3.2	3.3	3.9	4.0
		Delayed	4.9	3.1	3.3	3.8	4.1
Chemical engineers (2134)	3.5	Modest	3.9	3.2	3.3	3.9	4.0
		Delayed	4.7	3.2	3.4	3.8	4.0
Civil engineering technologists and technicians (2231)	3.5	Modest	4.0	3.2	3.5	3.9	4.0
		Delayed	4.4	3.2	3.6	3.9	4.1
Civil engineers (2131)	3.5	Modest	3.7	3.1	3.2	3.9	4.1
		Delayed	4.9	3.0	3.3	3.7	4.1
Construction managers (0711)	3.5	Modest	4.5	3.5	3.4	4.0	4.1
		Delayed	5.4	3.4	3.5	3.9	4.2
Crane operators (7371)	5.5	Modest	5.8	5.4	5.3	5.9	6.0
		Delayed	7.0	5.2	5.4	5.8	6.1
Drafting technologists and technicians (2253)	3.5	Modest	4.1	3.4	3.3	4.0	4.1
		Delayed	5.3	3.2	3.4	3.8	4.2
Electrical/instrumentation engineers (2133)	3.5	Modest	4.2	3.4	3.5	3.8	4.0
		Delayed	4.6	3.4	3.5	3.8	4.0
Engineering managers (0211)	3.5	Modest	3.7	2.9	3.4	3.7	3.9
		Delayed	4.0	2.9	3.4	3.7	3.9
Facility operations and maintenance managers (0714)	3.5	Modest	3.7	2.8	3.4	3.7	3.9
		Delayed	4.0	2.7	3.4	3.7	3.9
Geologists and geophysicists (2113)	3.5	Modest	3.6	3.1	3.1	3.9	4.1
		Delayed	5.3	2.8	3.1	3.7	4.1
Geological, petroleum and mining technologists (2212)	3.5	Modest	3.3	3.0	3.0	3.9	4.1
		Delayed	5.3	2.7	3.1	3.7	4.1

Occupation (NOC) (cont.)	**Balanced Unemployment Rate (%)**	**Scenario**	**Projected Unemployment Rate (%)**				
			2017	**2018**	**2019**	**2020**	**2021**
Geological, petroleum and mining technologists (2212)	3.5	Modest	3.3	3.0	3.0	3.9	4.1
		Delayed	5.3	2.7	3.1	3.7	4.1
Heavy equipment operators (except crane) (7521)	5.5	Modest	5.5	4.6	5.3	5.8	5.9
		Delayed	6.1	4.5	5.3	5.7	5.9
Heavy-duty equipment mechanics (7312)	5.5	Modest	5.5	4.8	5.3	5.8	5.9
		Delayed	6.2	4.6	5.3	5.7	5.9
Industrial electricians (7242)	6.5	Modest	6.5	6.0	6.2	6.8	6.9
		Delayed	7.5	5.8	6.3	6.7	6.9
Industrial engineering and manufacturing technologists and technicians (2233)	3.5	Modest	3.8	3.2	3.3	3.9	4.0
		Delayed	4.6	3.1	3.4	3.8	4.0
Inspectors in public and environmental health and safety (2263)	3.5	Modest	3.7	3.2	3.2	3.9	4.1
		Delayed	5.0	3.0	3.3	3.7	4.1
Inspectors, testers and technicians (non-destructive) (2261)	3.5	Modest	3.8	3.4	3.4	3.9	4.0
		Delayed	4.6	3.2	3.5	3.8	4.0
Instrumentation engineering technologists (2241)	3.5	Modest	3.8	3.4	3.4	3.8	3.9
		Delayed	4.3	3.3	3.5	3.8	4.0
Instrumentation technicians (2243)	3.5	Modest	3.7	3.1	3.4	3.7	3.9
		Delayed	4.2	3.0	3.4	3.7	3.9
Insulators (7293)	6.5	Modest	6.8	6.5	6.3	6.9	7.0
		Delayed	7.9	6.3	6.4	6.8	7.1
Machinists and machining and tooling inspectors (7231)	6.5	Modest	6.7	6.5	6.3	6.9	7.0
		Delayed	7.8	6.3	6.4	6.8	7.0
Managers in natural resources production, drilling and well servicing (0811)	3.5	Modest	3.5	3.1	3.0	3.9	4.1
		Delayed	5.4	2.8	3.1	3.6	4.1
Mechanical engineering technologists and technicians (2232)	3.5	Modest	3.9	3.2	3.4	3.9	4.0
		Delayed	4.6	3.1	3.5	3.8	4.0
Mechanical engineers (2132)	3.5	Modest	4.0	3.2	3.4	3.9	4.0
		Delayed	4.7	3.2	3.4	3.8	4.0

Occupation (NOC) (cont.)	**Balanced Unemployment Rate (%)**	**Scenario**	**Projected Unemployment Rate (%)**				
			2017	**2018**	**2019**	**2020**	**2021**
Millwrights (7311)	6.5	Modest	6.6	6.3	6.4	6.8	6.9
		Delayed	7.5	6.2	6.4	6.8	7.0
Mining engineers (2143)	3.5	Modest	4.5	3.2	3.6	4.0	4.2
		Delayed	5.0	3.2	3.6	3.9	4.2
Natural and applied science policy researchers, consultants and program officers (4161)	3.5	Modest	3.8	3.1	3.2	3.9	4.0
		Delayed	4.8	3.0	3.3	3.7	4.1
Oil and gas drilling, servicing and related labourers (8615)	7.0	Modest	6.7	6.8	6.6	7.5	7.5
		Delayed	8.2	6.4	6.8	7.3	7.6
Oil and gas well drillers, servicers, testers and related workers (8232)	7.0	Modest	6.6	6.8	6.6	7.5	7.6
		Delayed	8.3	6.3	6.8	7.2	7.6
Oil and gas well drilling workers and service operators (8412)	7.0	Modest	6.3	6.7	6.5	7.5	7.6
		Delayed	8.5	6.1	6.6	7.2	7.6
Power engineers and power systems operators (9241)	5.5	Modest	5.5	4.9	5.3	5.6	5.8
		Delayed	5.8	4.9	5.3	5.6	5.8
Petroleum, gas, chemical process operators (no steam ticket required) (9232)	5.5	Modest	5.8	5.3	5.5	5.8	5.9
		Delayed	6.1	5.3	5.6	5.8	6.0
Petroleum engineers (2145)	3.5	Modest	3.8	3.1	3.1	3.9	4.1
		Delayed	5.2	3.0	3.2	3.7	4.1
Production logistics co-ordinators (1523)	3.5	Modest	3.9	3.3	3.4	3.9	4.0
		Delayed	4.5	3.3	3.5	3.8	4.1
Professional occupations in advertising, marketing and public relations (1123)	3.5	Modest	3.7	3.1	3.2	3.9	4.1
		Delayed	4.9	3.0	3.2	3.7	4.1
Project/cost control engineers (2141)	3.5	Modest	3.6	2.8	3.2	3.7	3.8
		Delayed	4.0	2.7	3.2	3.6	3.8
Purchasing agents and officers including landmen (1225)	3.5	Modest	3.2	2.6	2.8	3.8	4.2
		Delayed	5.5	2.4	2.8	3.5	4.1
Purchasing and inventory control workers (1524)	3.5	Modest	3.7	3.3	3.3	3.9	4.0
		Delayed	4.7	3.2	3.4	3.8	4.0

Occupation (NOC) (cont.)	**Balanced Unemployment Rate (%)**	**Scenario**	**Projected Unemployment Rate (%)**				
			2017	**2018**	**2019**	**2020**	**2021**
Purchasing managers (0113)	3.5	Modest	3.7	3.2	3.2	3.9	4.1
		Delayed	5.0	3.0	3.2	3.7	4.1
Shippers and receivers (1521)	3.5	Modest	3.7	3.4	3.2	4.0	4.1
		Delayed	5.1	3.1	3.3	3.8	4.1
Steamfitters and pipefitters (7252)	6.5	Modest	6.8	6.4	6.3	6.9	7.0
		Delayed	7.8	6.3	6.4	6.8	7.0
Supervisors and contractors, heavy equipment operator crews (7302)	3.5	Modest	3.7	3.4	3.2	3.9	4.1
		Delayed	5.1	3.1	3.3	3.7	4.1
Supervisors and contractors, oil and gas drilling and services (8222)	3.5	Modest	2.8	3.0	2.9	4.0	4.1
		Delayed	5.2	2.5	3.0	3.6	4.2
Supervisors, petroleum, gas and chemical processing and utilities (9212)	3.5	Modest	3.8	3.3	3.4	3.9	4.0
		Delayed	4.4	3.3	3.5	3.8	4.0
Supervisors, supply chain, tracking and scheduling co-ordination occupations (1215)	3.5	Modest	3.7	3.4	3.3	3.9	4.1
		Delayed	5.0	3.2	3.4	3.8	4.1
Truck drivers (7511)	5.5	Modest	5.7	5.5	5.3	6.0	6.1
		Delayed	7.1	5.2	5.4	5.8	6.1
Welders (7237)	6.5	Modest	6.7	6.2	6.3	6.8	7.0
		Delayed	7.6	6.1	6.4	6.7	7.0
Other Occupations	6.0	Modest	6.1	5.8	5.7	6.4	6.6
		Delayed	7.5	5.6	5.8	6.2	6.6

Note: Labour supply/demand gaps are assessed by comparing the projected unemployment rates with what is considered to be the balanced unemployment rate for the occupation or industry overall. A labour surplus is assumed if the projected unemployment rate is above the balanced rate. Conversely, a labour shortage is expected if the unemployment rate falls below the balanced rate. For the total oil and gas industry, the balanced unemployment rate is determined to be 6%. The balanced rate differs for each occupation and tends to be higher than 6% if the occupation is highly transferable and/or has a high degree of movement from job-to-job, such as field workers and trades occupations.

Appendix 8: Glossary

Age-related attrition: Jobs vacated due to retirements and deaths.

Attraction: Activities based around the goal of attracting workers to a company, organization or industry.

Balanced labour market: Point at which the unemployment rate matches the balanced rate.

Bitumen: Tar-like form of crude oil, often found in oil sands deposits.

Capital expenditures (CAPEX): Funds used by a company to acquire or upgrade physical assets such as property, industrial buildings or equipment. It is often used to undertake new projects or investments.

Conventional exploration and production (E&P) sub-sector: Activity for conventional and unconventional oil and gas reserves, excluding oil sands.

Downstream (sector): Term commonly used to refer to the refining of crude oil, and the selling and distribution of natural gas and products derived from crude oil.

Employment: The number of workers required to support the activity levels in a given year (direct employment only).

Expansion demand: This is the projected change in the number of workers required to support industry activity levels.

Immigrant: Person who enters a country from another country. In this report, an immigrant refers to a person who comes Canada on their own, rather than by the initiation of a company via international recruitment.

In situ: Latin, meaning "in place."

Labour market: Collective term describing the dynamics and interaction of workers and employers, including employment, unemployment, participation rates and wages.

Labour force: Labour pool available in an industry and/or sector.

Labour shortage: Unemployment rate falls below the balanced rate.

Labour supply: Availability of suitable workers in a labour market.

Labour surplus: Unemployment rate is above the balanced rate.

Liquefied natural gas (LNG): Natural gas that undergoes a cooling process and is converted to liquid for ease of storage and/or transportation.

National Occupational Classification (NOC): Developed and updated in partnership with Statistics Canada, the NOC provides a standardized language for describing the work performed by Canadians in the labour market.

Net hiring requirements: Sum of job openings created due to expansion and replacement demand.

Offshore: Exploration for oil and/or natural gas located offshore, often in oceans or other large bodies of water. The offshore industry in Canada is mainly found in Newfoundland and Labrador and Nova Scotia.

Oil and gas services sub-sector: Contracted exploration, extraction and production services to the oil sands and non-oil sands E&P sectors and includes the following:

- Drilling and completion services, including drilling and service rig activities
- Geophysical services (also known as seismic) including surveying, permitting and reclamation, line construction and data acquisition
- Petroleum services pertaining to oilfield services including but not limited to acidizing wells, cementing and perforating well casings, well testing and servicing, pumping, and oil well logging

Oil sands sub-sector: Sector of the petroleum industry involved in the extraction and upgrading of bitumen.

Operating expenditures (OPEX): A category of expenditure that a business incurs as a result of performing its normal business operations.

Petroleum (or oil and gas) industry: Global processes of exploration extraction, refining, transporting and marketing petroleum products.

Pipelines sub-sector: Petroleum industry sector responsible for mainline transmission for transporting daily crude oil and natural gas production.

Replacement demand: See "age-related attrition".

Retention: Activities based around keeping or retaining workers within a company, organization or industry.

Shale: Fine-grained sedimentary rock from which liquid hydrocarbons can be extracted.

Steam-assisted gravity drainage (SAGD): In situ method of producing heavy oil that involves two horizontal wellbores, one above the other. Steam is injected into the upper wellbore and softened bitumen is recovered from the lower wellbore.

Sub-sector: Subset of an industry.

Transferability: Ability for something to be transferred. In this report, this term refers to the ability to transfer skills from one occupation, sector or industry to another.

Unemployment rate: Percentage of the economically active population that are not working but want to work and are actively looking for employment.

Upgrading: Process by which heavy oil and bitumen are converted into lighter crude by increasing the ratio of hydrogen to carbon, normally using either coking or hydroprocessing.

Upstream petroleum industry: Includes searching for, recovering and producing crude oil and natural gas.

Appendix 9: List of Tables and Figures

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Acknowledgments

The Petroleum Labour Market Information (PetroLMI) Division of Enform gratefully acknowledges the Government of Canada's department of Employment and Social Development Canada for the funding to undertake and complete this study.

PetroLMI is also grateful for the time and expertise provided by ARC Energy Research Institute, Canadian Association of Petroleum Producers (CAPP), other industry associations, petroleum companies and other stakeholders.

Last but not least, PetroLMI acknowledges the contributions of Creative Links International Inc., Stacy Kindopp, Projektor Brand Image Ltd., Prism Economics and Analysis, and Dynawise Inc. for assisting in the study and production of this report.

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Published March 2017

The **Petroleum Labour Market Information (PetroLMI) Division of Enform** is a leading resource for labour market information and trends in the Canadian petroleum industry.

PetroLMI specializes in providing petroleum labour market data, analysis and insights, as well as occupation profiles and other resources for workforce and career planning.

With the support of industry, PetroLMI has developed the **Careers in Oil + Gas** website to provide its resources and key industry information to those in workforce planning or who are planning and pursuing careers in the oil and gas industry.

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