



2019 OIL AND GAS LABOUR MARKET UPDATE





TABLE OF CONTENTS

Foreword	3
Introduction	5
Scope, methodology and assumptions	7
2019 Industry-wide labour market update	8
Oil and gas sub-sector analysis	11
Oil and gas services	12
Conventional exploration and production (E&P)	15
Oil sands	20
Pipeline	26
Regional oil and gas employment outlook	28
British Columbia	30
Alberta	33
Saskatchewan	34
Rest of Canada	35
Labour supply challenges	36
Employment impacts of oil and gas activity across Canada	38
Conclusion	42
Appendix 1: Scope and methodology	43
Appendix 2: National Occupational Classification (NOC) and sample industry job titles	45
Appendix 3: 2019 Total industry labour demand, by occupation	51
Appendix 4: Glossary	54
Acknowledgements	56



FOREWORD

One-year labour market update reflects industry uncertainty

Growing Canada's oil and gas industry and accessing global markets are essential factors for creating employment growth in Canada's oil and gas industry. At its peak in 2014, direct employment in the oil and gas sector hovered around 226,500 jobs. PetroLMI is forecasting direct employment to further decline to 173,300 in 2019, a 23% drop over the five-year period.

The low oil and gas prices that have persisted since late 2014 have played a key role in the industry's workforce restructuring as investment has decreased significantly and cost management has taken priority. Mergers and acquisitions have also impacted the workforce, along with technical improvements and innovation, enabling the industry to produce more oil and gas with less investment and fewer workers.

More recently, however, stalled progress on the development of pipeline and liquefied natural gas (LNG) infrastructure projects in Canada is driving lower capital spending and lower employment levels across the industry's conventional exploration and production (E&P), oil sands, oil and gas services and pipeline sub-sectors.

The inability of the oil and gas industry to access new markets came to a head in 2018, as growing oil production met transportation limits. The result was an oversupply of production, discounted prices, a loss of investor confidence and a decline in capital spending. Ultimately, in early December 2018 the Government of Alberta issued a mandatory curtailment of oil production to reduce oil inventories and stem revenue losses to government and some companies.

While oil prices have improved somewhat, and the curtailment of oil production is expected to wind down over 2019, market access issues continue to weigh heavily on investors and capital investment, which in turn impacts employment growth.

Similarly, natural gas prices, which fell into negative territory in the summer of 2018, will continue to be discounted until pipeline bottlenecks are addressed and LNG export infrastructure is constructed and operational.

Until additional export capacity becomes available, the employment outlook for Canada's oil and gas sector will be impacted. So too will the ability to accurately forecast medium- or long-term labour market requirements.

Faced with uncertain market conditions, many E&P and oil sands companies have chosen to report only limited capital and production guidance for 2019. Given

PetroLMI's reliance on company capital and operating expenditure forecasts to accurately project the industry's workforce requirements, we have for the first time limited our forecast to one year.

This **2019 Oil and Gas Labour Market Update** provides an overview of what we expect to occur in 2019, a look back at what has happened since the 2014 commodity price crash, and highlights some of the new industry employment and occupational opportunities for the longer term. We hope to follow up this report with a five-year labour market forecast in 2020.

While oil prices have since improved, and the curtailment of oil production is expected to wind down over 2019, market access issues continue to weigh on investors and capital investment, which in turn impacts employment growth.





INTRODUCTION

With the rapid deceleration of commodity prices beginning in late 2014, the Canadian oil and gas direct workforce declined by 18%, or 40,200 jobs, to 186,300 workers towards the end of 2016.

Since then, a much leaner workforce – forecasted for about 173,300 direct jobs in 2019 – is expected across the conventional exploration and production (E&P), oil sands, oil and gas services and pipeline sub-sectors of Canada’s oil and gas industry.

Several factors affect employment levels in the oil and gas industry. Changes in capital and operational spending result in a corresponding increase or decrease in employment, particularly in oil and gas services, which relies on the other sub-sectors for its revenue. Industry consolidation through mergers and acquisitions (M&As) regularly leads to employment losses through more efficiencies and the elimination of duplicate jobs. Improvements in technology and innovation, while leading to growth of new skills and occupations, can increase oil and gas production while decreasing the workforce required.

New infrastructure, particularly oil and gas pipelines and liquefied natural gas (LNG) export facilities, is key for industry access to new global markets and to expand domestic markets. Progress on construction

of new infrastructure has been challenged by several factors, however, including delays due to regulatory requirements and court proceedings, which have weighed heavily on capital investment decisions, investor confidence and employment growth.

In 2014, at the peak of activity, Canada’s oil and gas industry invested over \$80 billion of capital into Canada’s economy. By late 2016, capital investment had dropped to about \$38 billion. Investment rebounded slightly with improving commodity prices in 2017 to about \$43 billion, but fell 6% in 2018 and is expected to fall further to \$32 billion in 2019.

A closer look at the components of the industry’s capital spending shows that oil sands capital spending, while still a significant contribution to Canada’s economy compared to other industries, has been on a downward trend for the last five years and is forecasted to be about \$12 billion in 2019. E&P companies, meanwhile, are expected to cut conventional E&P capital spending by 28% to about \$20 billion in 2019.

Oil and gas industry expenditures and direct employment, 2014 to 2019

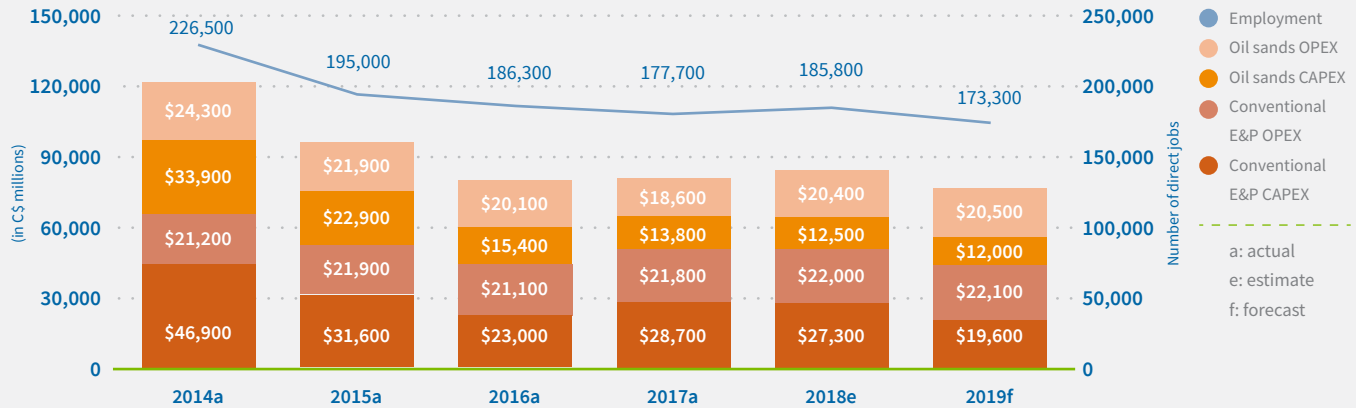


Figure 1 Sources: Statistics Canada, ARC Energy Research Institute, PetroLMI
Notes: Total industry expenditures includes oil sands and conventional E&P expenditures.

The result of these capital cuts is that any significant recovery of jobs lost between 2014 and 2016 remains on hold.

2018 was a particularly challenging year for Canada’s oil and gas industry. Infrastructure constraints came to a head. The selling price for Canadian oil fell sharply as production growth outstripped pipeline capacity just as maintenance requirements took refiners of Canadian heavy crude oil offline in the fall. In October 2018, the average discount was \$US 43 per barrel (/bbl) for Canada’s oil compared to the average price for US light oil. In December 2018, the Government of Alberta curtailed oil production to stem revenue losses to government and some companies.

Natural gas prices were also challenged in 2018. With no means to deliver growing natural gas supplies to market, prices were briefly negative in the summer months of 2018, with some E&P companies paying customers to take their natural gas away.

Oil prices have improved somewhat in early 2019 and the curtailment of oil production is expected to wind down later this year. However, uncertainty surrounding market access and diversification continues. Any optimism for transportation bottlenecks to be resolved in late 2019 with a combination of more pipeline

and railcar capacity was only dampened with the announcement of a one-year delay on the long-awaited upgrade to Enbridge’s Line 3 replacement project, which carries oil from Alberta to the U.S. Midwest.

The outlook for natural gas is similar. In British Columbia, LNG Canada and Woodfibre LNG are proceeding with construction and are expected to have a significant, positive impact on Canada’s future natural gas development. However, these projects won’t drive investment growth for some time.

Due to the level of uncertainty in the industry, this report examines workforce projections for Canada’s oil and gas industry for 2019 only, including corresponding job gains or losses, potential hiring activity due to age-related attrition, as well as the opportunities and challenges regarding the labour supply. Forecasts are provided for the total oil and gas industry, as well as by key occupations. Employment projections are made available for the E&P, oil sands, oil and gas services and pipeline sub-sectors as well as by province.

This report includes a section that explores the impact of oil and gas investment on jobs directly and indirectly across Canada. Finally, this report highlights some

changes and trends that will impact hiring over the next decade. These include advancing technologies, and with them shifting occupations and skill requirements; opportunities for Indigenous Peoples; market diversification through the expansion of domestic and international demand for natural gas; and construction employment driven by investment in oil and gas-related major projects.

PetroLMI's **2019 Labour Market Update** is intended to provide information for the oil and gas industry, educational and training institutions, and governments to assist with workforce planning, program and policy development. All projections are based on spending and production assumptions at the time of research.

Scope, methodology and assumptions

PetroLMI's labour market projections are produced using a modelling system developed in 2006 and continuously refined through consultation with industry, labour market economists and workforce planning analysts. Research for this report also includes survey and other data gathered through consultations with industry representatives. The PetroLMI model produces labour demand projections for the upstream and midstream oil and gas industry¹ (including yearly employment, expansion and replacement demand) by sub-sector and by occupation. 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.

The assumptions used in this report to project Canada's oil and gas workforce for 2019 are based on current

uncertain market conditions, expected oil and gas pricing, E&P and oil sands production, as well as E&P and oil sands capital and operating expenditures². These could change should market conditions improve. These assumptions include:

- **Conventional E&P:** Capital spending declines by 28% in 2019 to about \$20 billion compared to 2018. Operational spending remains flat at about \$22 billion as E&P companies focus on productivity improvements and cost-cutting measures to address lower oil and gas prices.
- **Oil sands:** Capital spending declines by about 5% in 2019 to \$12 billion as large mining projects completed in 2018 move into operation. Capital spending on in situ oil sands operations increases slightly as a handful of expansion projects progress. Operational costs to increase slightly to about \$21 billion.

With the 2014-2016 price collapse, Canada's oil and gas industry focused not only on workforce reductions, but also streamlined business processes and increased the use of technologies and innovation to reduce costs. Even as oil and gas prices began to recover somewhat in 2017 and early 2018, the industry maintained its focus on improving productivity and managing costs.

With this in mind, PetroLMI has adjusted its employment projections for 2019 using assumptions about factors that impact workforce productivity and requirements. These factors include synergies due to mergers and acquisitions and consolidation in the industry, ongoing production increases from major projects that have already been staffed, and technology and innovation application.

¹ Sectors considered out-of-scope: downstream, LNG construction and operations, construction including engineering, manufacturing, truck transportation, professional, technical and scientific services, financial, etc. Refer to Appendix 1 for further details on PetroLMI's scope, methodology and assumptions.

² Expenditure forecasts were supplied by ARC Energy Research Institute as of January 2019 and incorporate the production forecast from the Canadian Association of Petroleum Producers' (CAPP) June 2018 Crude Oil Forecast, Markets and Transportation report. PetroLMI conducted industry consultations in January and February 2019 to confirm assumptions and resulting labour demand projections and analysis.



Due to lower investment in 2019, continued focus on productivity improvements and ongoing consolidation through mergers and acquisitions, PetroLMI is forecasting that approximately 12,500 positions are at risk, which will shrink employment by 7% to 173,300 workers in 2019 from 185,800 workers in 2018.

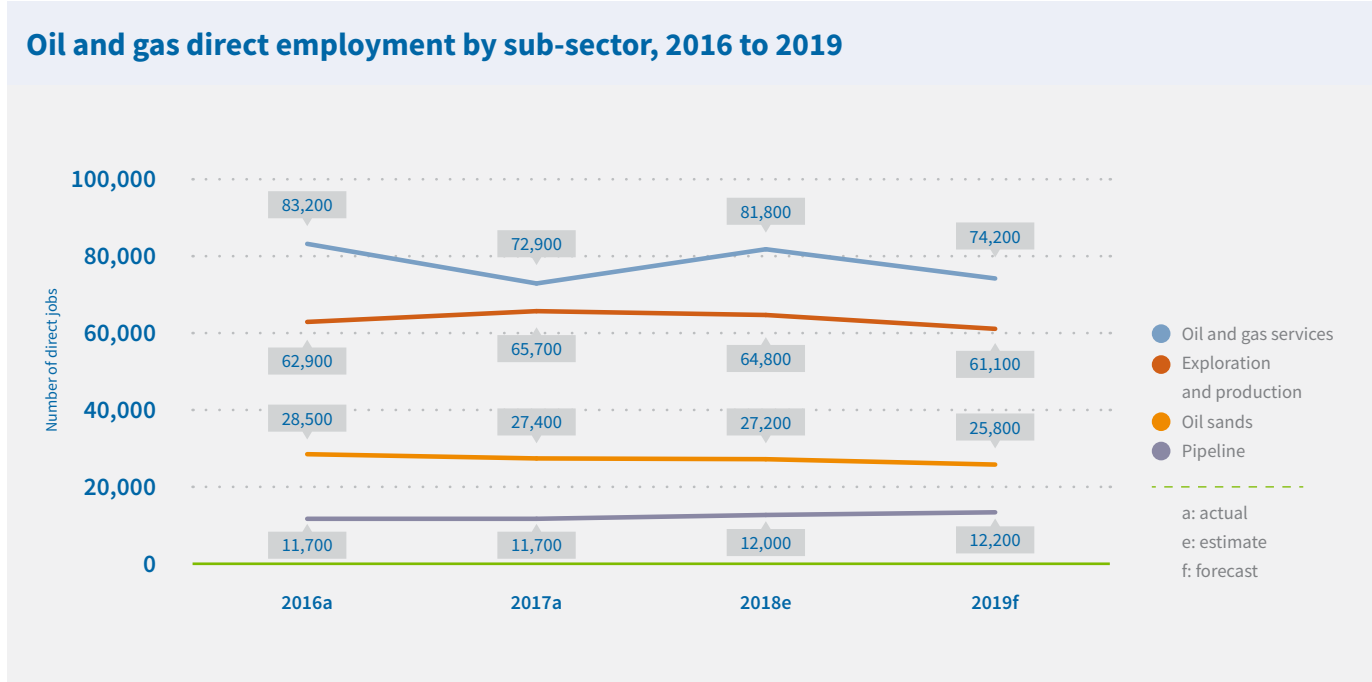


Figure 2 Sources: PetroLMI and Statistics Canada
 Notes: Total industry and sub-sector workforce numbers are rounded to the nearest hundred.

Risk of employment losses across all occupations

There is a risk of employment losses across all occupations according to PetroLMI's model, although occupations most at risk are those tied directly to short-term employment drivers such as reduced capital spending, productivity enhancements and corporate consolidations by the industry.

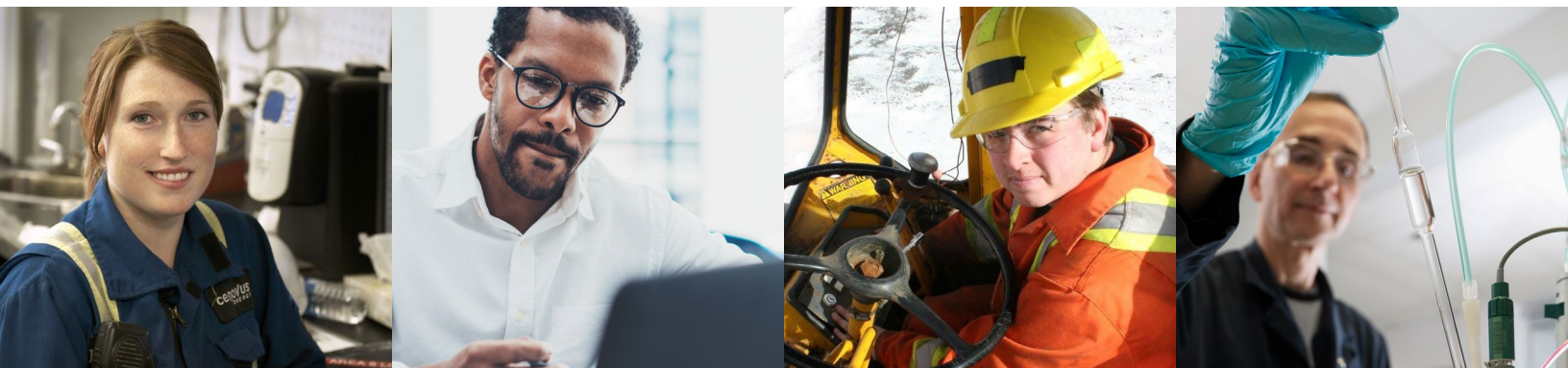
At the same time, there will be some targeted hiring for specific skills in 2019 and beyond, including information technology (IT) occupations as the industry looks to use information gathered at well sites and facilities to drive

the next wave of productivity improvements. There will also be targeted hiring of professionals with skills in managing regulatory requirements as a result of federal and provincial climate change policies, environmental regulations and impact assessment requirements. Limited job growth is expected as a result of expansion and improvements to some smaller pipeline systems, ramp-ups for recently approved natural gas pipeline projects, staffing for new natural gas processing infrastructure and expansion of some in situ oil sands operations.

Occupations most impacted in the short term (% of total oil and gas industry job losses)

1. Contractors and supervisors, oil and gas drilling and services **(6.4%)**
2. Managers in natural resources production, drilling and well servicing **(5.4%)**
3. Purchasing agents and officers, including landmen **(5.2%)**
4. Heavy equipment operators **(5%)**
5. Oil and gas well drillers, servicers, testers and related workers **(4.3%)**
6. Oil and gas well drilling workers and service operators **(3%)**
7. Petroleum engineers **(2.5%)**
8. Transport truck drivers **(2.3%)**
9. Construction millwrights and industrial mechanics **(2.1%)**
10. Geological and mineral technologists and technicians **(2.1%)**

Notes: Short-term employment drivers include declines in capital spending, productivity enhancements due to process improvements and implementation of technology, and corporate consolidations.



More than 4,000 workers eligible to retire

Approximately 4,200 workers across the industry are eligible to retire in 2019, based on industry demographics and historical retirement rates. However, all positions, whether vacated by turnovers or retirements, will be assessed for the most

cost-effective means of getting the required work done. As a result, age-related attrition may be used to offset positions eliminated due to consolidation, technology implementation and productivity gains, potentially skewing anticipated replacement rates³.

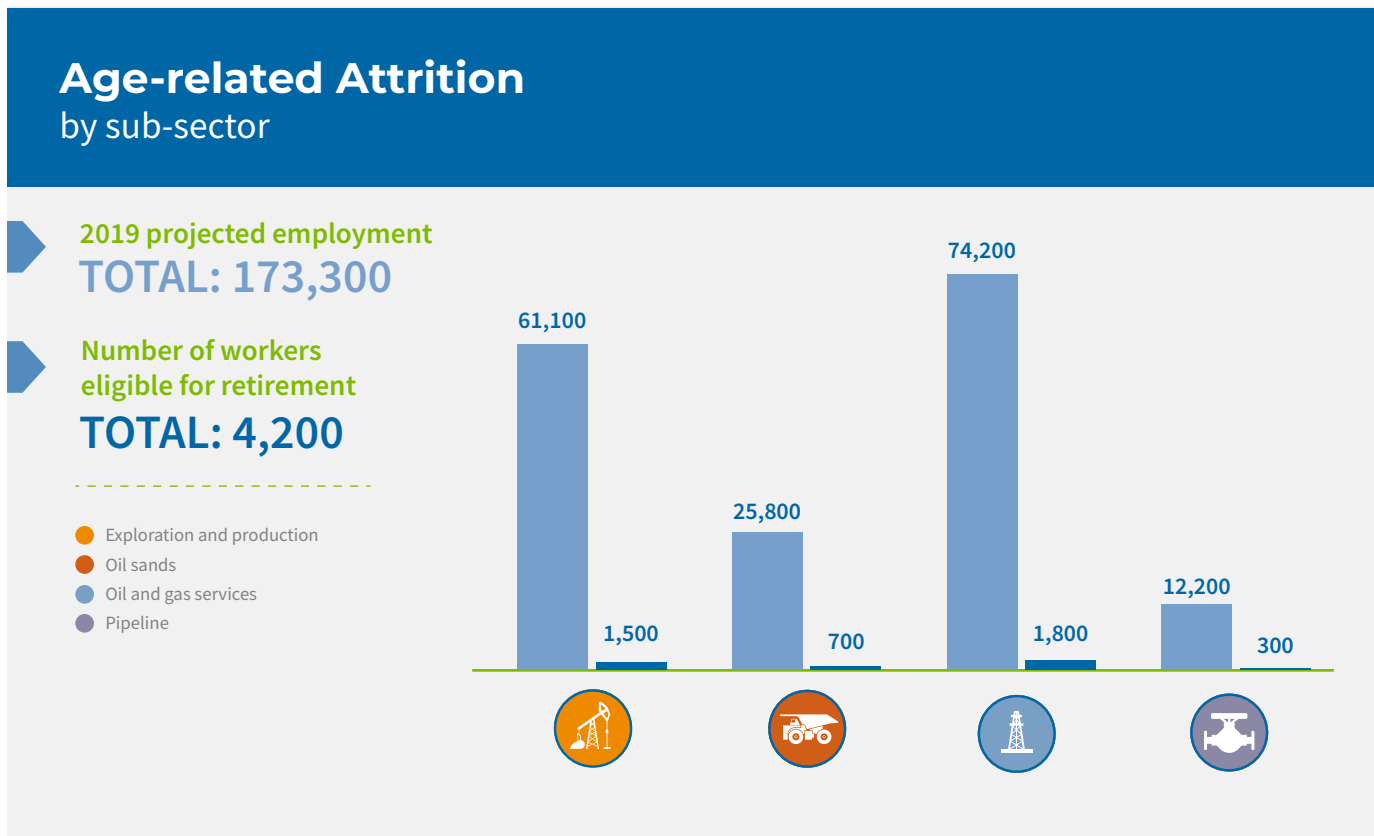


Figure 3 Source: PetroLMI

Notes: Numbers may not add up due to rounding. Refer to the detailed spreadsheet for a breakdown of workforce requirements by occupation and sub-sector.



³ As a result and with the exception of the labour demand table in Appendix 3, age-related attrition is not combined with expansion demand to present a net hiring requirement for the industry.



OIL AND GAS SUB-SECTOR ANALYSIS

Not all oil and gas industry sub-sectors will be impacted in the same way by short-term employment drivers such as reduced capital spending, productivity enhancements due to process improvements, implementation of technologies, and corporate consolidations.

Oil and gas services companies, which rely heavily on spending from other sub-sectors for revenue and business activity, face the greatest challenges in 2019. Despite significant cost-cutting and productivity improvements, the financial health of the many oil and gas services companies across Canada has not yet recovered from the 2014-2016

downturn, adding to the challenge. The decline in industry capital spending will put jobs focused on supporting exploration and development particularly at risk. At current investment levels, only in situ steam-assisted oil sands projects and the pipeline sub-sector will be spared from employment losses in 2019.

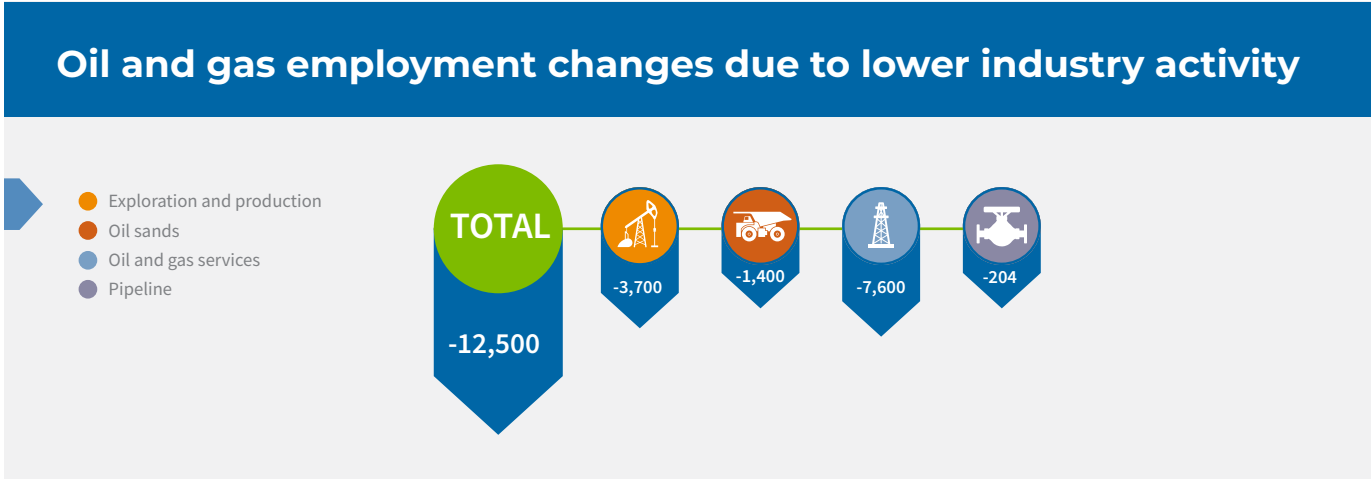


Figure 4 Source: PetroLMI

Oil and gas services

Oil and gas services employment rebound was short-lived

Employment in the oil and gas services sub-sector began to rebound in late 2017 and early 2018 along with capital spending. However, in 2019, as E&P capital spending retreats to below 2016 levels and oil sands capital spending continues its decline, rebound in employment has halted. About 9% of oil and gas services jobs are at risk of being lost in 2019. This represents approximately 7,600 positions. This sub-sector has seen significant consolidation recently, including Trican Well Service's acquisition of Canyon Services Group and Ensign Energy Services' acquisition of Trinidad Drilling. Acquisitions could account for job losses within the sub-sector as companies look for operational efficiencies and eliminate duplicate roles.

Technology, regulatory requirements creating new oil and gas services occupations

While demand for traditional occupations in drilling, completing and equipping new wells will decline

in 2019, some existing and new occupations are expected to see increased demand. With more drilling rigs automated, drilling contractors are reporting an increased demand for skills to maintain, update and repair automation systems at remote well sites. Demand for workers with skills in software development, sensor installation and maintenance, and IT infrastructure development and maintenance is growing as a number of E&P companies outsource automated well site monitoring and optimization systems to oil and gas service companies.

Regulatory requirements surrounding methane emissions mitigation are also expected to create more demand for select occupations in a lead-up to a required 40% emissions reduction target by 2025 in Alberta. British Columbia has initiated a similar regulation.

Oil and gas services occupations tied to capital spending by E&P and oil sands companies will be at greatest risk in 2019.

Occupations most impacted in the short term (% of total oil and gas services job losses)

- | | |
|--|--|
| 1. Oil and gas well drillers, servicers, testers and related workers (10.1%) | 6. Transport truck drivers (3.3%) |
| 2. Contractors and supervisors, oil and gas drilling and services (7.2%) | 7. Construction millwrights and industrial mechanics (3.1%) |
| 3. Oil and gas well drilling workers and service operators (4.8%) | 8. Heavy equipment operators (except crane) (2.8%) |
| 4. Oil and gas drilling, servicing and related labourers (4.6%) | 9. Welders and related machine operators (1.8%) |
| 5. Managers in natural resources production, drilling and well servicing (3.5%) | 10. Geoscientists and oceanographers (1.7%) |

Notes: Short-term employment drivers include declines in capital spending, productivity enhancements due to process improvements and implementation of technology, and corporate consolidations.

Positions left vacant by retirements unlikely to be filled

Approximately 1,800, or 2%, of oil and gas services workers will be eligible for retirement in 2019, based on industry demographics and historical retirement rates.

Given the large number of positions at risk of being lost in 2019 for this sub-sector, most of these positions will probably not be filled. Some service companies will likely still need to fill select, key roles in management or in highly skilled occupations that cannot be filled internally.

Top 10 oil and gas services occupations with the greatest number of eligible retirements

Occupation (NOC 2016)	2019 projected employment	Number of positions eligible for retirement	Retirement rate
TOTAL	74,235	1,780	2%
Contractors and supervisors, oil and gas drilling and services (8222)	5,385	150	3%
Oil and gas well drillers, servicers, testers and related workers (8232)	7,495	105	1%
Managers in natural resources production, drilling and well servicing (0811)	2,605	90	3%
Transport truck drivers (7511)	2,435	75	3%
Construction millwrights and industrial mechanics (7311)	2,300	55	2%
Heavy equipment operators (except crane) (7521)	2,095	45	2%
Geoscientists and oceanographers (2113)	1,250	45	4%
Oil and gas drilling, servicing and related labourers (8615)	3,455	45	1%
Oil and gas well drilling workers and service operators (8412)	3,540	45	1%
Petroleum, gas, chemical process operators (no steam ticket required) (9232)	1,515	40	3%

Table 1 Source: PetroLMI

Notes: Refer to Statistics Canada National Occupational Classification (NOC) 2016 version 1.2 for details on these occupations.

Numbers may not add up due to rounding. Refer to the detailed spreadsheet for a full list of occupational projections for the sub-sector.

Orphan well program to spur employment activity in Alberta

In 2018, with significant advocacy efforts from the Petroleum Services Association of Canada (PSAC), the Government of Alberta loaned the Orphan Well Association (OWA) \$235 million to decommission approximately 2,340 orphan well sites over three years, activity that would create over 2,000 full-time equivalent (FTE) direct jobs. This spending is above and beyond what the OWA will spend with funds from industry levies each year, plus what industry itself would spend decommissioning company-owned inactive wells.

As a result, the OWA decommissioned a total of 1,088 wells in 2018. Most of the direct jobs generated by this spending will be within the oil and gas services sub-sector. Decommissioning of a well site typically involves 29 to 35 workers on site, depending on the complexity of the activities required.

The occupations involved include:

- Oil and gas well drillers, servicers, testers and related workers
- Oil and gas well drilling and related workers and services operators
- Transport truck drivers
- Heavy equipment operators (except crane)
- Inspectors in public and environmental health and occupational health and safety
- Engineering inspectors and regulatory officers
- Crane operators
- Contractors and supervisors, oil and gas drilling and services

- Paramedical occupations
- Welders and related machine operators
- Oil and gas drilling, servicing and related labourers
- Construction trades helpers and labourers

A well site becomes an orphan when the company or other entity legally or financially responsible for it becomes insolvent, typically through bankruptcy. The Orphan Well Association is responsible for decommissioning and closure of orphan well sites in Alberta.

Decommissioning activities include:

- Cleaning and plugging the wellbore
- Cutting well casing and capping it with a vented cap
- Removing all equipment and buildings
- Replacing topsoil and restoring vegetation and/or reforestation



Source: Petroleum Services Association of Canada (PSAC)

Conventional exploration and production (E&P)

As oil and gas prices and capital spending began to recover in 2017, employment in the E&P sub-sector experienced a slight increase. In 2018, jobs were once again eliminated as capital budgets retreated and the impact of insolvencies and mergers and acquisitions impacted the labour force. Along with the further decline in capital spending, E&P employment will continue to be impacted by insolvencies and ongoing mergers and acquisitions in 2019. In 2018 there were some significant consolidations, including Baytex Energy's acquisition of Raging River Exploration and Vermilion Energy's takeover of Spartan Energy.

Decline in projected E&P employment may not be the biggest workforce risk

Approximately 3,700 positions in the E&P sub-sector are at risk in 2019. The jobs include highly skilled occupations tied to identifying and developing new oil and gas opportunities, well planning activities and managing drilling and completions operations. This will only further erode the talent and skills needed to discover, design and build new projects when activity picks up.

Operational spending flat, less risk of job losses

Spending on E&P operations – all of the processes involved in producing, processing and storing oil and gas – has been relatively flat for the past four years. At the same time, production of non-oil sands oil and natural gas in Western Canada has climbed 7% and 5%, respectively, indicating a significant increase in operational productivity over the same time period.

While occupations tied to oil and gas field and plant operations are at less risk from price fluctuations than those tied to capital projects, productivity improvements with individual oil and gas wells and increases in multi-well pad production are lessening the need for more workers to match growing production. Growth in natural gas processing in northeastern British Columbia and western Alberta is forecast to provide opportunities for certain occupations in 2019, including supervisors in petroleum, gas and chemical processing and utilities, and operators in petroleum, gas and chemical processing. In addition, more natural gas processing plants will require operators to be certified as power engineers.

Rise of digital oilfields impacting E&P workforce and skill requirements

Not unlike the oil and gas services sub-sector, exploration and production activities are undergoing technological disruption that is beginning to affect employment opportunities and the type of occupations in demand. Consultations with E&P operators and technology suppliers have focused on the introduction of automation technologies that are being integrated into well sites and facilities. The use of remote well site monitoring systems, for instance, is growing across the oil and gas industry and has cut routine site visits by as much as 50%. The use of artificial intelligence (AI) to optimize production from conventional oil wells is also now commercial in at least two fields in Canada. These technologies reduce the need for field operators where deployed.

The integration of new technologies is creating demand in a variety of IT-related roles. Many of these new roles are

not within E&P companies, because third-party service providers offer out-of-the-box solutions to the industry.

Occupations most impacted in the short term (% of total E&P job losses)

1. Purchasing agents and officers **(16.3%)**
2. Managers in natural resources production, drilling and well servicing **(10.2%)**
3. Contractors and supervisors, oil and gas drilling and services **(6.8%)**
4. Geoscientists and oceanographers **(6.6%)**
5. Petroleum engineers **(5.5%)**
6. Geological and mineral technologists and technicians **(4%)**
7. Heavy equipment operators (except crane) **(1.4%)**
8. Chemical engineers **(1.3%)**
9. Mechanical engineers **(1.3%)**
10. Transport truck drivers **(1.1%)**

Notes: Short-term employment drivers include declines in capital spending, productivity enhancements due to process improvements and implementation of technology, and corporate consolidations.



Age-related attrition could help E&P companies manage risk of job losses

Approximately 1,500, or 2%, of the E&P workforce is eligible for retirement in 2019, based on industry demographics and historical retirement rates. Controlling costs continues to be a priority for oil and gas producers, which may result in many of these retirement positions not being filled.

Technological improvements, including the digitization and automation of some accounting and supply chain functions, are already enabling employees to be more productive and limiting the need to fill some vacant positions.

Top 10 E&P occupations with the greatest number of eligible retirements

Occupation (NOC 2016)	2019 projected employment	Number of positions eligible for retirement	Retirement rate
TOTAL	61,130	1,485	2%
Contractors and supervisors, oil and gas drilling and services (8222)	3,840	100	3%
Purchasing agents and officers (1225)	2,925	100	3%
Geoscientists and oceanographers (2113)	2,220	80	4%
Managers in natural resources production, drilling and well servicing (0811)	2,030	75	4%
Petroleum, gas, chemical process operators (no steam ticket required) (9232)	2,760	65	2%
Petroleum engineers (2145)	2,290	45	2%
Heavy equipment operators (except crane) (7521)	1,640	35	2%
Geological and mineral technologists and technicians (2212)	890	30	3%
Power engineers and power systems operators (steam ticket required) (9241)	1,445	30	2%
Supervisors, petroleum, gas and chemical processing and utilities (9212)	810	20	2%

Table 2 Source: PetroLMI

Notes: Refer to Statistics Canada National Occupational Classification (NOC) 2016 version 1.2 for details on these occupations.

Numbers may not add up due to rounding. Refer to the detailed spreadsheet for a full list of occupational projections for the sub-sector.



SPOTLIGHT

Technology advancements changing workforce and skill requirements

Canada's oil and gas industry is just beginning to experience the effects of the next wave of technological advancements. Emerging, disruptive technologies are expected to reduce the number of workers required to perform certain tasks while increasing demand for other skills.

At Suncor Energy's North Steepbank oil sands mining site near Fort McMurray, Alberta, autonomous heavy haulers operate using GPS (global positioning system), wireless communication and perceptive technologies. At its Sarnia refinery in Ontario, Suncor is preparing to deploy wireless technology that uses wearable equipment to transmit near real-time data to improve workers' safety and productivity on site. Unmanned aerial vehicles (UAV), or drones, are being deployed for several initiatives in Suncor's operations to assist with equipment inspection and conduct surveying. At Shell autonomous gas-detection robotics are at work, as are remote assistance monitoring and operations equipment, and 3D imaging to detect fugitive emissions⁴.

The adoption of data analytics, cloud technology, wearable electronics, machine learning, blockchain and other technologies is creating new occupations and transforming existing roles.

New technologies range from automated systems that run oilfield facilities remotely from offices hundreds of kilometres away, to artificial intelligence (AI) that enhances or replaces human decision-making, to aerial and stationary robotics. These technologies are driving the next wave of efficiencies, safety and productivity improvements. Integrating technology is also changing the skills required across many oil and gas occupations. Field workers require more computer and analytical skills as paper documents are eliminated and more analytics are deployed to analyze and improve productivity⁵. Demand for skills such as creativity, critical thinking and analysis, as well as emotional intelligence is on the rise, while demand for physical skills such as manual dexterity and endurance is on the decline.

For some time, international exploration and production companies have automated offshore oil and gas production facilities – in some cases eliminating on-site operators – and have increased efficiencies in their operations using predictive maintenance. While low oil and gas prices have slowed investment in digital technologies in onshore operations, that is changing and is having an impact.

⁴ Energy Safety Canada Executive Summit, February 2019

⁵ PetroLMI, *Labour Productivity in Canada's Oil and Gas Industry*, September 2017

As an example, one large Canadian oil sands company expects the integration of digital technologies to support its production growth of 15% in the near future without hiring any new employees.

Precision Drilling, one of Canada's largest drilling companies, reports reductions in crew counts on 60% of its wells drilled in 2018 due to automation and that number is only expected to grow as more rigs are equipped with digital technologies.

The use of data analytics is increasing the speed of operations, allowing fewer workers to do more. Machine learning, meanwhile, is becoming a skill of central importance to petroleum engineers, and demand is growing for big data architects, automation technicians and information technology project managers.

Emerging skills required to support implementation of technology:

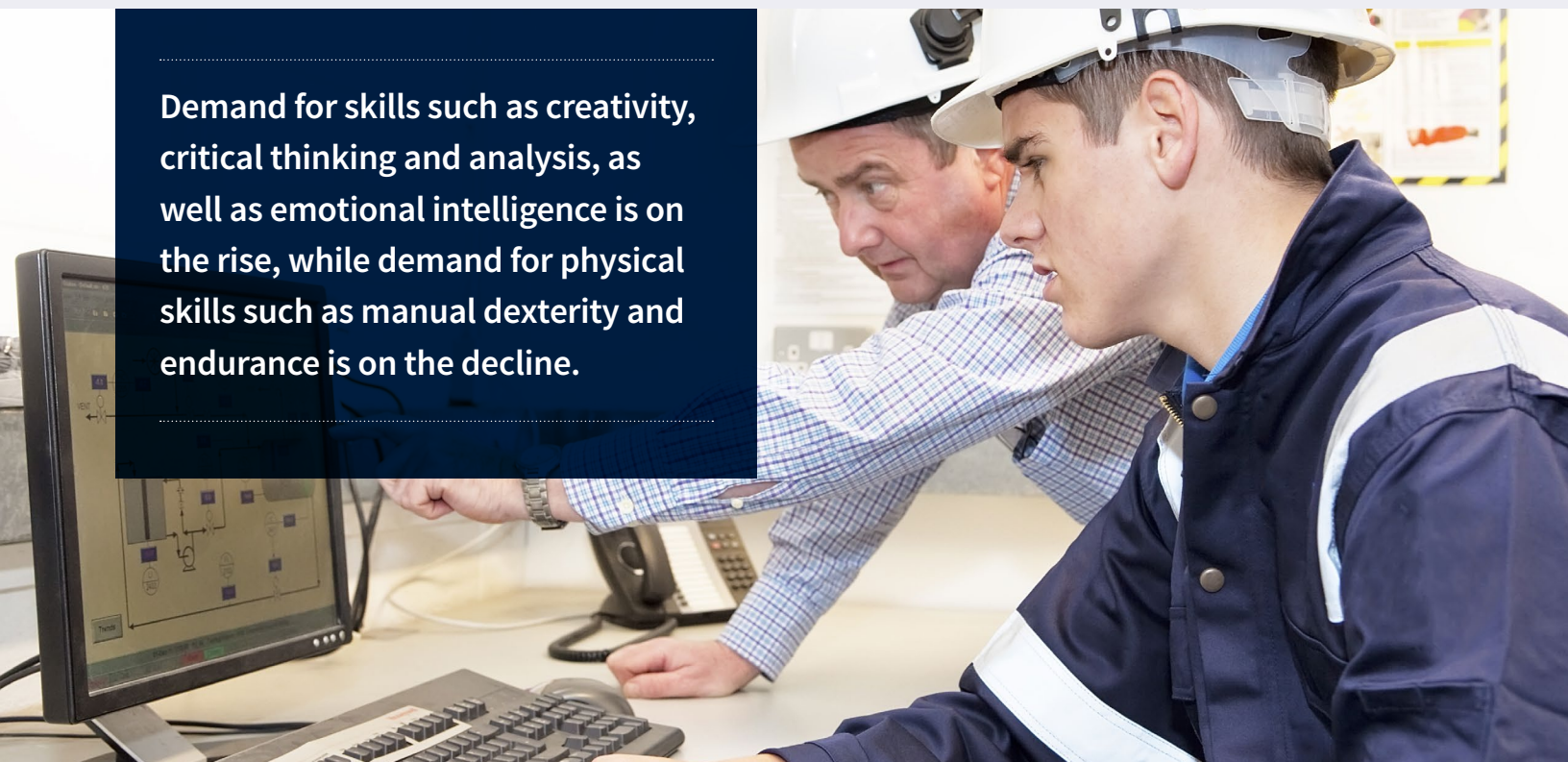
- Data analysis, including big data
- Robotics
- AI and machine learning
- Process automation
- Software and applications development
- Information technology
- Systems engineering
- Digital transformation
- Organizational development

Occupations most likely to be impacted by accelerated use of technology:

- Accounting occupations
- Data entry occupations
- Plant and field operations
- Maintenance trades
- Heavy haulers (oil sands mining)

Source: World Economic Forum, *The Future of Jobs Report 2018* September 2018

Demand for skills such as creativity, critical thinking and analysis, as well as emotional intelligence is on the rise, while demand for physical skills such as manual dexterity and endurance is on the decline.



Oil sands

With relatively flat capital spending in 2019, corporate consolidation of ownership and continuing productivity improvements, job losses of about 1,400, or 5%, are expected in the oil sands. Operators will focus on sustaining their oil production levels. Over 75% of capital will be spent on sustaining activities such as drilling, tying in development wells to maintain production and facility maintenance, and turnarounds to improve production and remove bottlenecks. Less than 25% of capital expenditures will be spent on growth projects.

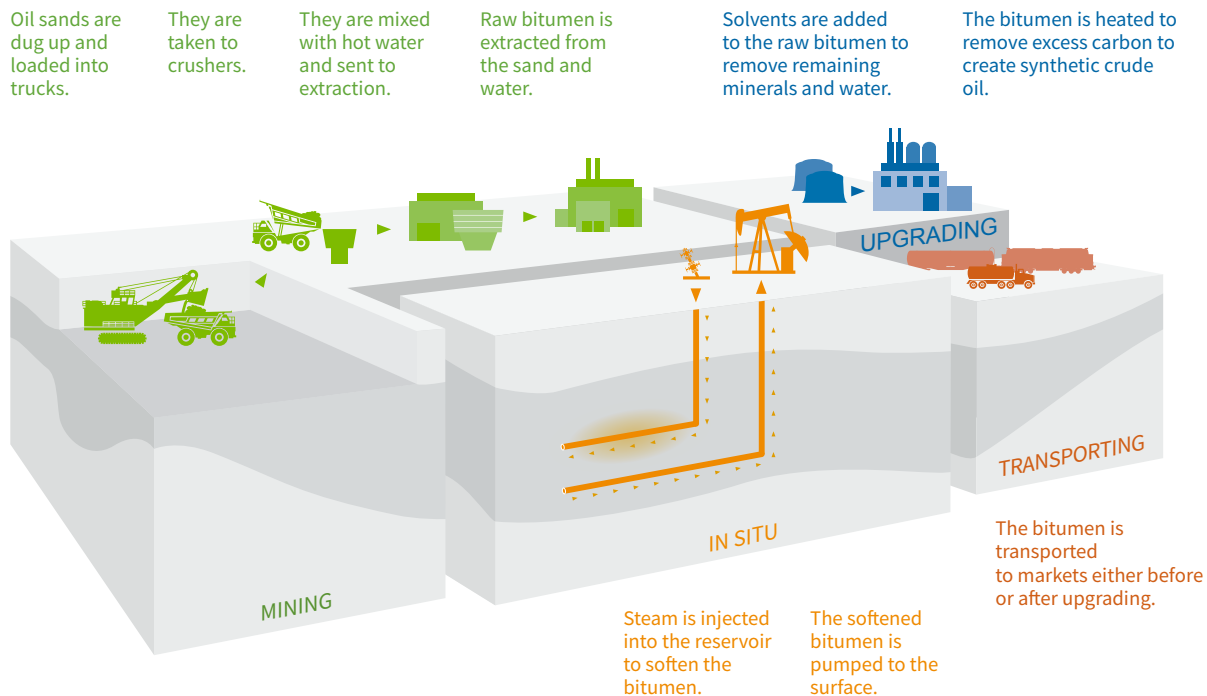
At the same time, oil sands production is expected to climb by almost 5%, or 148,000 bbls/d, driven by recently completed oil sands mining projects ramping up to full capacity and some previously announced in situ projects coming on stream. Operational staff were

hired in 2017 and 2018 in preparation of the completed mining projects, so no related additional hiring activity is expected for 2019. Some hiring activity is expected by in situ expansion projects as they ramp up to operation in late 2019 or early 2020. Overall, spending on oil sands operations is expected to increase only slightly.

In 2019, oil sands companies are also expected to continue to focus on leveraging technology to improve operational efficiency and control costs across all operation types. Recent corporate consolidation in the oil sands is expected to drive a portion of the job losses as duplicate jobs are eliminated and operational efficiencies are gained.

Changes to oil sands employment will vary depending on the type of operations.

Oil sands mining, in situ and upgrading operations



Source: PetroLMI

Mining operations will experience the majority of employment losses

Oil sands mining operations are forecast to lose approximately 1,200 jobs in 2019 and will account for 86% of total oil sands job losses. Driving some of the employment change is Suncor’s Fort Hills mining project moving from construction into full operation with no new projects on the horizon. Consolidation, including Canadian Natural Resources’ acquisition of Shell Canada’s oil sands assets and Suncor’s increased ownership in Syncrude Canada, will also

impact employment this year as companies continue to eliminate duplicate jobs and find operational efficiencies. Technology changes, including the introduction of autonomous heavy haulers, will impact mining employment in 2019 and beyond. Employment for in situ oil sands operations, meanwhile, is expected to increase by over 100 jobs as new projects ramp up towards commercial production in 2020. For upgrading projects there is a forecasted decline of more than 300 positions, due largely to improved operational efficiencies.

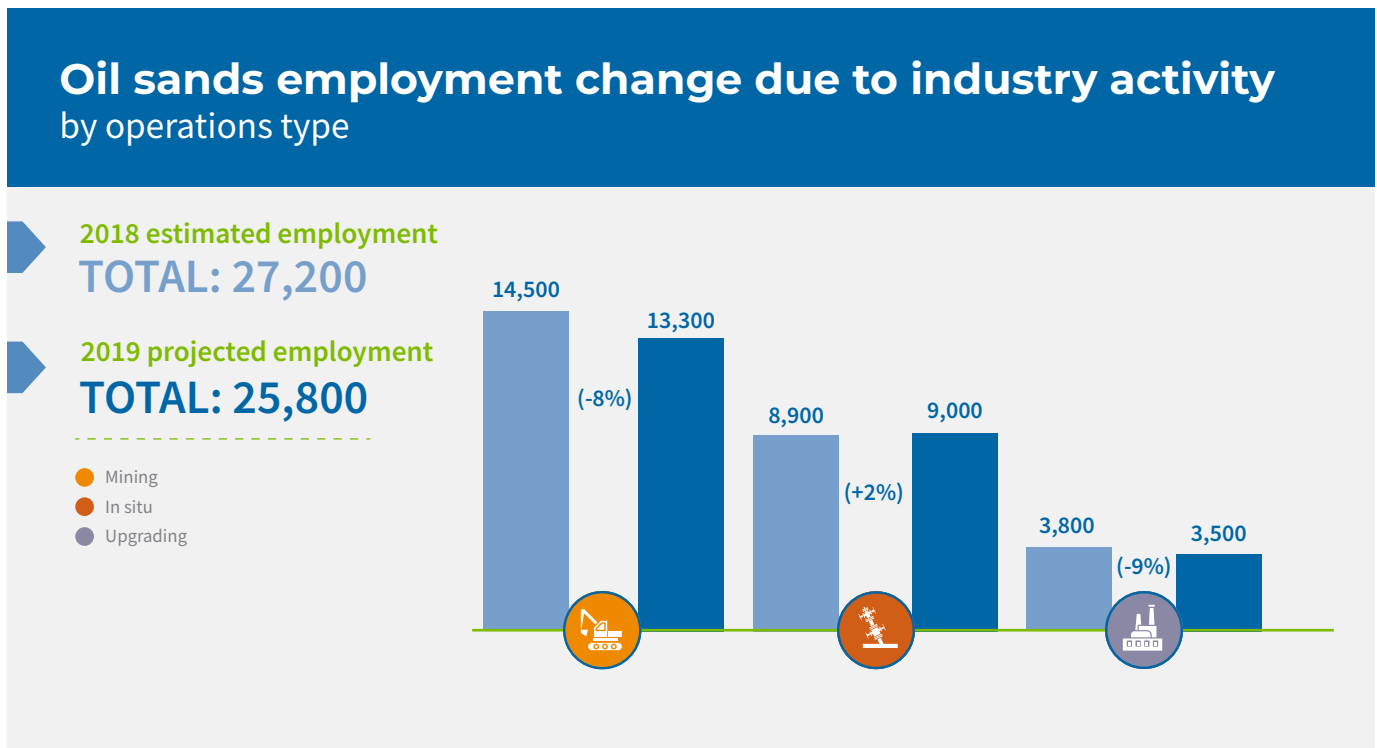


Figure 5 Source: PetroLMI

Notes: Numbers may not add up due to rounding. Refer to the detailed spreadsheet for a breakdown of workforce requirements by occupation and sub-sector.

Productivity improvements leading to less demand for production-related occupations

As the shift in capital investment away from expanding oil sands operations to sustaining capital continues to temper the creation of new jobs in the oil sands sub-sector, productivity improvements and technology implementation will lead to less demand for specific

occupations in the short term. Demand for heavy equipment operators and heavy-duty mechanics, for instance, is expected to see significant declines, accounting for almost one-third of the losses in 2019. Other declining occupations could include power engineers and power systems operators, and facility operation and maintenance managers.

Occupations most impacted in the short term (% of total oil sands job losses)

- | | |
|--|---|
| 1. Heavy equipment operators (except crane) (25.4%) | 7. Mechanical engineers (2.8%) |
| 2. Power engineers and power systems operators (steam ticket required) (9.5%) | 8. Petroleum, gas and chemical process operators (2.7%) |
| 3. Heavy-duty equipment mechanics (6.8%) | 9. Construction millwrights and industrial mechanics (2.6%) |
| 4. Facility operation and maintenance managers (5.6%) | 10. Managers in natural resources production, drilling and well servicing (2.4%) |
| 5. Engineering managers (3.5%) | |
| 6. Industrial electricians (3%) | |

Notes: Short-term employment drivers include declines in capital spending, productivity enhancements due to process improvements and implementation of technology and corporate consolidations.

Technology replacing workers, driving demand for different skills

The application of automation, data analytics and AI in oil sands operations is beginning to have an impact on the number and types of positions required. For instance, autonomous heavy haulers that carry product from mines to processing facilities are expected to move from the pilot stage to commercial use. Suncor, which has fully operational driverless heavy haulers at one of its sites, expects to convert all three of its oil sands mines to autonomous haulers over the next five years, resulting in a net loss of about 400 jobs. New employment of 100 jobs will come in the way of control centre operators

overseeing the remote operation. Road maintenance equipment operators will also increase at mine sites to allow the driverless heavy haulers to operate unimpeded. Two other oil sands mining operators, Imperial Oil and Canadian Natural Resources, are currently testing the driverless technology, with expectations of switching their fleets over beginning in 2020. If proven effective, this will result in another 400 net job losses. Companies consulted for this report indicated that wherever possible, those impacted by the conversion to autonomous vehicles will be provided opportunities to train for other roles.

Retirements may be offset by technology

Retirements are expected to open up about 700 jobs in the oil sands in 2019. However, some of these opportunities may not be filled due to technology implementation and continued corporate consolidation of assets. The occupations of heavy equipment operators, power engineers and power systems

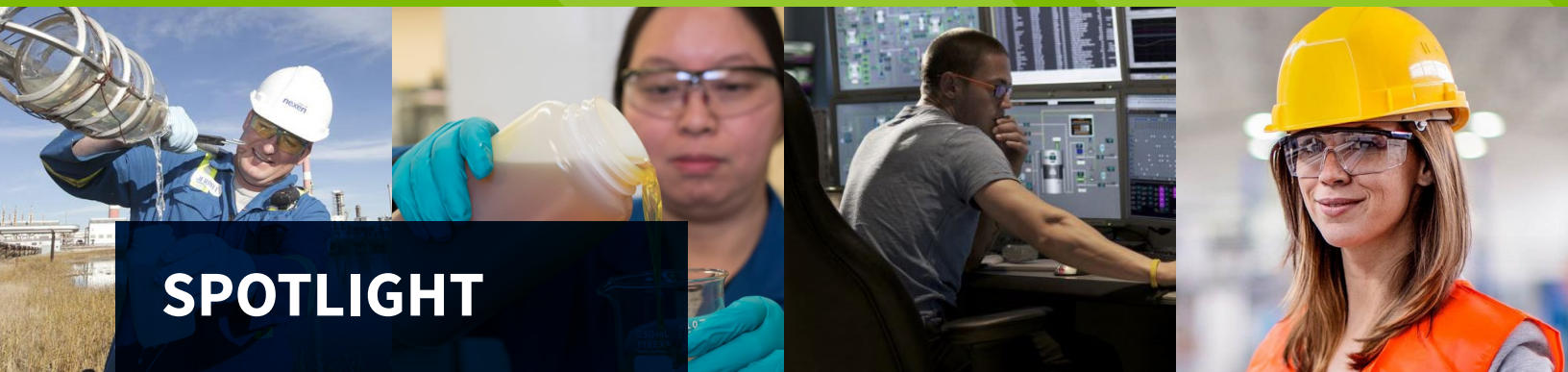
operators, and facility and maintenance managers are likely to experience the greatest age-related attrition, or retirements. At the same time, these occupations are expected to be the most impacted by technology advancements. Process automation technologies will impact how many power engineer jobs created by retirements will ultimately be filled.

Top 10 oil sands occupations with the greatest number of eligible retirements

Occupation (NOC 2016)	2019 projected employment	Number of positions eligible for retirement	Retirement rate
TOTAL	25,765	685	3%
Heavy equipment operators (except crane) (7521)	4,145	90	2%
Power engineers and power systems operators (steam ticket required) (9241)	4,350	85	2%
Facility operation and maintenance managers (0714)	1,110	35	3%
Engineering managers (0211)	975	30	3%
Heavy-duty equipment mechanics (7312)	1,275	25	2%
Managers in natural resources production, drilling and well servicing (0811)	710	25	4%
Construction millwrights and industrial mechanics (7311)	645	15	2%
Petroleum engineers (2145)	770	15	2%
Instrumentation technicians (2243)	645	15	2%
Industrial electricians (7242)	685	10	1%

Table 3 Source: PetroLMI

Notes: Numbers may not add up due to rounding. Refer to the detailed spreadsheet for a full list of occupational projections for the sub-sector.



SPOTLIGHT

Indigenous communities seeking “life-cycle” career opportunities in oil and gas

Wapahki Energy Ltd., an Indigenous energy company, is looking to a joint venture project with Canadian National Railway to transform bitumen from Alberta’s oil sands into pucks the size of a bar of soap for safe shipping. If successful, the project would provide revenue for its owner, the Heart Lake First Nation, help recycle plastic waste and create jobs for the northern Alberta community. The Heart Lake First Nation would join a number of Indigenous communities growing their involvement in the oil and gas industry, including the Fort McKay First Nation and the Mikisew Cree First Nation, which joined forces to buy a 49% stake in an oil storage project known as the East Tank Farm Development located about 30 kilometres north of Fort McMurray. The facility is a bitumen storage, blending and cooling operation handling production from Suncor’s Fort Hills oil sands mining project.

Indigenous Peoples accounted for 6.3% of the direct Canadian oil and gas industry workforce in 2016, or 11,900 workers, compared with 3.9% of the national

workforce⁶. The oil and gas services sub-sector hired the largest number of Indigenous Peoples, with 6,800 workers making up 7.4% of the workforce. Meanwhile, Indigenous Peoples accounted for 5.3% of exploration and production workers, and 3.9% of the industry’s pipeline workers. Alberta’s oil sands operations have traditionally been a significant employer of Indigenous workers. Between 2015 and 2016, oil sands operators invested more than \$3.3 billion on procurement and worked with 399 Indigenous businesses in 66 Alberta communities⁷. Indigenous involvement in the oil and gas industry has grown in recent decades through benefits agreements in addition to Indigenous-owned business providing services to the oil and gas industry.

Much like the rest of Canada’s oil and gas workforce, Indigenous communities have experienced the impacts of reduced investment and job losses. Canada’s oil and gas industry and Indigenous groups are working together to increase both the number of workers and the quality of employment opportunities available as activity expands into areas which are home to large Indigenous populations.

“Many Indigenous communities want to build business relationships and participate in the oil and gas industry. There is a real opportunity to share the benefits of employment and economic stability,” says Jamie Saulnier, President and CEO of Running Deer Resources⁸.

⁶ PetroLMI, *Diversifying Canada’s Oil and Gas Workforce*, June 2018.

^{7,8} Canadian Association of Petroleum Producers (CAPP), *Toward a Shared Future: Canada’s Indigenous Peoples and the Oil and Natural Gas Industry*, November 2018

One such project is Coastal GasLink, a 670-kilometre pipeline which will connect natural gas fields in British Columbia to an LNG Canada export terminal at Kitimat. Indigenous businesses have been awarded contracts valued at \$620 million in contracting and employment opportunities. Another \$175 million has been awarded for work on the LNG export terminal.

Challenges remain, however, in ensuring the workers have the skill sets to meet the needs of a changing industry. Indigenous leaders consulted for this report say in the past much of the work available to their communities has consisted of short-term contracts. They are now looking for “life-cycle careers” that follow projects from inception through to reclamation after the production phase of the project is completed. This would provide opportunities for jobs using traditional and scientific knowledge in the planning of projects,

operational employment, environmental monitoring through the project life and reclamation work.

As Indigenous communities increasingly take ownership positions in Canada’s oil and gas projects, they are also looking to increase opportunities for employment in administrative and managerial roles within those projects. Gaps in education and training need to be narrowed to increase employment and improve the type of opportunities available. With the industry moving towards digitization and other technology integration, there is a need for training ranging from basic computer skills through to data management. There is also a need for more Indigenous students to pursue science, technology, engineering and math (STEM) training to gain access to a wider range of employment opportunities in the oil and gas industry.

As Indigenous communities increasingly take ownership positions in Canada’s oil and gas projects, they are also looking to increase opportunities for employment in administrative and managerial roles within those projects.



Pipeline

Employment in the pipeline sub-sector remained flat from 2016 to 2017, before slightly increasing in 2018. The pipeline operations workforce is expected to increase by 2%, or about 200 positions to 12,200 in 2019 as several smaller pipeline system expansions are constructed and move into operation. PetroLMI's model also forecasts a need for roles to support one or more proposed major pipeline projects such as regulatory and stakeholder engagement occupations, engineers, technologists and technicians, and supply chain occupations. This includes the Coastal GasLink pipeline, which will connect northeastern British Columbia gas supplies to the proposed LNG Canada export facility located in Kitimat. The demand for these types of occupations will be magnified if there are further approvals for the proposed Trans Mountain pipeline which will carry oil

from Alberta to the coast of British Columbia. Many of the approval conditions for this project would require regulatory or community engagement activities.

Going forward, prospective employees, including Indigenous Peoples, are likely to be unfamiliar with the oil and gas industry as operations move into areas of northwestern B.C. for the first time. This would also mean further investment in stakeholder and community engagement as well as training workers for employment through the planning, construction and operation phases of the LNG and pipeline projects.

As the pipeline sub-sector adopts technologies to mitigate environmental and safety risks, demand for IT workers is forecast to expand in this sub-sector through 2019 and beyond.

Occupations with the greatest hiring requirements in the short term (% of total pipeline job growth)

- | | |
|---|--|
| 1. Petroleum, gas, chemical process operators (no steam ticket required) (11%) | 5. Supervisors, petroleum, gas and chemical processing and utilities (2.5%) |
| 2. Information technology occupations (5.9%) | 6. Chemical engineers (2%) |
| 3. Regulatory and stakeholder engagement occupations (5.5%) | 7. Engineering managers (2%) |
| 4. Construction millwrights and industrial mechanics (2.5%) | 8. Purchasing agents and officers (2%) |
| | 9. Mechanical engineers (2%) |
| | 10. Mechanical engineering technologists and technicians (1.5%) |

Notes: Short-term employment drivers include declines in capital spending, productivity enhancements due to process improvements and implementation of technology, and corporate consolidations.

Age-related attrition likely to be filled in pipeline sub-sector, but could mean shortages for some occupations

Approximately 300 employees in Canada's pipeline sub-sector are eligible to retire in 2019. If one or more large pipeline projects were to advance in 2019, it is likely most of these positions will be filled. In terms of the

availability of labour supply, pipeline companies could face challenges, particularly in recruiting IT workers due to competition from other sub-sectors and other industries. There could also be a shortage of skills in some occupations that would directly support major projects if the Trans Mountain pipeline is sanctioned before the end of 2019.

Top 10 pipeline occupations with the greatest number of eligible retirements

Occupation (NOC 2016)	2019 projected employment	Number of positions eligible for retirement	Retirement rate
TOTAL	12,220	290	2%
Petroleum, gas, chemical process operator (no steam ticket required) (9232)	1,335	31	3%
Regulatory and stakeholder engagement occupations	865	21	3%
Information technology occupations	745	18	2%
Supervisors, petroleum, gas and chemical processing and utilities (9212)	295	10	3%
Construction millwrights and industrial mechanics (7311)	345	8	2%
Engineering managers (0211)	205	6	3%
Purchasing agents and officers (1225)	230	6	3%
Chemical engineers (2134)	265	5	2%
Transport truck drivers (7511)	180	5	3%
Mechanical engineers (2132)	240	4	2%

Table 4 Source: PetroLMI

Notes: Regulatory and stakeholder engagement occupations include occupations within NOC 2263, 4161, 1123, 2261, 1452, 2262, 2264, 4162, 1253, 1254, 4164, 1454 and 4423. Information technology occupations include occupations within NOC 2171, 2281, 0213, 1422, 2174, 2172, 2282, 2173, 2147, 2283 and 2175.

Refer to Statistics Canada National Occupational Classification (NOC) 2016 version 1.2 for details on these occupations.

Numbers may not add up due to rounding. Refer to the detailed spreadsheet for a full list of occupational projections for the sub-sector.



REGIONAL OIL AND GAS EMPLOYMENT OUTLOOK

Oil and gas employment across Canada rises and falls with investment in new projects and new production. With capital investment projected to be down significantly nationwide in 2019, it is no surprise that employment is also forecasted to decline in most producing provinces.

British Columbia will be the one bright spot in 2019, with the province benefiting from the startup or sanction of new natural gas processing infrastructure and the Coastal GasLink pipeline. Meanwhile on the East Coast,

it is anticipated that oil exploration activity will increase offshore Newfoundland and Labrador beginning in early 2020, making the 2019 decline in employment projected for that area short-lived.

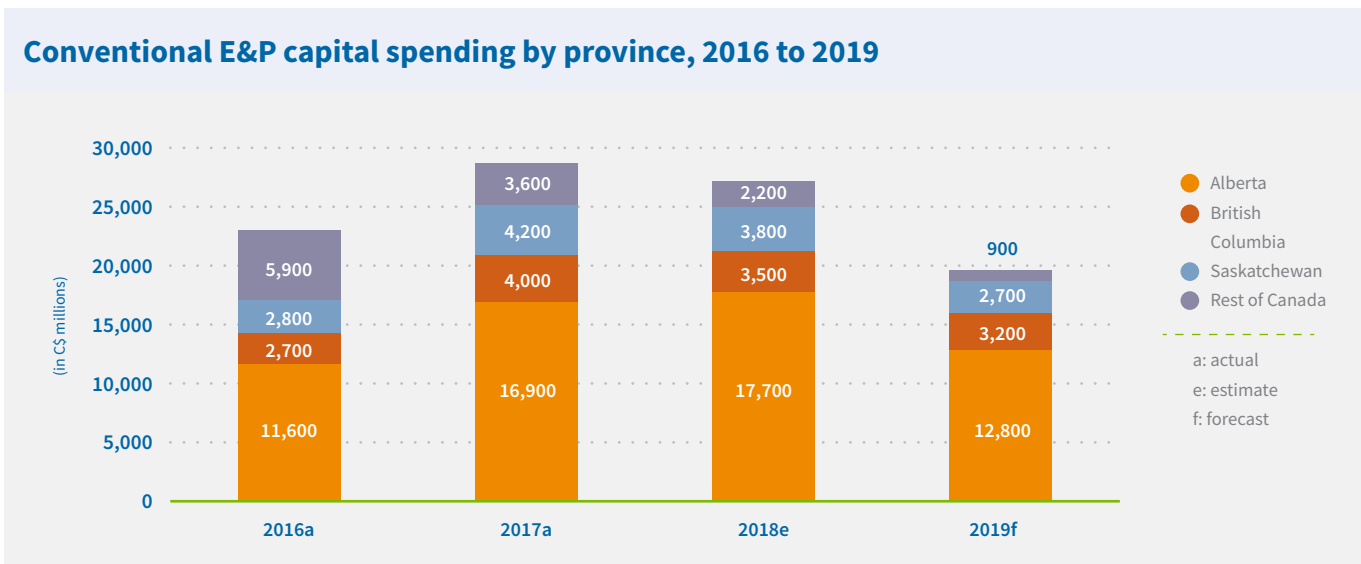


Figure 6 Source: ARC Energy Research Institute for spending projections (January 2019) and Statistics Canada and CAPP for actual spending numbers

Oil and gas employment by province, 2018 to 2019

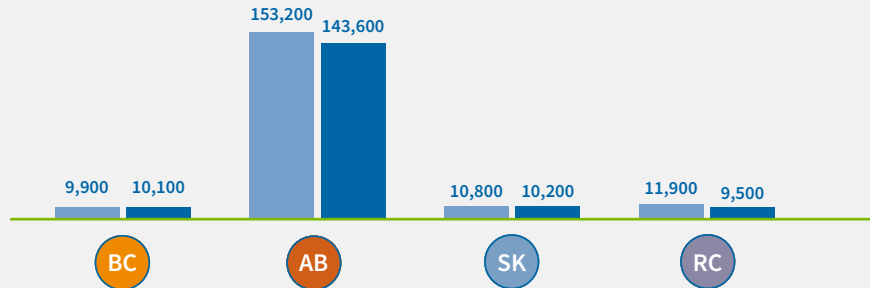
2018 estimated employment

TOTAL: 185,800

2019 projected employment

TOTAL: 173,300

● British Columbia ● Saskatchewan
● Alberta ● Rest of Canada



2018-2019 change
(% of 2018 employment)

● British Columbia ● Saskatchewan
● Alberta ● Rest of Canada

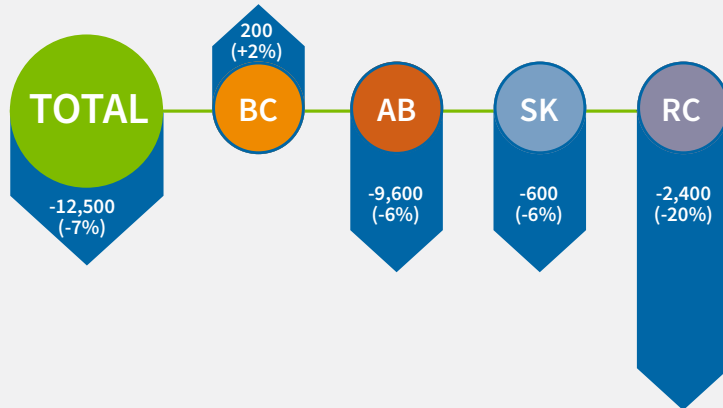


Figure 7 Source: PetroLMI

Notes: Numbers may not add up due to rounding.



British Columbia

British Columbia has been adjusting to lower natural gas prices since before 2014. However, it was the 2014-2016 commodity price downturn that impacted its emerging LNG export industry with a number of potential LNG export facilities either cancelled or deferred. Capital spending rebounded in 2017 as oil and gas prices improved before retreating once again in 2018 with a summer drop in natural gas prices. Capital expenditures are expected to decline by almost 9%, from about \$3.5 billion in 2018 to \$3.2 billion in 2019, and with it an 8% decline in the number of wells drilled. Despite volatility in capital investment and drilling activity in British Columbia, employment levels have been steady in the province. Oil and gas services jobs have been negatively impacted by decreased spending, but other occupations

have benefited from the pipeline activity and natural gas processing activity. This trend is expected to continue in 2019, with the growth of 200 jobs forecasted. Any increased employment in occupations related to LNG exports is not expected in 2019.

Occupations with growth opportunities in B.C. include:

- Petroleum, gas, chemical process operators including pipeline
- Power engineers and power systems operators (steam ticket required)
- Supervisors, petroleum, gas and chemical processing and utilities
- Information technology occupations
- Regulatory and stakeholder engagement occupations

British Columbia oil and gas employment, 2018 to 2019

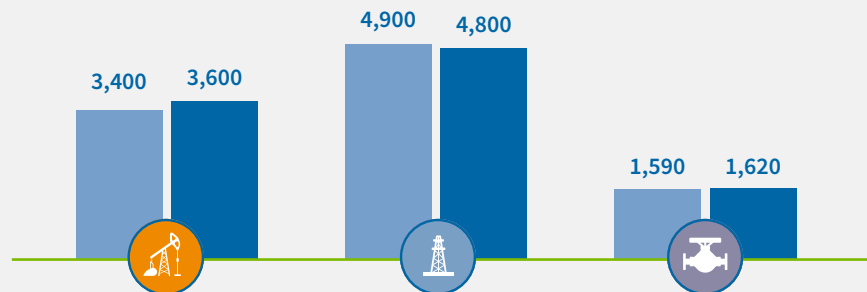
2018 estimated employment

TOTAL: 9,900

2019 projected employment

TOTAL: 10,100

- Exploration and production
- Oil and gas services
- Pipeline



2018-2019 change (% of 2018 employment)

- Exploration and production
- Oil and gas services
- Pipeline

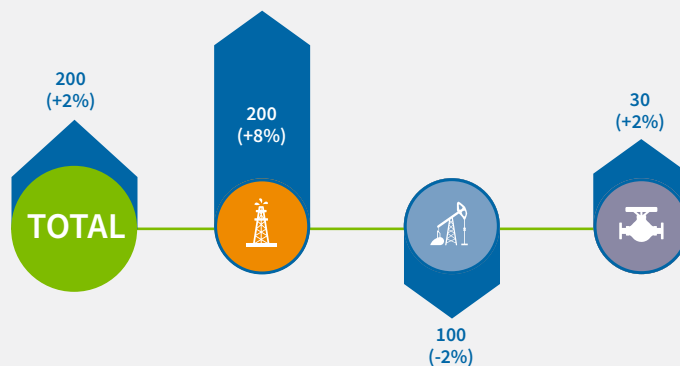


Figure 8 Source: PetroLMI

Notes: Numbers may not add up due to rounding.



SPOTLIGHT

New natural gas infrastructure projects poised to spur investment and employment

In recent years, rapidly increasing shale natural gas production in the United States, enabled by horizontal drilling and hydraulic fracturing, has been displacing natural gas from Western Canadian producers to traditional markets such as Eastern Canada and the northeastern United States. Coupled with pipeline constraints and bottlenecks in Canada, the increased competition has put downward pressure on prices, lowering capital investment and activity – and employment levels. The number of natural gas wells drilled in Canada has been on a steady decline, with 883 wells targeting natural gas in 2018, down from 1,592 in 2017⁹.

The solution for reversing investment declines in Canada’s natural gas industry is to increase global and domestic demand for natural gas and ensure it can get to those markets. Global markets for liquefied natural gas (LNG) are targeted to grow substantially over the next decade as natural gas replaces coal as the

world’s second largest energy source by 2030. Currently, two LNG facilities are poised for development on the West Coast. Two others are proposed for the region, and three are proposed for Canada’s East Coast and Quebec. Developing an export market for LNG will not only renew natural gas drilling activity, but will also broaden opportunities for power generation and natural gas liquids (NGLs) production, such as propane and butane, which can also serve as feedstock to support petrochemical manufacturing projects.

The Canadian Association of Petroleum Producers (CAPP) estimates that every billion cubic feet per day of incremental natural gas production to serve LNG exports will create or sustain 10,000 direct and indirect jobs¹⁰. Construction of the two processing trains associated with the first phase of LNG Canada’s export facility in Kitimat will require 3.5-4 billion cubic feet per day (Bcf/d) of incremental natural gas production. A decision for further expansion to LNG Canada’s facility is expected before 2025.

Other infrastructure that will support global expansion for Canada’s natural gas includes AltaGas’ Ridley Island Propane Export project, the first propane export terminal on Canada’s West Coast and a smaller-scale liquid petroleum gas (LPG) export project by Pembina Pipeline located on Watson Island. These two projects,

⁹ Daily Oil Bulletin, Data Central

¹⁰ CAPP, *Leveraging Opportunities: Diversifying Canada’s Oil and Natural Gas Markets*, March 2019

with a combined capacity of 65,000 barrels per day (bbl/d), are also expected to drive increased investment in natural gas drilling in British Columbia and Alberta.

Domestically, over the next decade natural gas power generation is expected to replace some of Alberta's coal-fired power generation, creating approximately

1-1.5 Bcf/d of incremental natural gas demand. New and expanded petrochemical projects will add another 40,000 bbl/d of demand for natural gas liquids. All of these projects are expected to generate hundreds of new jobs.



The Canadian Association of Petroleum Producers estimates that every billion cubic feet per day of incremental natural gas production to serve LNG exports will create or sustain 10,000 direct and indirect jobs.

Alberta

As Canada's largest energy-producing province, Alberta will experience the greatest impact of industry's reduced spending. E&P capital expenditures are forecast to decline by 28% in 2019, from about \$17.7 billion to \$12.8 billion. When combined with decreased oil sands investment, the employment risk for Alberta is 9,600 positions in 2019. The majority of these job losses will come in the oil and gas services sub-sector, which is most sensitive to changes in capital spending. The Government of Alberta's oil curtailment effort is expected to impact the oil and gas services sub-sector for at least the first half of 2019 as E&P and oil sands companies pull back on capital investment until the curtailment ends. Since most head offices in the oil and gas industry are located in Calgary, E&P employment and head office positions across all sub-sectors are also at risk due to mergers and acquisitions in 2019.

Despite the significant number of positions at risk in Alberta, demand for some occupations related to pipelines is expected to increase as construction of the Coastal GasLink Pipeline progresses and other larger pipeline projects come closer to being sanctioned. Employment opportunities include those that support project development.

Occupations with growth opportunities include:

- Regulatory and stakeholder engagement occupations including HS&E and engineering inspectors, regulatory analysts and reporting and stakeholder/community engagement specialists
- Information technology occupations
- Engineering managers
- Purchasing agents and officers
- Mechanical engineers, technologists and technicians
- Civil engineers, technologists and technicians

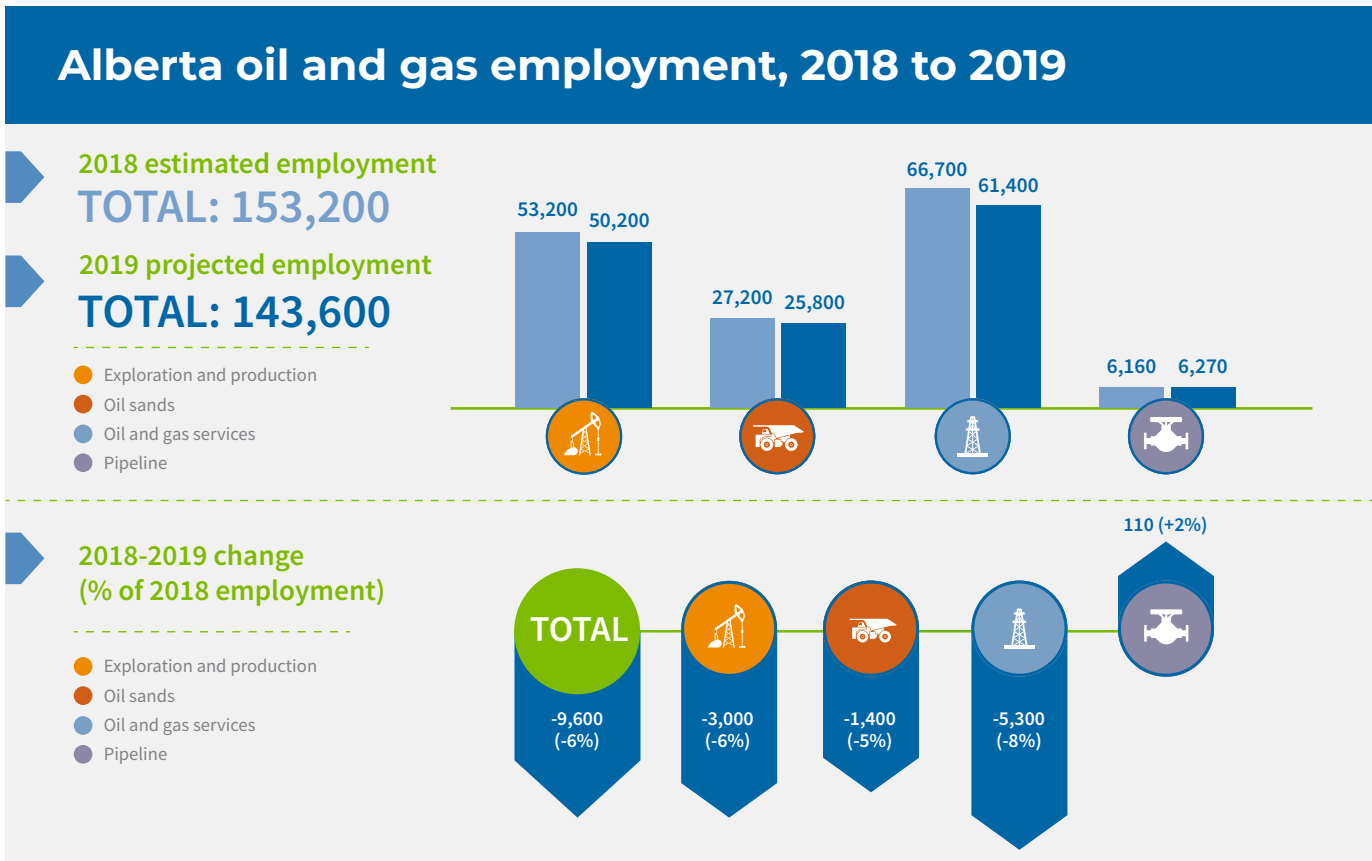


Figure 9 Source: PetroLMI
Notes: Numbers may not add up due to rounding.

Saskatchewan

Capital spending in Saskatchewan recovered by about 50% from 2016 to 2017, but declined 10% in 2018 as uncertainty over prices and market access began impacting investment decisions. Saskatchewan saw a

5% decline in the number of wells drilled in 2018. For 2019, drilling is forecast to decline by 21% as capital investment declines by 29%, from \$3.8 billion to \$2.7 billion. Over 600 jobs are at risk in Saskatchewan, with most of the positions in the oil and gas services sub-sector.

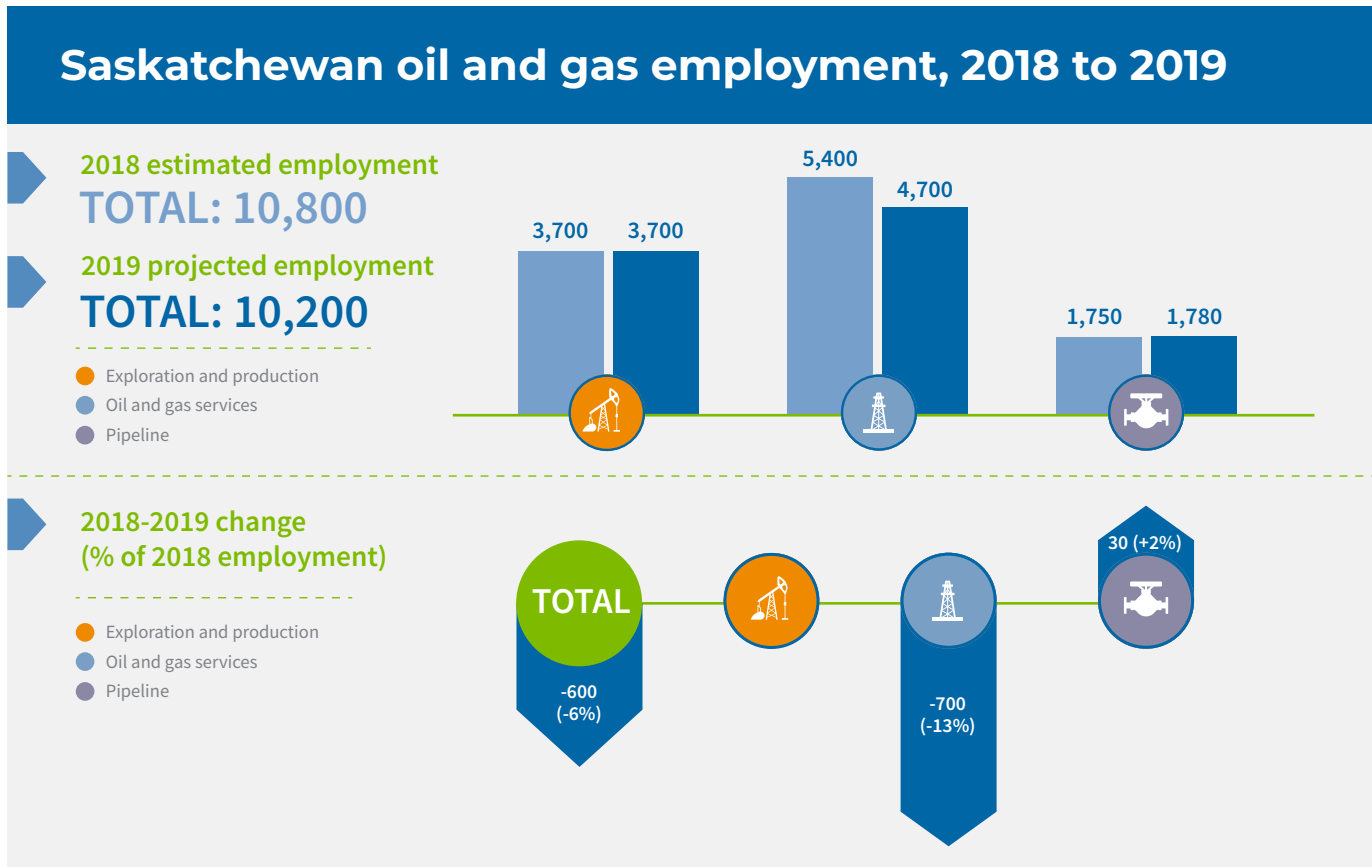


Figure 10 Source: PetroLMI
Notes: Numbers may not add up due to rounding.



Rest of Canada

The vast majority of oil and gas activity outside of Western Canada occurs offshore Newfoundland and Labrador. There is also active development and production in Manitoba. Unlike other regions, the East Coast offshore projects are not affected by market access constraints. However, investment, activity and employment are subject to exploration commitments and development phases, including construction that can last as long as a decade before production is brought on stream.

Capital investment in the rest of Canada is expected to decline by 59%, from \$2.2 billion in 2018 to just under

\$1 billion in 2019, putting 2,400 jobs at risk. A number of factors will come into play: decommissioning of Nova Scotia's offshore natural gas industry as the economically recoverable resource has been exhausted; ongoing shift from development to the operation phase at the Hebron oil development offshore Newfoundland; and, completing a major geoscience acquisition program offshore Newfoundland and Labrador.

Some job losses may be short-lived, however, based on increased activity planned for offshore Newfoundland and Labrador. Six exploration projects are currently undergoing environmental assessment, and the province's first deepwater project, Bay du Nord, is expected to be sanctioned for development in 2020.

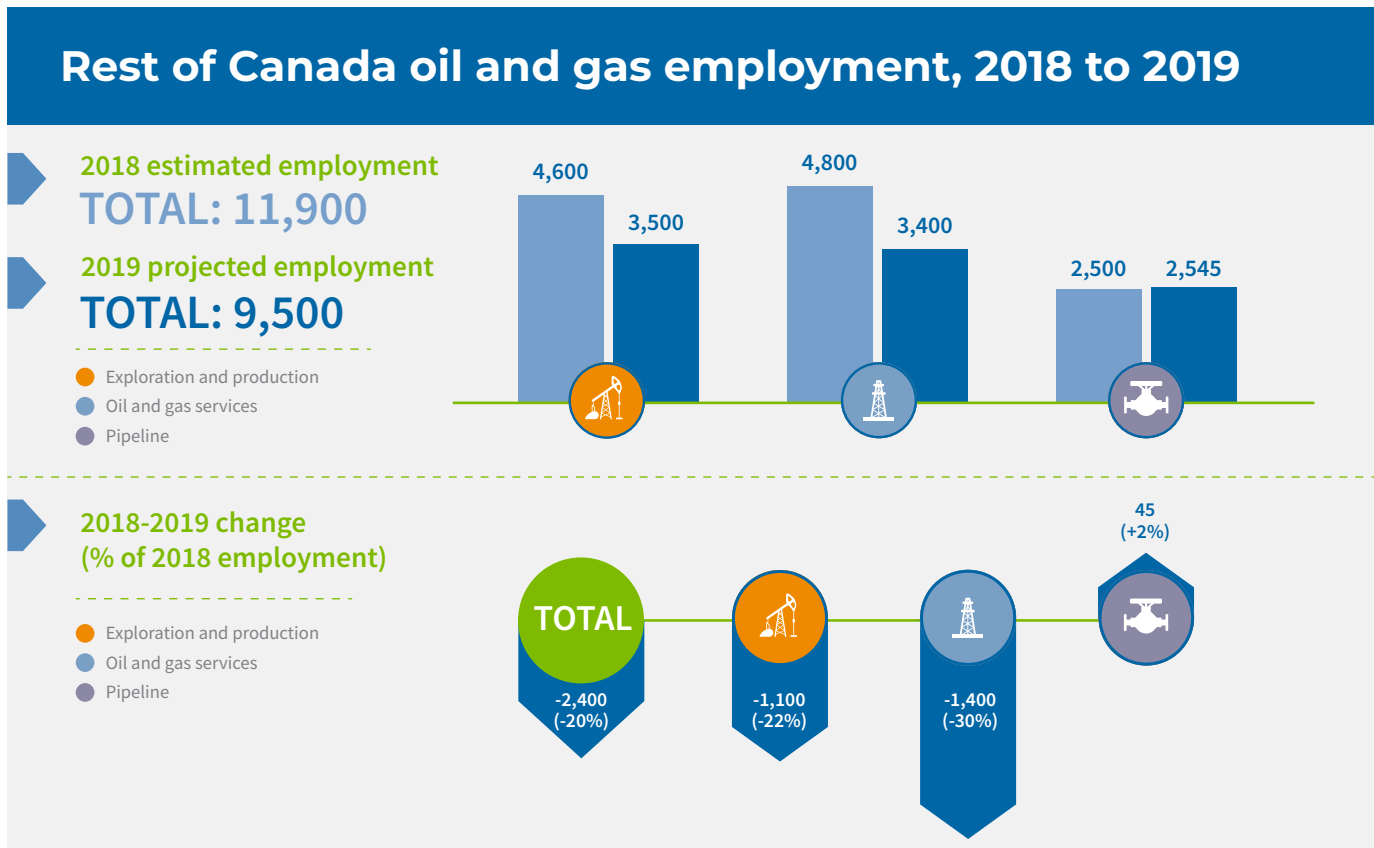


Figure 11 Source: PetroLMI

Notes: Numbers may not add up due to rounding.



LABOUR SUPPLY CHALLENGES

The restructuring of Canada's oil and gas industry has impacted the labour supply and the type of talent the industry requires.

Not only has oil and gas employment declined since 2014, so has the pool of potential workers. Between 2014 and 2017, the labour force – that is the number of workers indicating they were available to work in the industry – declined by 19%. This was particularly troublesome for the oil and gas services sub-sector when by 2017 it became apparent that many of the drilling and oilfield workers laid off during the downturn had left the industry. The inability to attract qualified and experienced workers back when activity levels improved in 2017 and early 2018, resulted in significant labour and skills shortages which continue even today for some occupations and in some locations. With lower capital investment and the government-mandated production curtailment, the oil and gas services sub-sector will continue to be the hardest hit in 2019 and is expected to lose more of its labour force to other

industries. Yet it will also face the greatest pressure to ramp up its workforce when activity picks up.

The focus on production from proven reserves, rather than exploration of new oil and gas plays, is likely to create a gap in exploration, geoscience and engineering expertise for the E&P sub-sector. The accelerated use of technologies and innovation will only increase the need for specific IT occupations including information systems professionals, computer programmers and software developers. Yet companies across all sub-sectors have indicated it is already difficult to compete with other industries to attract this expertise to oil and gas.

Another growing risk is the skills mismatches where the talent available in the labour force does not fit the industry's requirements.

Calgary's high unemployment rate is an indicator that large numbers of oil and gas engineering, geoscience and other business and technical workers remain unemployed. However, a more automated and digitized industry means that much of this talent pool will not have the skills the industry is looking for when needed, without some upskilling.

Canada's Labour Market Information Council (LMIC) describes three types of labour market challenges that can occur¹¹:

1. Labour shortages, where there is a lack of candidates for a specific job in a specific labour market
2. Skills shortages, referring to a lack of candidates with the skills required
3. Skills mismatches, referring to situations in which skills available are not well suited to jobs available



With the decline in capital investment and government-mandated production curtailment, the oil and gas services sub-sector will be the hardest hit in 2019 and is expected to lose more of its labour force to other industries.

¹¹ LMIC, *What's in a Name? Labour Shortage, Skills Shortages, and Skills Mismatches*, 2018



EMPLOYMENT IMPACTS OF OIL AND GAS ACTIVITY ACROSS CANADA

While direct employment in the oil and gas industry is concentrated in regions with the greatest production, indirect employment is widespread, as the industry sources goods and services from across Canada. In 2017, Canada's oil and gas industry spending generated approximately 178,000 direct and more than 350,000 indirect jobs.

This does not include the thousands of additional jobs generated due to consumer spending by those employed directly or indirectly by the industry – those known as induced jobs. The decline in oil and gas spending in 2019 will have a ripple effect on employment in many other industries.

The other industries that realized the greatest employment benefits from oil and gas spending include:

- Construction (30% of indirect jobs)
- Professional, scientific and technical services (16%)
- Wholesale trade and retail (12%)
- Administrative and support, waste management and remediation services (10%)
- Manufacturing (7%)
- Finance and insurance (6%)
- Management of companies and enterprises (5%)
- Transportation and warehousing (5%)

Employment impacts of oil and gas activity across Canada

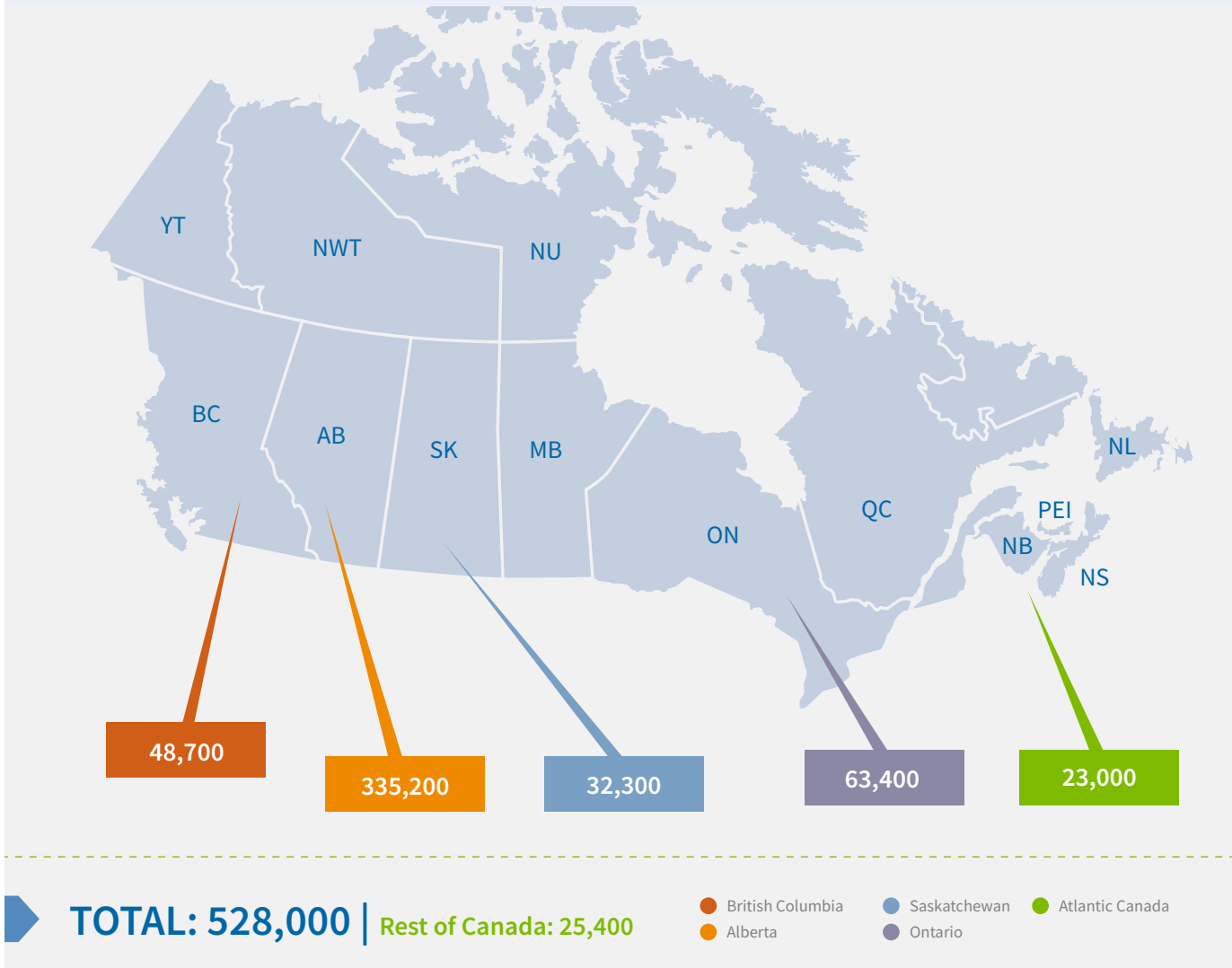


Figure 12 Source: Canadian Association of Petroleum Producers (CAPP) calculations using Prism Economics Analysis of Statistics Canada's Input/Output tables.

Notes: The employment impact numbers received from CAPP have been adjusted based on PetroLMI's definition of direct and indirect workers.

Rest of Canada includes Manitoba, Quebec, the Northwest Territories, Yukon and Nunavut.



SPOTLIGHT

Construction employment tied to oil and gas activity

The oil and gas industry has long been a significant contributor to the health of Canada's construction industry. In 2017, oil and gas investment generated approximately 107,000 construction jobs across Canada¹².

Construction of LNG Canada's export facility and the associated Coast GasLink pipeline linking natural gas resources to the terminal in Kitimat, as well as the proposed Trans Mountain pipeline expansion, is expected to generate thousands of construction jobs and help to make British Columbia the centre of industrial construction employment for the next three years. LNG Canada estimates that at the peak of construction in 2021 it will require approximately 4,500 workers on site. Coastal GasLink pipeline will require another 2,000-2,500 workers during its four-year construction period. Construction of the Trans Mountain pipeline expansion, meanwhile, will need 5,500 workers during its peak construction period.

British Columbia is already in the midst of a boom of non-residential construction, with investment expected

to increase by 37% from 2018 to 2021, according to BuildForce Canada¹³, driving the need for an additional 13,400 workers from outside the province or from other industries in order to meet demand. Investment in oil and gas-related construction activity in Alberta, meanwhile, is expected to remain flat until at least 2023, when additional oil sands construction could begin, according to BuildForce Canada. With no new large oil sands projects on the horizon, Alberta's industrial construction workforce will focus on sustaining oil sands production, maintaining oil sands facilities and building new pipelines and petrochemical facilities to 2020. Sustaining capital maintenance work accounts for 85% of oil sands activity, so that is expected to result in just under 20,000 jobs from 2019 to 2022.

Investment is expected to pick up should additional larger pipeline construction proceed and expand takeaway capacity for new oil sands production, resulting in 7,300 jobs added between 2022 and 2028.

Two large petrochemical projects will also add to construction employment opportunities in Canada – Inter Pipeline's Heartland Petrochemical project, which will employ 2,300 workers during its four-year construction phase and a similar project by Pembina Pipeline which expects to employ 3,000 workers on site over the next four years. Construction of a methanol processing facility in Grande Prairie Alberta, in 2019 will

¹² Canadian Association of Petroleum Producers (CAPP) calculations using Prism Economics Analysis of Statistics Canada's input/output tables

¹³ BuildForce Canada, 2019 Construction and Maintenance Looking Forward, January 2019

generate about 1,000 construction jobs. Nautical Energy, the company behind the project, has also announced its intention to construct a similar facility in Bécancour, Quebec, with construction anticipated to start in 2020.

Development of Pieridae Energy's Goldboro LNG project in Nova Scotia is also progressing. Recent company announcements indicate construction could start as early as 2019 and require approximately 3,500 workers at peak.

Industrial construction in Newfoundland and Labrador is forecast to decline 24% by 2021 as major projects such as the West White Rose oil platform and large mining and hydroelectric projects wind down. Without new projects, non-residential construction employment is forecast to decline 32% by 2023 compared to 2018 levels. However, the sanction of a major project such as the Bay du Nord oil development could stem some of the employment losses.



The oil and gas industry has long been a significant contributor to the health of Canada's construction industry. In 2017, oil and gas investment generated approximately 107,000 construction jobs across Canada.



CONCLUSION

Canada's oil and gas industry is facing a challenging 2019 due to constrained market access. Industry will focus investment on smaller projects that meet incremental demand. The result will be continued erosion of Canada's oil and gas workforce. Labour demand will remain flat or decline until there is more certainty in the industry to drive new investment.

While there is some optimism that transportation bottlenecks will be partially alleviated with Enbridge's Line 3 pipeline replacement in operation in 2020 and expansion of oil-by-rail services, it is unlikely capital spending will increase significantly until longer-term solutions are implemented. This would not occur until late 2022 should the Trans Mountain expansion project and construction of TransCanada's Keystone XL pipeline move forward. Similarly, natural gas prices will remain low until LNG facilities move through construction and pipeline bottlenecks are cleared from the existing pipeline system – not until at least 2021.

Canadian E&P and oil sands companies will continue to focus their efforts on controlling costs and improving productivity. This, in turn, will put downward pressure on labour markets as productivity improvements require less capital and labour to sustain and grow production. While technology advancements will contribute to workforce

contraction in the E&P and oil sands sub-sectors, they will also create opportunities in certain occupations, including those that involve developing, implementing and maintaining data analytics and automated systems.

The oil and gas services sub-sector will face most of the employment risk in 2019 as the capital investment that it relies on to employ workers declines. Meanwhile, pipeline employment in Canada is forecast to be relatively stable in 2019 as smaller projects are completed and operators are hired. If major pipeline projects do move ahead in 2019, there is the potential for employment expansion in some occupations, such as those dealing with public consultation and regulatory compliance.

All in all, any significant employment growth in Canada's oil and gas industry is not expected to materialize until oil and natural gas infrastructure projects are approved, constructed and operational.

Appendix 1: 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. 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.

The chart below outlines the employment drivers PetroLMI uses to identify workforce levels required to support industry activity for each of four upstream and midstream sub-sectors based on capital and operating spending forecasts and production forecasts.

PetroLMI’s forecasting does not include sub-sectors such as the downstream sector, construction, or professional, technical and scientific services. Adjustments are made in PetroLMI’s forecast for labour productivity changes.

Industry Sub-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: <ul style="list-style-type: none"> • 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, acidizing wells, cementing and perforating well casings, well testing 	●	●	●	●	
Conventional E&P: exploration and production of oil and gas for onshore and offshore conventional and unconventional reserves except oil sands.	●	●			
Oil sands: extraction, production and upgrading of bitumen specifically within mining, in situ and upgrading operations.			●		●
Pipelines: storage and mainline transmission of oil and gas.		●		●	

Table 5 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 2018. Expenditure assumptions were sourced from ARC Energy Research Institute as of January 2019.

In-scope occupations

The model is able to produce labour market projections for 67 occupations considered core to Canada's upstream and midstream sectors, which account for 69% of the industry's workforce. The occupations have been mapped to the National Occupational Classification (NOC) 2016 version. An "other occupations" category captures the residual workforce (remaining 31%) 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 67 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 direct industry surveys, then uses "employment drivers" to identify the required workforce levels to

support the level of industry activity (e.g., spending and/or production) in a given year. The model does this by sub-sector and occupation with some adjustments for labour productivity and other factors.

Replacement demand

The model uses historical, average retirement age and takes into account the age demographic trends of each occupation 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

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.

Appendix 2: National Occupational Classification (NOC) and Sample Industry Job Titles

The following table provides sample job titles for the 67 and other occupations mapped to NOC 2016 version.

NOC Title and Code	Sample Job Titles per Sector			
	Oil and gas services	Conventional E&P	Oil sands	Pipeline
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	Sample Job Titles per Sector			
	Oil and gas services	Conventional E&P	Oil sands	Pipeline
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 specialist (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-duty mechanic, heavy-duty technician	Heavy-duty mechanic, heavy-duty technician	Heavy-duty mechanic	Heavy-duty mechanic
Heavy-duty equipment mechanics (7312)	Drafting technologist, CAD technologist	Drafting technologist, CAD technologist	Drafting technologist, CAD technologist	Pipeline design technologist, piping technologist, drafting technologist, CAD technologist
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

NOC Title and Code	Sample Job Titles per Sector			
	Oil and gas services	Conventional E&P	Oil sands	Pipeline
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
Oil and gas drilling, servicing and related labourers (8615)	Labourer, floorhand, leasehand, roustabout, seismic surveyor, vibrator operator, observer	Field labourer	Labourer	Field labourer, tank farm labourer

NOC Title and Code	Sample Job Titles per Sector			
	Oil and gas services	Conventional E&P	Oil sands	Pipeline
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
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

NOC Title and Code	Sample Job Titles per Sector			
	Oil and gas services	Conventional E&P	Oil sands	Pipeline
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
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
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

NOC Title and Code	Sample Job Titles per Sector			
	Oil and gas services	Conventional E&P	Oil sands	Pipeline
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
Regulatory & stakeholder engagement occupations (Includes NOC 2263, 4161, 1123, 2261, 1452, 2262, 2264, 4162, 1253, 1254, 4164, 1454, 4423)	Environmental technician, emergency preparedness analyst, waste management coordinator, environmental advisor, health & safety inspector, EH&S specialist, occupational hygienist, OHSE field advisor, quality assurance analyst, mechanical QA inspector, QA /QC coordinator, government and public affairs specialist, permits coordinator, industrial construction inspector, safety inspector, boiler inspector, construction safety officer, pipeline inspector	Environmental technician, emergency preparedness analyst, policy analyst, environmental analyst, environmental advisor, health & safety inspector, EH&S specialist, quality assurance analyst, NDT technician, NDT analyst, measurement integrity analyst, communications specialist, government and public affairs specialist, engineering inspector, regulatory officer, economic policy advisor, socio-economics analyst, document management technician, information management technician, Aboriginal relations advisor, community relations specialist	Environmental technician, emergency preparedness analyst, policy analyst, environmental analyst, environmental advisor, health & safety inspector, EH&S specialist, quality assurance analyst, NDT technician, NDT analyst, government and public affairs specialist, permits coordinator, boiler and machinery inspector, economic policy analyst, socio-economics analyst, document management technician, information management technician, Aboriginal relations advisor, community relations specialist	Environmental technician, emergency preparedness analyst, policy analyst, environmental analyst, environmental advisor, health & safety inspector, EH&S specialist, quality assurance analyst, measurement integrity analyst, government and public affairs specialist, permits coordinator, measurement specialist, pipeline equipment inspector, economic policy researcher, socio-economics analyst, document management technician, information management technician, Aboriginal relations advisor, community relations specialist
Information technology occupations (Includes NOC 2171, 2281, 0213, 1422, 2174, 2172, 2282, 2173, 2147, 2283, 2175)	Business systems analyst, computer systems analyst, information systems analyst, systems integration analyst, IT security, systems quality assurance, computer network technician, server administrator, computer systems manager, software design manager, computer systems integration manager, data processing control clerk, applications programmer, software programmer, systems programmer, data scientist, database architect, user support technician, software engineer, software designer, cloud engineer, systems architect, wireless communications engineer, computer engineer, computer hardware engineer, information systems testing technician, applications tester, e-business website developer			
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 3: 2019 Total Industry Labour Demand, by Occupation

	2018 Estimated Employment	2019 Projected Employment	Employment Change due to Industry Activity	Age-related Attrition	Net Hiring Requirements
TOTAL	185,829	173,348	-12,481	4,245	-8,236
Chemical engineers (2134)	1,490	1,402	-88	27	-61
Chemical technologists and technicians (2211)	726	674	-52	15	-37
Civil engineering technologists and technicians (2231)	409	390	-19	12	-7
Civil engineers (2131)	704	657	-47	14	-33
Construction managers (0711)	726	678	-48	14	-34
Construction millwrights and industrial mechanics (7311)	4,015	3,758	-257	90	-167
Contractors and supervisors, heavy equipment operator crews (7302)	1,174	1,073	-101	24	-77
Contractors and supervisors, oil and gas drilling and services (8222)	10,080	9,280	-800	252	-548
Crane operators (7371)	450	416	-34	10	-24
Drafting technologists and technicians (2253)	473	438	-35	14	-21
Electrical and electronics engineering technologists and technicians (2241)	693	646	-47	16	-31
Electrical and electronics engineers (2133)	925	864	-61	23	-38
Engineering managers (0211)	1,677	1,596	-81	52	-29
Facility operation and maintenance managers (0714)	2,014	1,880	-134	62	-72
Geological and mineral technologists and technicians (2212)	2,660	2,394	-266	75	-191
Geoscientists and oceanographers (2113)	4,192	3,807	-385	133	-252
Heavy equipment operators (except crane) (7521)	8,545	7,925	-620	172	-448
Heavy-duty equipment mechanics (7312)	2,746	2,531	-215	53	-162
Industrial and manufacturing engineers (2141)	567	554	-13	5	-8

	2018 Estimated Employment	2019 Projected Employment	Employment Change due to Industry Activity	Age-related Attrition	Net Hiring Requirements
Industrial electricians (7242)	2,125	1,949	-176	35	-141
Industrial engineering and manufacturing technologists and technicians (2233)	304	292	-12	7	-5
Information technology occupations (Includes NOC 2171, 2281,0213,1422,2174,2172,2282, 2173,2147,2283,2175)	4,822	4,677	-145	116	-29
Instrumentation technicians (2243)	1,595	1,516	-79	31	-48
Insulators (7293)	336	314	-22	8	-14
Machinists and machining and tooling inspectors (7231)	573	528	-45	11	-34
Managers in natural resources production, drilling and well servicing (0811)	6,070	5,398	-672	188	-484
Mechanical engineering technologists and technicians (2232)	665	625	-40	13	-27
Mechanical engineers (2132)	1,848	1,729	-119	34	-85
Mining engineers (2143)	340	303	-37	5	-32
Oil and gas drilling, servicing and related labourers (8615)	6,072	5,849	-223	69	-154
Oil and gas well drillers, servicers, testers and related workers (8232)	12,132	11,597	-535	151	-384
Oil and gas well drilling workers and service operators (8412)	5,718	5,342	-376	62	-314
Petroleum engineers (2145)	4,543	4,231	-312	84	-228
Petroleum, gas, chemical process operator (no steam ticket required) (9232)	6,186	6,087	-99	146	47
Power engineers and power systems operators (steam ticket required) (9241)	6,420	6,186	-234	121	-113
Production logistics co-ordinators (1523)	584	575	-9	16	7
Purchasing agents and officers (1225)	4,678	4,024	-654	129	-525
Purchasing and inventory control workers (1524)	359	341	-18	10	-8
Purchasing managers (0113)	420	392	-28	12	-16
Regulatory & stakeholder engagement occupations (Includes NOC 2263, 4161,1123,2261, 1452, 2262,2264, 4162,1253,1254, 4164, 1454, 4423)	6,624	6,263	-361	171	-190

	2018 Estimated Employment	2019 Projected Employment	Employment Change due to Industry Activity	Age-related Attrition	Net Hiring Requirements
Shippers and receivers (1521)	547	503	-44	15	-29
Steamfitters, pipefitters and sprinkler system installers (7252)	2,042	1,896	-146	35	-111
Supervisors, petroleum, gas and chemical processing and utilities (9212)	1,493	1,456	-37	51	14
Supervisors, supply chain, tracking and scheduling co-ordination occupations (1215)	380	355	-25	10	-15
Transport truck drivers (7511)	3,873	3,586	-287	105	-182
Welders and related machine operators (7237)	2,606	2,422	-184	50	-134
Other occupations	58,209	53,947	-4,262	1,497	-2,765

Note: Numbers may not add up due to rounding. Refer to detailed spreadsheets for employment forecast by oil and gas sub-sector, occupation and province.

Appendix 4: 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.

Artificial intelligence (AI): The theory and development of computer systems able to perform tasks that normally require human intelligence.

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

Big data: Large volumes of digital information that can be analyzed to reveal trends and insights to guide decision making.

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

Blockchain: A system in which a record of transactions made in cryptocurrency is maintained across several computers that are linked in a peer-to-peer network.

Capital expenditures (CAPEX): Funds used by a company to acquire or upgrade physical assets such as property, industrial buildings or equipment. They are 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): 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).

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 or sector.

Labour shortage: Unemployment rate falls below the balanced rate.

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

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.

Labour surplus: Unemployment rate is above the balanced rate.

Liquefied natural gas (LNG): Natural gas that is cooled and converted to liquid for ease of storage and transportation.

Machine learning: An application of artificial intelligence that provides systems with the ability to automatically learn and improve from experience without being programmed by a human. It focuses on the development of computer programs that can access data and use it to learn for themselves.

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 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:

- 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 acidizing wells, cementing and perforating well casings, well testing and servicing, pumping, and oil well logging

Oil sands sub-sector: Sub-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.

Pipeline sub-sector: Petroleum industry sub-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.

Acknowledgements

The Petroleum Labour Market Information (PetroLMI) 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 the following organizations:

- ARC Energy Research Institute
- Canadian Association of Geophysical Contractors (CAGC)
- Canadian Association of Oilwell Drilling Contractors (CAODC)
- Canadian Association of Petroleum Producers (CAPP)
- Canadian Energy Research Institute (CERI)
- CEPA Foundation
- Devon Energy Corporation
- Indian Resource Council (IRC)
- Indigenous Works
- Petroleum Services Association of Canada (PSAC)
- Precision Drilling Corporation
- Shell Canada
- Trican Well Service

Last but not least, PetroLMI acknowledges the contributions of Stokes Economics, JuneWarren-Nickle's Energy Group (JWN Energy), Creative Links International Inc. and Mario Scarffardi Design Inc. for assisting in the study and production of this report.

Photos courtesy of Cenovus Energy Inc., CNOOC International, Energy Safety Canada, Enerplus Corp., Halliburton, Husky Energy, Syncrude Canada Ltd., TransCanada Corporation and Women in Resource Development Corporation

Disclaimer

This project is funded by the Government of Canada's Sectoral Initiatives Program.

All rights reserved.

The reader of this report has permission to use "limited labour market information (or LMI) content" for general reference or educational purposes in the reader's analysis or research reports. "Limited LMI Content" is defined as not exceeding 400 words or a maximum of two data tables or graphs per document. Where Limited LMI Content is used, the reader must cite the source of the Limited LMI Content as follows: Source (or "adapted from"): PetroLMI, name or product, catalogue, volume and issue numbers, reference period and page(s).

The reader of this report cannot:

- Market, distribute, export, translate, transmit, merge, modify, transfer, adapt, loan, rent, lease, assign, share, sub-license or make available to another person or entity, this report in any way, in whole or in part
- Use this report and its contents to develop or derive any other information product or information service for commercial distribution or sale
- Use this report and its contents in any manner deemed competitive with any other product or service sold by PetroLMI

The information and projections contained herein have been prepared with information sources PetroLMI has deemed to be reliable. PetroLMI makes no representations or warranties that this report is error free and therefore shall not be liable for any financial or other losses or damages of any nature whatsoever arising from or otherwise relating to any use of this document. The opinions and interpretations in this publication are those of PetroLMI and do not necessarily reflect those of the Government of Canada.

For more information, contact:

Petroleum Labour Market Information (PetroLMI)

Phone: 403-516-8100

Email: info@careersinoilandgas.com

www.careersinoilandgas.com

Copyright © PetroLMI 2019

Published April 2019

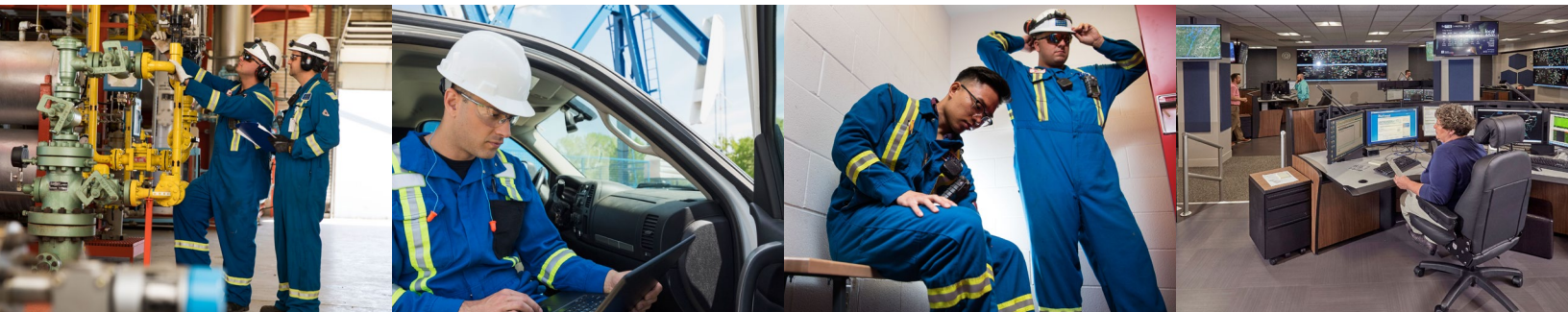
PetroLMI

DIVISION OF ENERGY SAFETY CANADA

Overview

The Petroleum Labour Market Information (PetroLMI) division of Energy Safety Canada is a leading resource for labour market information and trends regarding Canada's oil and gas industry. PetroLMI specializes in providing petroleum labour market data, analysis and insights, as well as occupation profiles and other resources.

Careers in Oil + Gas is a PetroLMI initiative and is Canada's leading website for petroleum labour market information and insights, as well as occupational tools and other resources for career and workforce planning.



info@CareersinOilandGas.com

403-513-8100 or toll free 1-866-537-1230

5055 11 Street NE, Calgary, AB T2E 8N4

CareersinOilandGas.com