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Oil Sands Construction, Maintenance and Operations Labour Demand Outlook to 2023

OIL SANDS CONSTRUCTION, MAINTENANCE AND OPERATIONS LABOUR DEMAND OUTLOOK TO 2023

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EXECUTIVE SUMMARY

The oil sands sector remains a key economic and employment driver for Canada. Attracting and retaining skilled workers for oil sands construction, maintenance and operations are critical to cost-effective expansion. Nearly one-third of the economic benefits of oil sands investment will carry over to other Canadian provinces, including economic gains from the spending of some \$172 billion in wages and salaries.¹

Expansion-related hiring for both construction and oil sands operations is projected to reach approximately 98,380 jobs over the next decade, and each of the sectors face common challenges when addressing skills shortages and meeting workforce demands.

To help stakeholders understand these challenges, the Petroleum HR Council (a division of Enform Canada); BuildForce Canada (formerly the Construction Sector Council); Construction Owners Association of Alberta (COAA); and the Government of Alberta's Ministry of Jobs, Skills, Training and Labour (GoA) have combined efforts to produce the *Oil Sands Construction, Maintenance and Operations Labour Demand Outlook to 2023*.

This report presents three distinct models and is intended to complement, not replace, the detailed labour market projections and analysis offered by each organization:

- BuildForce Canada's annual *Construction and Maintenance Looking Forward* forecasts
- GoA and COAA's Oil Sands Information, Labour Market Analysis and Projection (OILMAP) workforce projection model
- Petroleum HR Council's Oil Sands Labour Demand model

The first two models project numbers for construction labour demand. BuildForce's model captures the need for off-site and on-site construction workers and analyzes production numbers from CAPP's *Crude Oil Forecast, Markets & Transportation*² outlook to build its projections. OILMAP's model is driven by current and announced (planned) oil sands construction projects, and data (for on-site workers only) collected from oil and gas companies.

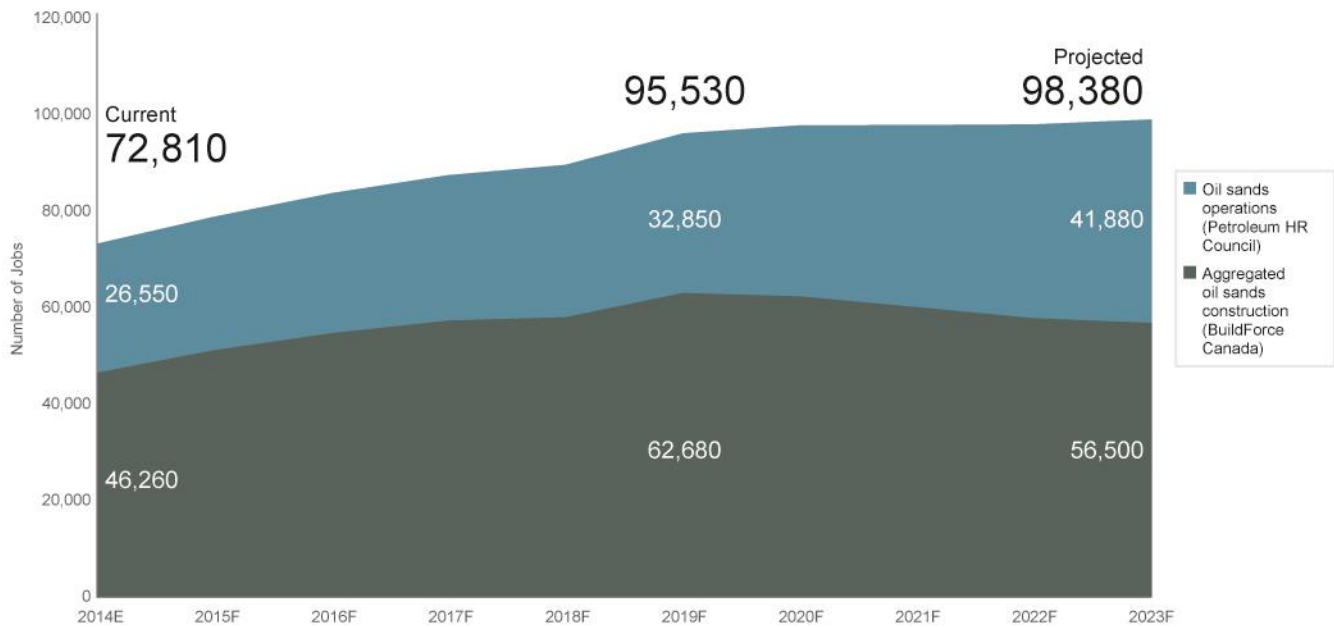
The Petroleum HR Council's model covers operations labour demand and also uses production numbers from CAPP's *Crude Oil Forecast* as inputs to its model. Similar to CAPP's oil sands production forecast, the Petroleum HR Council's projections are available by operation type: in situ, mining and upgrading.

Because the inputs into each model are slightly different, it is not possible to derive cumulative labour demand; however, this data can assist oil sands companies with workforce development planning by highlighting trends and labour demand at an occupational level. The combined look at BuildForce, OILMAP and the Petroleum HR Council's respective labour demand projections into a single report provides the most reliable, comprehensive picture of oil sands construction, maintenance and operations workforce requirements currently available.

OIL SANDS CONSTRUCTION, MAINTENANCE AND OPERATIONS WORKFORCE REQUIREMENTS

It is estimated that the **oil sands sector will generate about 72,810 direct construction and operations jobs in 2014**. Approximately 64 per cent or 46,260 of the jobs are within “aggregated oil sands construction” which includes off-site prefabrication and modular construction, on-site construction, sustaining, ongoing and turnaround maintenance. The remaining 36 per cent or about 26,550 are direct oil sands operations jobs.

Oil Sands Construction and Operations Workforce Projections to 2023



E = Estimated; F = Forecasted

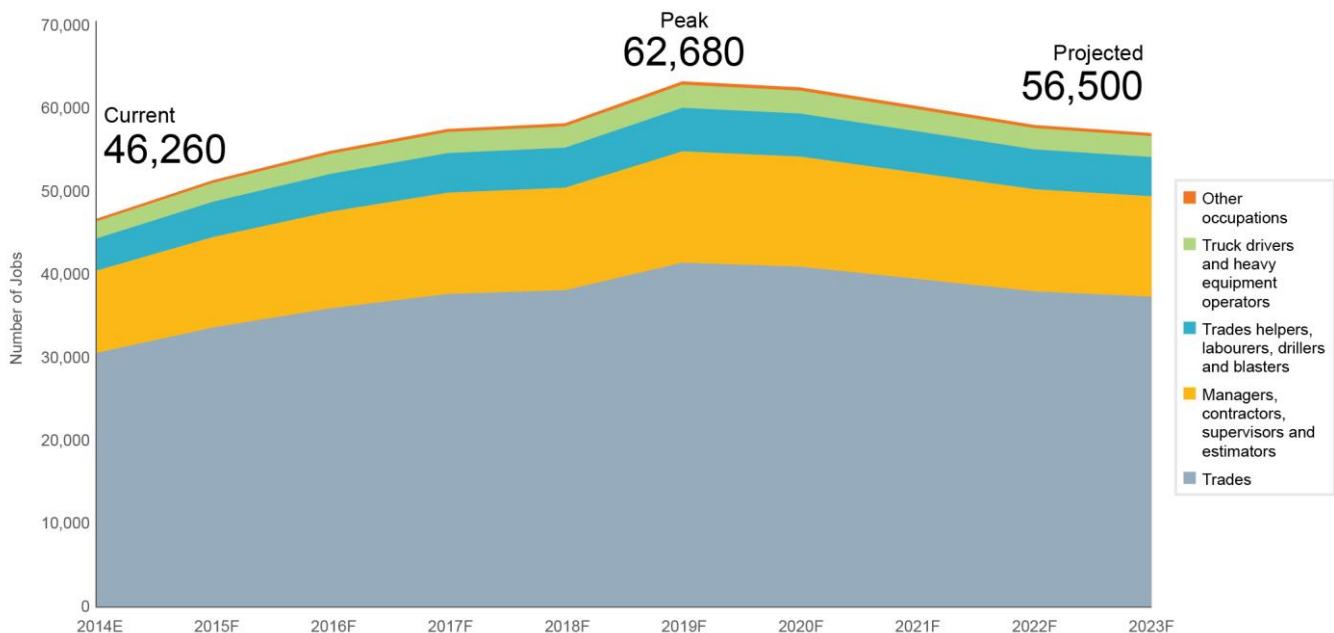
FIGURE 1 Source: Petroleum HR Council and BuildForce, 2014

With workforce requirements for both construction and oil sands operations expected to reach 98,380 jobs over the next decade, companies, industry groups and several collaborative entities are making efforts to address labour demand challenges. Any losses in economic benefits caused by a shortage of workers for either oil sands construction or operations impacts all of Canada.

AGGREGATED OIL SANDS CONSTRUCTION (BUILDFORCE CANADA)

Job creation in the oil sands construction sector will be significant over the next five years. Based on the current oil sands production forecast, the average annual **aggregated oil sands construction workforce requirements will peak³ in 2019 at about 62,680 workers** – an increase of 16,420 jobs or a 35 per cent increase over 2014 employment levels. The oil sands construction workforce is currently projected to decrease after 2019 but this will change if additional oil sands expansion is announced.

BuildForce – Aggregated Oil Sands Construction Workforce Projections to 2023



E = Estimated; F = Forecasted

FIGURE 2 Source: BuildForce Canada, 2014

For aggregated oil sands construction, the top five occupations make-up over 50 per cent of the workforce at the peak in 2019. These occupations also account for over 50 per cent of new jobs created between 2014 and 2019.

BUILDFORCE – TOP FIVE AGGREGATED OIL SANDS CONSTRUCTION LABOUR DEMAND & WORKFORCE AT PEAK (2019)				
Occupation	Estimated Employment in 2014	Estimated Employment at Peak (2019)	Increase in Number of Jobs (2015-2019)	Per Cent of Peak Workforce
Total BuildForce Trades Occupations	46,260	62,680	16,420	100%
1 Contractors and supervisors	6,370	8,635	2,265	14%
2 Steamfitters, pipefitters and plumbers	6,105	8,275	2,170	13%
3 Electricians	5,595	7,585	1,990	12%
4 Trades helpers and labourers	3,700	5,015	1,315	8%
5 Carpenters (including scaffolders)	3,285	4,450	1,165	7%

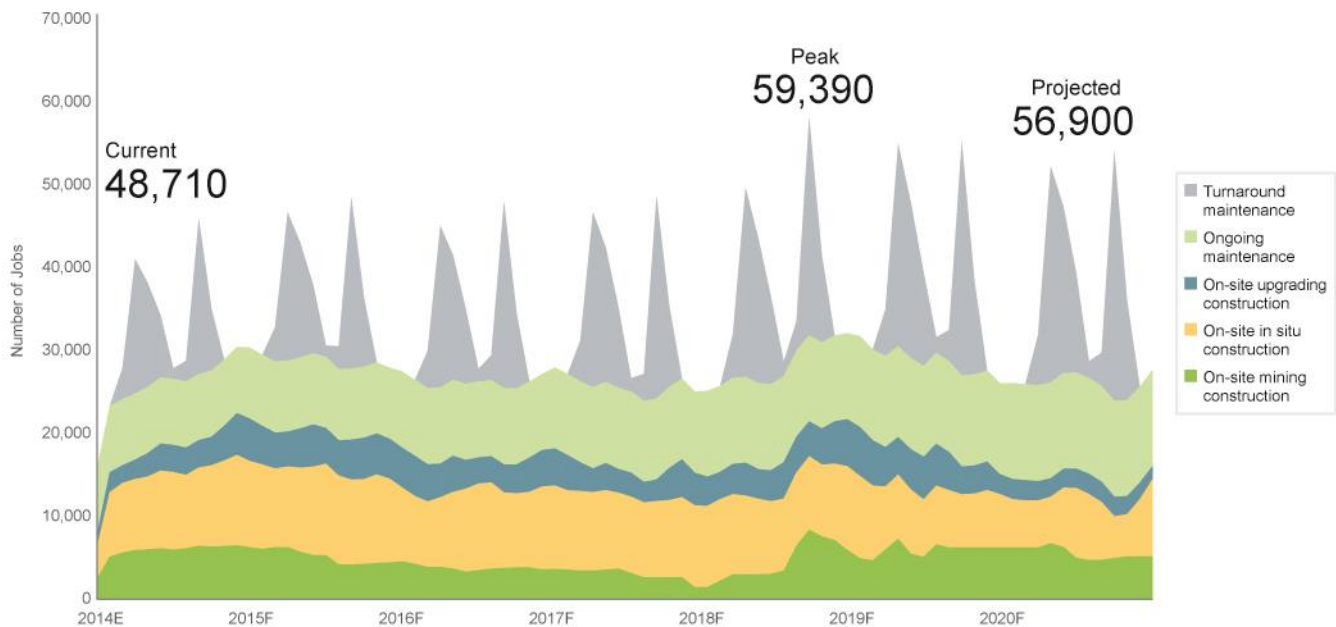
TABLE 1 Source: BuildForce Canada, 2014.

ON-SITE CONSTRUCTION, TURNAROUND AND ONGOING MAINTENANCE (OILMAP)

OILMAP provides insight into the construction and maintenance occupations required to be on-site at oil sands key operating areas. OILMAP's model has been designed to look at the annual peak demands associated with three distinct activities: construction, turnaround maintenance and ongoing maintenance.

The workforce required for on-site oil sands construction, turnaround and ongoing maintenance will be around 48,710 workers in 2014 and will increase to about 56,900 jobs in 2020, a 17 per cent increase over 2014 levels. The workforce will peak at about 59,390 jobs in 2019.

OILMAP – Oil Sands On-Site Construction, Turnaround and Ongoing Maintenance Employment to 2020



E = Estimated; F = Forecasted

FIGURE 3 Source: OILMAP, 2014

OILMAP – TOP FIVE ON-SITE OIL SANDS CONSTRUCTION, TURNAROUND AND ONGOING MAINTENANCE EMPLOYMENT AT PEAK (2019)

Occupation	Estimated Employment in 2014	Estimated Employment at Peak (2019)	Increase in Number of Jobs (2015-2019)	Per Cent of 2014 Workforce
Total OILMAP Trades Occupations	37,680	58,840	21,160	56%
1 Pipefitters	6,480	11,265	4,785	74%
2 Boilermakers	5,045	9,670	4,625	92%
3 Carpenters	3,970	6,750	2,780	70%
4 Electricians	3,030	4,765	1,735	57%
5 Labourers	7,165	9,150	1,985	28%

TABLE 2 Source: OILMAP, 2014

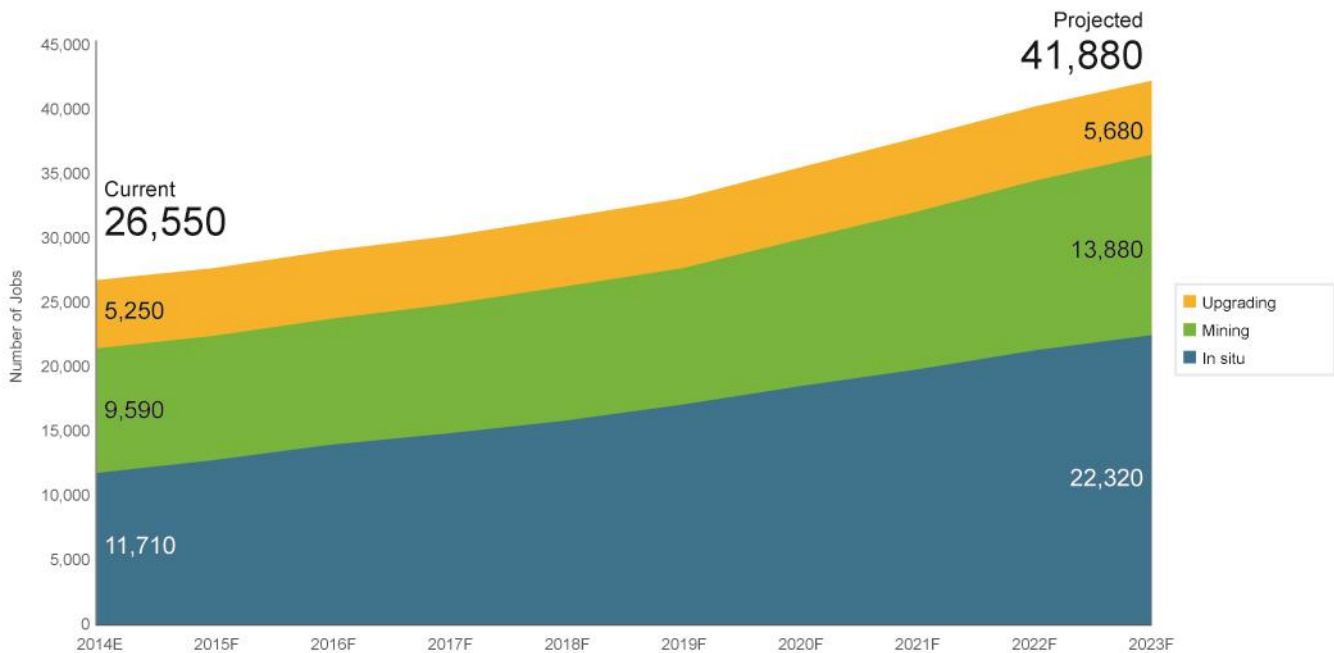
OIL SANDS OPERATIONS LABOUR DEMAND (PETROLEUM HR COUNCIL)

Oil sands operations workforce requirements increase steadily over the next decade with an average year-over-year growth rate of five per cent. **By 2023, oil sands operations employment is projected to increase by 58 per cent, creating about 15,330 new operations jobs for total employment of about 41,880.**

As has been the trend in recent years, in situ operations add the most jobs over the forecast period:

- In situ: 10,610 additional jobs; 91 per cent increase over 2014 employment levels.
- Mining: 4,290 additional jobs; 45 per cent increase over 2014 employment levels.
- Upgrading: 430 additional jobs; 8 per cent increase over 2014 employment levels.

Petroleum HR Council – Oil Sands Operations Workforce Projections to 2023



E = Estimated; F = Forecasted

FIGURE 4 Source: Petroleum HR Council, 2014

PETROLEUM HR COUNCIL – TOP FIVE OIL SANDS OPERATIONS OCCUPATIONS WITH GREATEST JOB INCREASES DUE TO INDUSTRY ACTIVITY TO 2023				
Occupations (NOC)		2014 Employment	Hiring due to Industry Activity to 2023	Growth (Percentage of 2014 Employment)
Total Oil Sands Operations Occupations		26,550	15,330	58%
1	Power engineers and power systems operators (9241)	4,715	2,895	61%
2	Heavy equipment operators (except crane) (7521)	3,305	1,470	44%
3	Petroleum engineers (2145)	1,025	825	80%
4	Engineering managers (0211)	1,035	660	64%
5	Facility operation and maintenance managers (0714)	1,125	555	49%

TABLE 3 Source: Petroleum HR Council, 2014

In addition to support new jobs created due to industry expansion, age-related attrition has the potential to drive a significant number of job openings within oil sands operations over the next decade. **Approximately 6,380 jobs or 24 per cent of 2014 employment levels are eligible for retirement during the projection period.**

WORKFORCE CHALLENGES FOR OIL SANDS CONSTRUCTION, MAINTENANCE AND OPERATIONS

An unemployment rate of 4.9 per cent⁴ is an indicator that Alberta is experiencing a tight labour market, which exacerbates the task of addressing labour demand for oil sands construction, maintenance and operations.

Construction spending and labour demand requirements are up across Canada, adding to the challenges of meeting workforce requirements for the foreseeable future. Major resource, infrastructure and engineering projects in other provinces will compete for the same key trades and occupations that are in high demand in Alberta.

The growing demand for maintenance and sustaining capital projects in Alberta's existing major industrial facilities will contribute to the labour supply challenges within the construction sector. For oil sands operations, shortages will be especially acute for occupations requiring specialized training, as well as occupations that are in demand in other industries including construction. The challenges of a competitive labour environment and shortages of specific skills are worsened by an aging workforce for both the construction and operations sectors.

Many oil sands project owners have multiple projects planned (e.g., oil sands, LNG, offshore) and they are susceptible to the cumulative risks of labour shortages. There is a significant upside to investing

in increasing the pool of qualified construction and operations labour, rather than the alternative, where different companies compete for workers.

MEETING FUTURE WORKFORCE DEMANDS – OIL SANDS CONSTRUCTION AND OPERATIONS

The need for collaborative action is required in the construction and oil and gas industries to increase the workforce and address labour requirements. This report is a prime example of the oil sands sector, industrial construction sector, provincial government and industry associations collaborating to provide robust labour market analysis and information to mitigate workforce challenges.

Initiatives aimed at enhancing the supply of skilled workers to support the future hiring needs of oil sands construction and operations include:

- Attracting and retaining workforce groups that are under-represented in the construction and oil sands operations sectors.
- Recruiting workers from across Canada and internationally to augment local labour supply.
- Improving productivity through the use of fabrication facilities and modular assembly yards and advances in construction workforce procurement and training. Owner companies are taking a “cookie cutter” or manufacturing approach by constructing large projects in smaller, repeatable phases and pre-building sites for future expansion.
- Investing in talent management, including career development and succession planning programs and competency-based programs to assist with shortening the “time to productivity” for new hires.

INTRODUCTION

The oil sands sector continues to demonstrate resiliency and remain a key economic and employment driver for Canada. Alberta's economy and employment consistently outperformed the rest of Canada.⁵ The construction and oil sands operations sectors were key contributors to job creation. This is despite the fact that the oil sands sector has not seen significant developments to address key business constraints such as market diversification and securing capital.⁶ Attracting and retaining a skilled workforce for oil sands construction and operations remain critical to cost-effective expansion.

Market diversification remains a top priority as the United States, Canada's primary oil customer, continues to increase its own oil production and decrease its reliance on imports from Canada. Pipeline projects that will transport oil to other geographic areas are progressing but final approvals are still pending. In the meantime, the sector is using rail and trucking to transport production to market. The number of carloads of oil moving by rail increased 75 per cent between 2012 and 2013.⁷

New federal rules and increased scrutiny on foreign investment affected the level of investment and merger and acquisition activity in 2013 bringing it to low levels experienced in 2004.⁸ In 2014 some large projects have moved forward, including the approval of the Fort Hills mine; a 180,000 barrels per day Suncor Energy Inc. operated joint venture with Total E&P Canada Ltd. and Teck Resources Limited.⁹ While at the same time, some smaller start-up operations have struggled to secure capital and are openly examining strategic and financial alternatives to ensure project viability.

In response to changing demographics and the pace of industry activity, focused attraction, retention and development of workers for the construction and operations of oil sands is now the new normal. The industrial construction industry and the oil sands sector are linked by the multi-year, multi-phase construction strategy used by oil sands companies to expand their operations. In addition, the need for ongoing and scheduled turnaround maintenance has resulted in a common quest for a productive labour force.

A shortage of workers for either oil sands construction or operations impacts all of Canada. Nearly one-third of the economic benefits of oil sands investment will accrue to other Canadian provinces including economic gains from the spending of some \$172 billion in wages and salaries.¹⁰

"Worker shortages have inflationary implications, including cost increases for construction projects and increased project execution risk, and could impact the private sector's ability to attract investment."

– Canadian Association of Petroleum Producers. *Oil and natural gas industry supports budget measures for improved access to skilled trades training and building future workforce*. February 12, 2014.¹¹

Labour market information (LMI) can serve as a powerful tool to assist oil sands partners with workforce development planning. To help stakeholders to understand the most serious risks associated with oil sands construction, maintenance and operations labour shortages, the Petroleum HR Council (a division of Enform Canada); BuildForce Canada¹²; Construction Owners Association of Alberta (COAA); and the Government of Alberta's Ministry of Jobs, Skills, Training and Labour (GoA) have worked together to produce the *Oil Sands Construction, Maintenance and Operations Labour Demand Outlook to 2023*. This year's report will replace the Petroleum HR Council's annual Oil Sands Outlook to provide broadened labour demand projections, insights into workforce trends and information on potential labour solutions for oil sands construction, operations and ongoing and turnaround maintenance.

This report aims to increase understanding of the occupational demand and workforce trends for oil sands construction and operations by compiling information and data from each source. It is intended to complement, not replace, the detailed labour market projections and analysis offered by each organization by looking at the workforce required to support an industry sector that has proven to be a key contributor to the well-being of the Canadian economy.

This report presents three separate labour demand modelling systems:

- BuildForce Canada's annual Construction and Maintenance Looking Forward forecasts
- GoA and COAA's Oil Sands Information, Labour Market Analysis and Projection (OILMAP) workforce projection model
- Petroleum HR Council's Oil Sands Labour Demand model

The report begins with an overview of the scope and methodology for each model (BuildForce, OILMAP and Petroleum HR Council) and then provides highlights of their respective workforce

projections. Where possible, consolidated tables and graphs have been developed.

Quantitative data may overlap in some instances because three distinct models are presented. The quantitative data is useful for highlighting trends and labour demand at an occupational level but should not be used to calculate cumulative labour demand. Summary analysis and observations on workforce solutions are offered by the Petroleum HR Council.

Further information on BuildForce's and Petroleum HR Council's labour market products can be obtained from their websites. Additional information on OILMAP is included in Appendix 2.

OVERVIEW OF SCOPE AND METHODOLOGY

BuildForce, OILMAP and the Petroleum HR Council employ similar labour demand models as they all analyze the relationship between oil sands production and their in-scope occupations to project workforce requirements. Although the oil sands production forecasts used as inputs are slightly different, this consolidated report provides the most reliable, comprehensive picture of oil sands construction, maintenance and operations workforce requirements currently available.

The following is a summary of each of the three labour demand methodologies used to produce the *Oil Sands Construction, Maintenance & Operations Labour Demand to 2023*. Detailed methodology descriptions can be found in Appendices 1, 2 and 3.

BUILDFORCE METHODOLOGY

BuildForce publishes the outlook report *Construction and Maintenance Looking Forward* for the oil sands sector, which covers off-site prefabrication and modular construction, on-site construction, maintenance and sustaining capital work. BuildForce's methodology compares the Canadian Association of Petroleum Producers' (CAPP) annual *Crude Oil Forecast, Markets & Transportation* outlook with other industry data sources, such as the Alberta Government's *Alberta Oil Sands Quarterly Update*, which details the expected start date for operations and the production targets by project. BuildForce then estimates the construction investment necessary to meet oil sands production targets and the model converts construction investment into labour requirements. BuildForce's Alberta Labour Market Information Committee completes the final review of the oil sands construction investment and employment forecast.

OILMAP METHODOLOGY

OILMAP projects the trades workforce required on-site to construct and maintain oil sands operations. OILMAP does not include manager or supervisor roles. OILMAP's model includes only construction trades. Consequently, these occupations as well as others are a part of the occupational scope for BuildForce projections.

OILMAP determines on-site construction workforce requirements by analyzing data from oil sands companies to establish the relationship between the following:

- different types of construction trades
- project type (mining, in situ and upgrading)
- project size (production capacity)

Input from oil sands companies on the type, timing and capacity of their projects allows OILMAP to determine on-site construction workforce requirements by trade. OILMAP's workforce projection for turnarounds and ongoing maintenance is driven by historical workforce data provided by the General Presidents' Maintenance Committee for Canada and the National Maintenance Council for Canada. The OILMAP methodology relies on input and validation from industry groups including Alberta Council of Turnarounds Industry Maintenance Stakeholders (ACTIMS), Rose Committee, COAA and individual oil sands companies.

PETROLEUM HR COUNCIL METHODOLOGY

The Petroleum HR Council's oil sands labour demand model estimates the operations workforce required to support industry expansion. It calculates the number of workers required by occupation to realize projected production increases. Similar to BuildForce, the Petroleum HR Council also uses CAPP's *Crude Oil Forecast* as a key indicator for industry expansion. Like CAPP's oil sands production forecast, the Petroleum HR Council's projections are available by operation type: in situ, mining and upgrading.

The Petroleum HR Council's model also calculates age-related attrition of the oil sands workforce by comparing occupation-specific age of retirement to the age demographic of industry's core occupations.

Net hiring requirements are determined by adding the labour demand required to support industry expansion and age-related attrition.

IN-SCOPE OCCUPATIONS

The quantitative labour demand projections provided by BuildForce, OILMAP and the Petroleum HR Council provide workforce requirements and analysis for 64 different occupations, as defined by the National Occupational Classification (NOC):¹³

- Aggregated oil sands construction: 23 occupations required for off-site prefabrication and modular construction, on-site construction, maintenance and sustaining capital work¹⁴ as provided by BuildForce.¹⁵
- On-site oil sands construction and maintenance: 16 occupations required on-site to construct and maintain oil sands operations as provided by OILMAP.¹⁶
- Oil sands operations: 52 occupations hired by oil sands companies for on-site and head

office operations as provided by the Petroleum HR Council.¹⁷ Additionally, an "other occupations" category captures any residual occupations and ensures the total oil sands workforce is incorporated.

The Petroleum HR Council defines the oil sands operations sector as the extraction, production and upgrading of bitumen, which is broken down into the following operation types:

- **Mining:** activities to explore and recover oil sands reserves through open pit mines.
- **In situ:** activities to explore and recover oil sands reserves in place or in situ, by drilling wells.
- **Upgrading:** converting bitumen into a product with a lower density and viscosity.

IN-SCOPE OIL SANDS CONSTRUCTION, MAINTENANCE AND OPERATIONS OCCUPATIONS				
Occupation (NOC)		BuildForce (Aggregated Oil Sands Construction)	OILMAP (On-site Oil Sands Construction & Maintenance)	Petroleum HR Council (Oil Sands Operations)
1	Automotive service technicians, truck and bus mechanics and mechanical repairers (7321)			•
2	Boilermakers (7234)	•	•	
3	Bricklayers (primarily refractory) (7281)	•		
4	Carpenters (7271)	•	•	
5	Cement masons/Concrete finishers (7282)	•	•	
6	Chemical engineers (2134)			•
7	Chemical technologists and technicians (2211)			•
8	Civil engineering technologists and technicians (2231)			•
9	Civil engineers (2131)			•
10	Construction estimators (2234)	•		•
11	Construction managers (0711)	•		•
12	Construction millwrights and industrial mechanics (7311)	•	•	•
13	Contractors and supervisors, trades and related occupations ¹⁸ (7202, 7302, 7201, 7301, 7203)	•		•
14	Crane operators (7371)	•	•	•
15	Drafting technologists and technicians (2253)			•
16	Drillers and blasters (7372)	•		
17	Electrical and electronics engineering technologists and technicians (2241)			•
18	Electrical and electronics engineers (2133)			•
19	Electrical power line and cable workers (7244)			•
20	Engineering managers (0211)			•
21	Facility operation and maintenance managers (0714)			•
22	Geological and mineral technologists and technicians (2212)			•
23	Geological engineers (2144)			•
24	Geoscientists and oceanographers (2113)			•
25	Heavy equipment operators (except crane) (7521)	•	•	•
26	Heavy-duty equipment mechanics (7312)	•		•
27	Industrial and manufacturing engineers (2141)			•
28	Industrial electricians (7242)	•	•	•
29	Industrial engineering and manufacturing technologists and technicians (2233)			•
30	Industrial instrument technicians and mechanics (2243)	•	•	•
31	Inspectors in public and environmental health and occupational health and safety (2263)			•
32	Insulators (7293)	•	•	
33	Ironworkers (7236)	•	•	
34	Land survey technologists and technicians (2254)			•

IN-SCOPE OIL SANDS CONSTRUCTION, MAINTENANCE AND OPERATIONS OCCUPATIONS				
Occupation (NOC)		BuildForce (Aggregated Oil Sands Construction)	OILMAP (On-site Oil Sands Construction & Maintenance)	Petroleum HR Council (Oil Sands Operations)
35	Machinists and machining and tooling inspectors (7231)			•
36	Managers in natural resources production and fishing (0811)			•
37	Mechanical engineering technologists and technicians (2232)			•
38	Mechanical engineers (2132)			•
39	Metallurgical and materials engineers (2142)			•
40	Mining engineers (2143)			•
41	Natural and applied science policy researchers, consultants and program officers (4161)			•
42	Non-destructive testers and inspection technicians (2261)			•
43	Oil and gas drilling, servicing, and related labourers (8615)			•
44	Other automotive mechanical installers and servicers (7535)			•
45	Painters (7294)	•	•	
46	Petroleum engineers (2145)			•
47	Petroleum, gas, and chemical process operator (9232)			•
48	Power engineers and power systems operators (9241)			•
49	Power system electricians (7243)			•
50	Production logistics co-ordinators (1523)			•
51	Professional occupations in advertising, marketing and public relations (1123)			•
52	Purchasing agents and officers (1225)			•
53	Purchasing and inventory control workers (1524)			•
54	Purchasing managers (0113)			•
55	Scaffolders (7611)	•	•	
56	Sheet metal workers (7233)	•		
57	Shippers and receivers (1521)			•
58	Steamfitters, pipefitters and sprinkler system installers (7252)	•	•	•
59	Supervisors, mining and quarrying (8221)			•
60	Supervisors, supply chain, tracking and scheduling co-ordination occupations (1215)			•
61	Trades helpers and labourers (7611)	•	•	
62	Truck drivers (7511)	•	•	
63	Water and waste treatment plant operators (9243)			•
64	Welders and related machine operators (7237)	•	•	•
65	Other occupations	•		•

TABLE 4

OVERVIEW OF CANADA'S OIL SANDS

The majority of Canada's oil sands deposits and all of its current operations are located in Alberta. Although the Athabasca deposit near Fort McMurray is the largest and the most well-known, the Cold Lake deposit has also undergone significant development in recent years. Peace River is the province's smallest oil sands deposit with five small projects currently operating, three other pilot/demonstration projects either approved or under-construction and one larger 40,000 barrel per day project under construction.¹⁹ Figure 5 illustrates the oil sands key operations areas.²⁰

Oil Sands Key Operating Areas

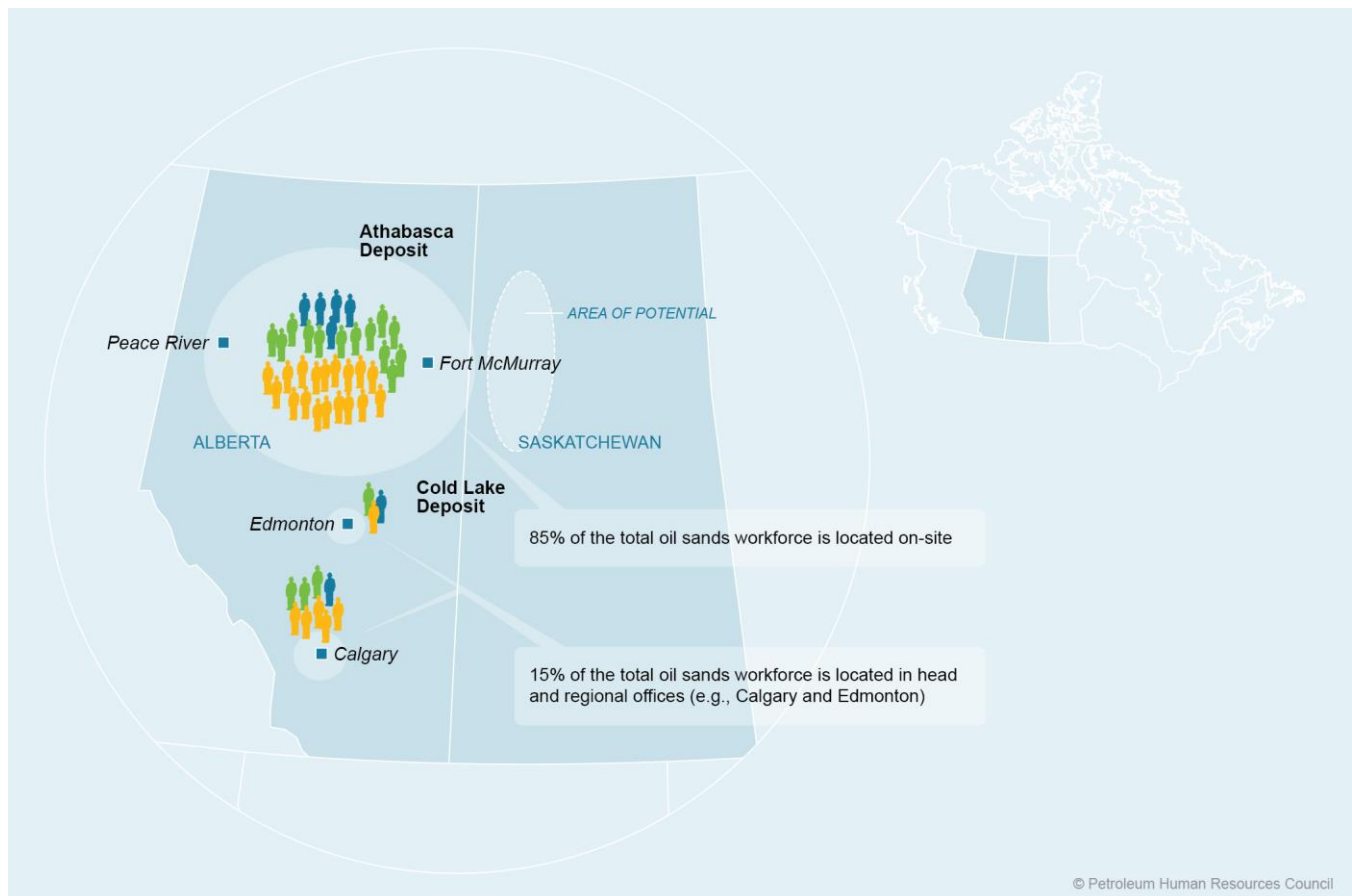


FIGURE 5

OIL SANDS CONSTRUCTION

Oil sands construction activities include off-site prefabrication and modular construction, on-site construction, and maintenance and sustaining capital work.

Off-site prefabrication and modular construction involves the building of oil sands operations modules in a plant setting where construction, assembly, testing and pre-commissioning can occur in a controlled environment. Modules are then transported to the operations site for final assembly.

In Alberta, the majority of off-site pre-fabrication and modular construction for the oil sands sector takes place in the Edmonton region, so it is closer to oil sands operations, making transportation easier. Some oil sands fabrication and modularization also occurs outside of Alberta and in some cases, outside of Canada.

On-site construction involves the assembly and construction work that needs to be completed in the field. In Alberta, on-site oil sands construction takes

place in the same locations as ongoing operations: Athabasca, Cold Lake and Peace River regions.

Operations also require ongoing maintenance and large-scale shutdown or “turnarounds” of plants for

maintenance and equipment replacement to ensure the operations are as efficient as possible. Again, ongoing and turnaround maintenance occur at the operation site.



Photo Courtesy Suncor Energy Inc.

OIL SANDS OPERATIONS

Since 1967, Canada has been commercially producing oil from the oil sands. Initially, bitumen was extracted using huge shovels and trucks and open-pit mining techniques. However, only 20 per cent of Canada’s known oil sands resource is close enough to the surface to be mined.

The other 80 per cent of Canada’s oil sands resource is deeper or in situ and requires different extraction technologies, such as steam-assisted gravity drainage (SAGD), to bring the bitumen to the surface.

As the name suggests, steam is used in SAGD to soften the bitumen so it can be pumped to the

surface. In many ways, SAGD is similar to conventional oil production in that it uses horizontal drilling and wells.

Upgrading is a process manufacturing operation that converts bitumen into a product similar to light conventional oil. It also produces a number of other useful by-products, such as sulphur which is used in the manufacturing of fertilizers, pharmaceuticals and other products.

Figure 6 illustrates the three distinct types of operations within the oil sands sector.

Oil Sands Mining, In Situ and Upgrading Operations

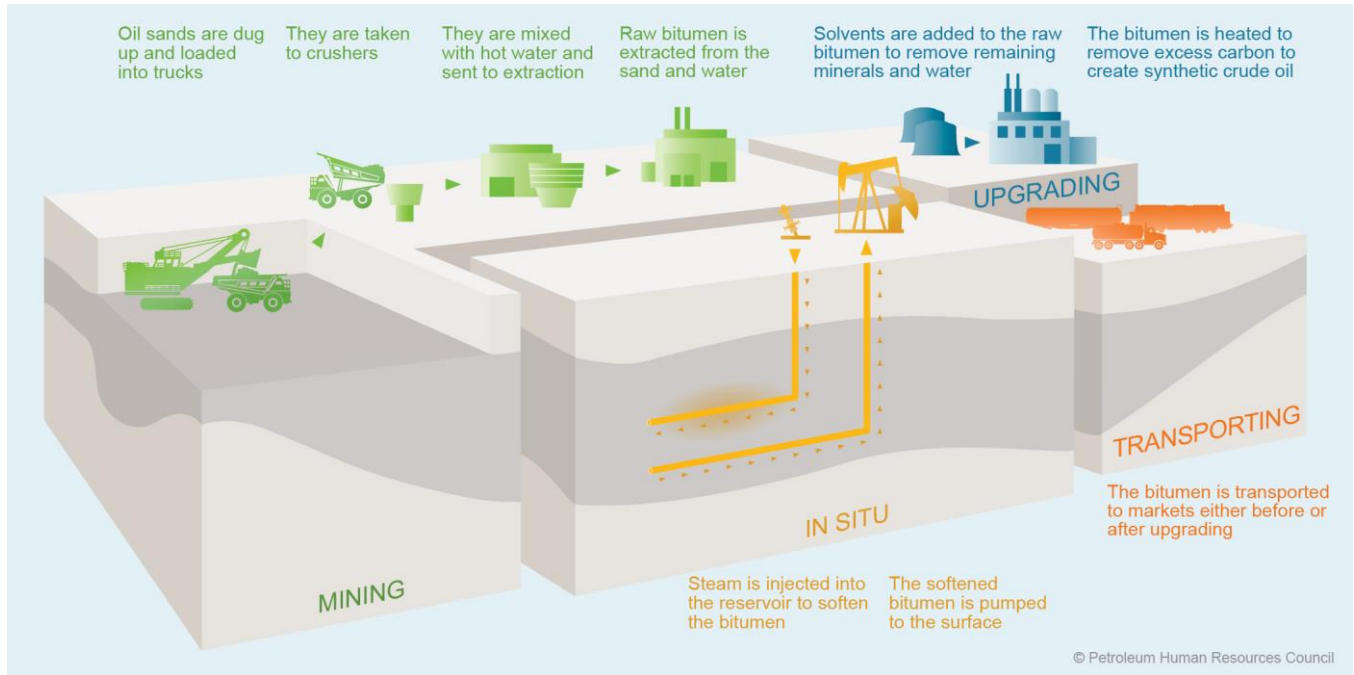


FIGURE 6

OIL SANDS CONSTRUCTION, MAINTENANCE AND OPERATIONS WORKFORCE REQUIREMENTS

Current

It is estimated the **oil sands sector will generate about 72,810 direct construction and operations jobs in 2014**. Approximately 46,260 or 64 per cent of the jobs are within “aggregated oil sands construction” which includes off-site prefabrication and modular construction, on-site construction, ongoing and turnaround maintenance. The remaining 36 per cent or about 26,550 are direct oil sands operations jobs.

Peak

Based on current oil sands production forecasts, the oil sands construction workforce will peak in 2019. Between 2014 and 2019, the sector will require 16,420 additional workers, a 35 per cent increase

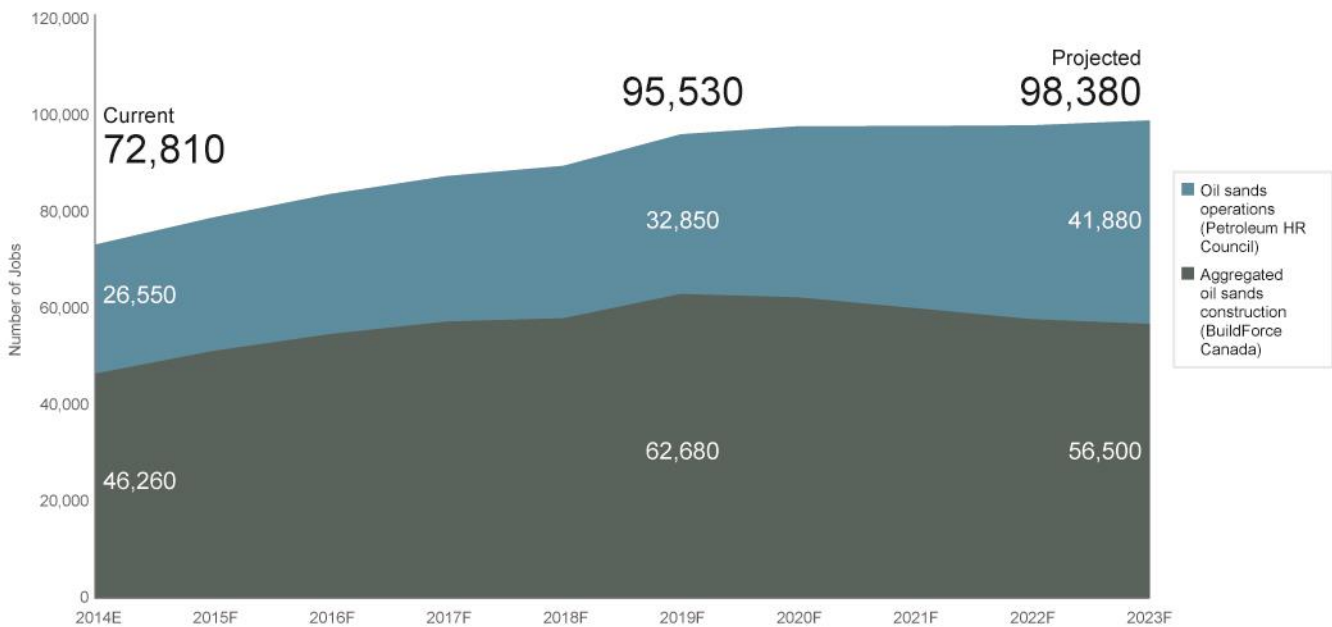
over 2014 employment levels. Currently, the oil sands construction workforce is projected to decrease after 2019, as new capital investment slows, but this will change if additional oil sands expansion projects are announced.

Projected

Oil sands operations demand increases steadily throughout the forecast period. By 2023 an additional 15,330 positions will be required to support new oil sands production, a 58 per cent increase over 2014 employment levels.

Figure 7 consolidates oil sands construction, maintenance and operations workforce projections to 2023.

Total Oil Sands Construction and Operations Workforce Projections to 2023



E = Estimated F = Forecasted

FIGURE 7 Source: Petroleum HR Council and BuildForce, 2014

AGGREGATED OIL SANDS CONSTRUCTION LABOUR DEMAND (BUILDFORCE CANADA)

The following section is the analysis for aggregated oil sands construction labour demand based on BuildForce Canada's labour market model.

BuildForce Canada estimates the **current (2014) average annual aggregated oil sands construction workforce is 46,260 workers** – a level of employment that surpasses the previous peak achieved in 2008.²¹ Trades constitute 66 per cent of the construction workforce (Figure 8).

BuildForce – Distribution of Aggregated Oil Sands Construction Workforce Requirements in 2014

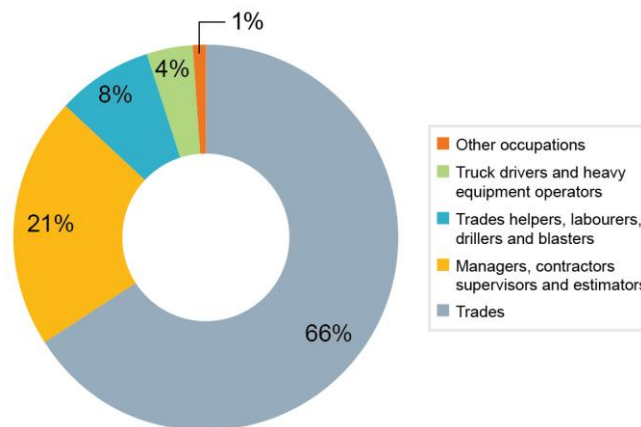
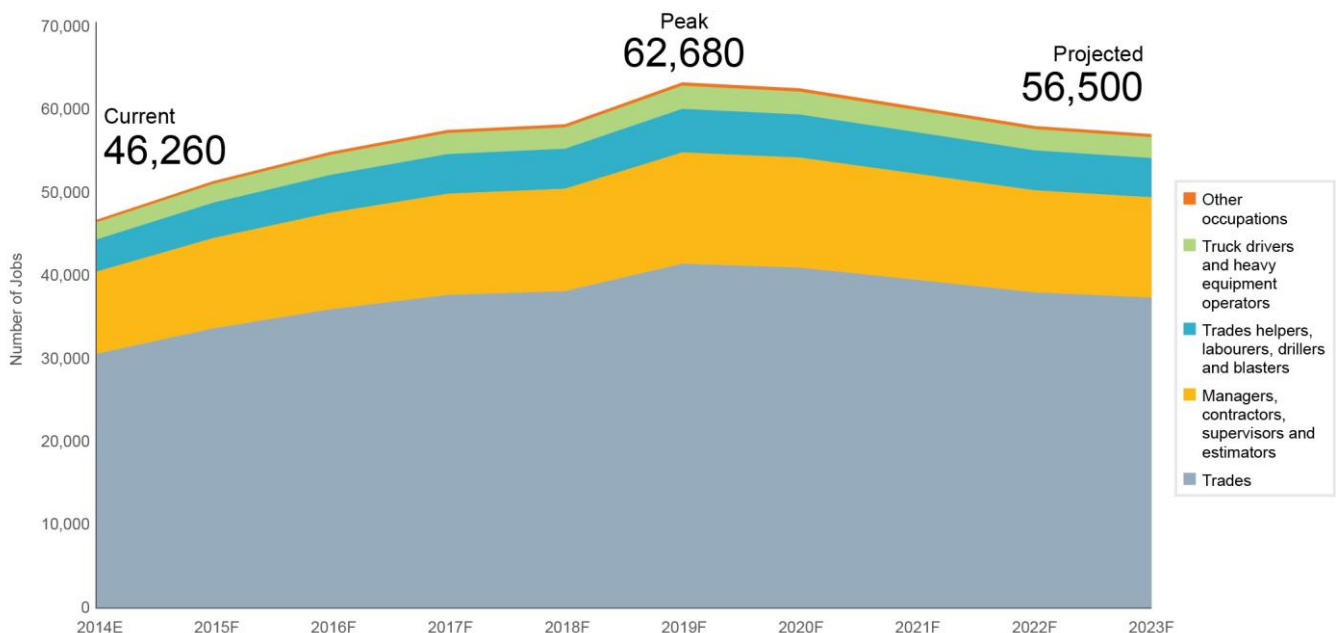


FIGURE 8 Source: BuildForce Canada, 2014

The number of jobs created in the oil sands construction sector will be significant over the next five years. Based on the current oil sands production forecast, **aggregated oil sands construction workforce requirements will peak in 2019 at almost 62,680 workers** – an increase of 16,420 jobs or a 35 per cent increase over 2014 employment levels.

BuildForce – Aggregated Oil Sands Construction Workforce Projections to 2023



E = Estimated F = Forecasted

FIGURE 9 Source: BuildForce Canada, 2014

A closer look at BuildForce's workforce data indicates that the **top five occupations make up over 50 per cent of the aggregated oil sands construction workforce** at the 2019 peak. These occupations also account for over 50 per cent of new jobs growth between 2014 and 2019 (Table 5).

Manager, contractor and supervisor positions are projected to increase by about 3,480 jobs between 2014 and 2019 and make-up 21 per cent of the construction workforce required at peak. This is a

significant number given the industry experience, technical knowledge and people skills required for such workers.

The construction industry also provides sustainable employment opportunities for occupations such as labourers, heavy equipment operators, truck drivers, and drillers and blasters. These occupations will grow by 2,090 jobs between 2014 and 2019 and make-up 13 per cent of the workforce at peak.

BUILDFORCE – AGGREGATED OIL SANDS CONSTRUCTION LABOUR DEMAND AND WORKFORCE OCCUPATIONAL DISTRIBUTION AT PEAK (2019)				
Occupation	Estimated Employment in 2014	Estimated Employment at Peak (2019)	Increase in Number of Jobs (2015-2019)	Percentage of Peak Workforce
Total BuildForce Trades Occupations	46,260	62,680	16,420	100.0%
Contractors and supervisors	6,370	8,635	2,265	13.8%
Steamfitters, pipefitters and plumbers	6,105	8,275	2,170	13.2%
Electricians	5,595	7,585	1,990	12.1%
Trades helpers and labourers	3,700	5,015	1,315	8.0%
Carpenters (including scaffolders)	3,285	4,450	1,165	7.1%
Boilermakers	2,775	3,760	985	6.0%
Construction managers	2,775	3,760	985	6.0%
Sheet metal workers	2,545	3,445	900	5.5%
Ironworkers (structural and reinforcing)	2,430	3,290	860	5.2%
Insulators	2,315	3,135	820	5.0%
Welders	2,130	2,885	755	4.6%
Heavy equipment operators (except crane)	1,110	1,505	395	2.4%
Crane operators	925	1,255	330	2.0%
Truck drivers	925	1,255	330	2.0%
Construction estimators	655	885	230	1.4%
Bricklayers (primary refractory)	575	780	205	1.2%
Concrete finishers (cement masons)	510	690	180	1.1%
Construction millwrights	510	690	180	1.1%
Heavy-duty equipment mechanics	230	315	85	0.5%
Industrial Instrument technicians	230	315	85	0.5%
Painters	185	250	65	0.4%
Drillers and blasters	140	190	50	0.3%
Other occupations (unspecified)	245	325	80	0.5%

TABLE 5 Source: BuildForce Canada, 2014

ON-SITE OIL SANDS CONSTRUCTION AND MAINTENANCE WORKFORCE PROJECTIONS (OILMAP)

The following section is a summary of the trade workforce requirements produced by OILMAP for on-site oil sands construction, turnaround and ongoing maintenance between 2014 and 2020.

OILMAP provides insight into the construction and maintenance trades required to be physically on site at oil sands key operating areas. OILMAP's model examines the annual peak demands associated with three distinct activities: construction, turnaround and ongoing maintenance.

ON-SITE CONSTRUCTION

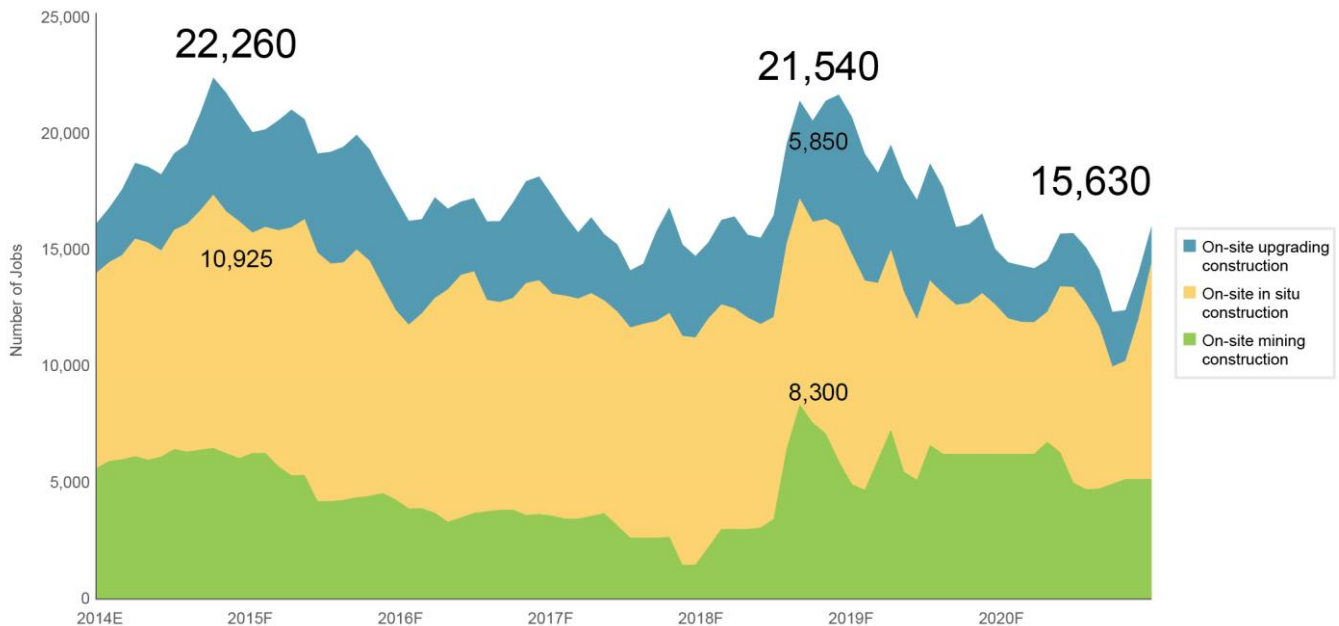
On-site oil sands construction refers to the building of new industrial infrastructure at oil sands operations sites to support production expansion.

The OILMAP model has the capability to project workforce requirements for on-site construction by operations type: mining, in situ and upgrading. New and expanding in situ projects are expected to lead oil sands expansion over the projection period, driving most of the on-site construction demand.

- On-site in situ construction trades are projected to peak over the summer of 2015 at approximately 10,920.
- Based on current project announcements, on-site mining construction trades will peak in the fall of 2018 at about 8,310.
- On-site upgrading construction trades will peak in early 2019 at approximately 5,850 (Figure 10).

Based on current project plans, labour force demand for oil sands on-site construction projects will peak twice during the forecast period. **The first peak hiring requirement occurs in late 2014 at 22,260 jobs. The second peak projects 21,540 jobs in late 2018.** The decline in on-site construction labour demand at the end of the forecast period to approximately 15,630 jobs may be reversed if new projects are announced.

OILMAP – On-site Oil Sands Construction Employment to 2020



E = Estimated F = Forecasted

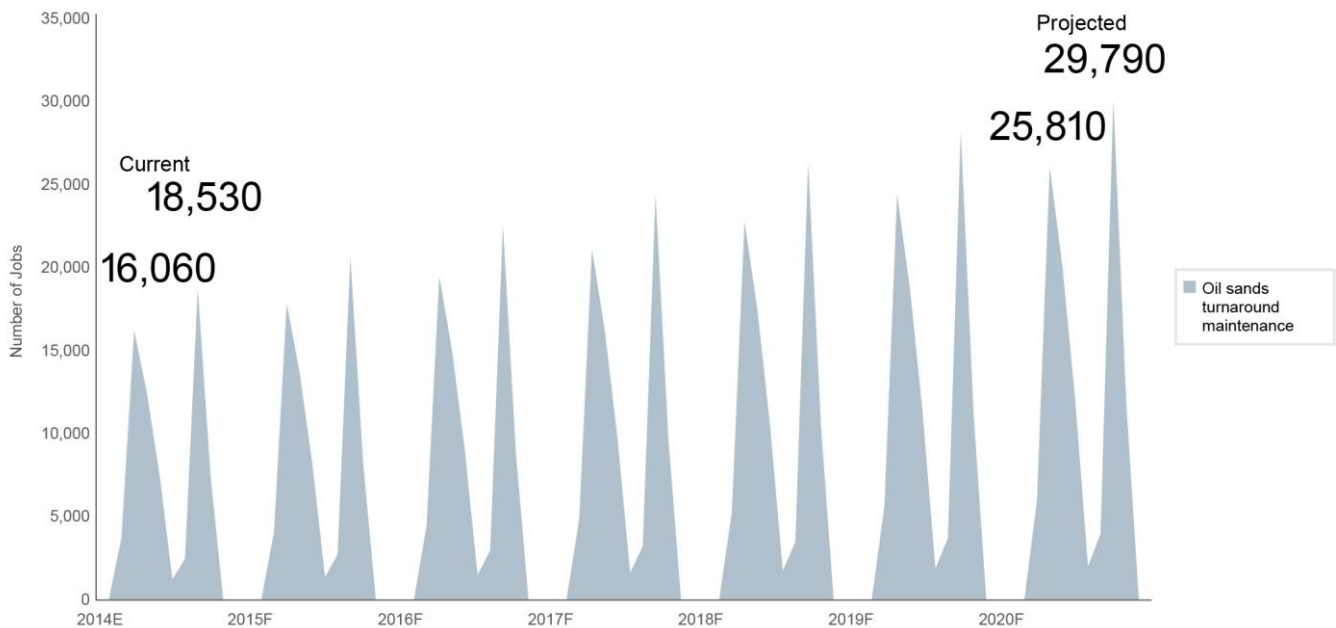
FIGURE 10 Source: OILMAP, 2014

TURNAROUND MAINTENANCE

Oil sands turnaround maintenance is the scheduled shutdown of oil sands processing units or plants for overhaul and repairs. Turnarounds typically occur in the spring and the fall to take advantage of warmer weather and limit interference with the in situ drilling season. As a result, the workforce for turnaround maintenance required on site is large but for a relatively short period of time.

The workforce requirements for oil sands **turnaround maintenance are projected to grow from 16,060 jobs in the spring of 2014 to about 29,790 jobs in the fall of 2020**, suggesting an 85 per cent increase in the workforce required for this type of construction activity during the forecast period (Figure 11).

OILMAP – Oil Sands Turnaround Maintenance Employment to 2020



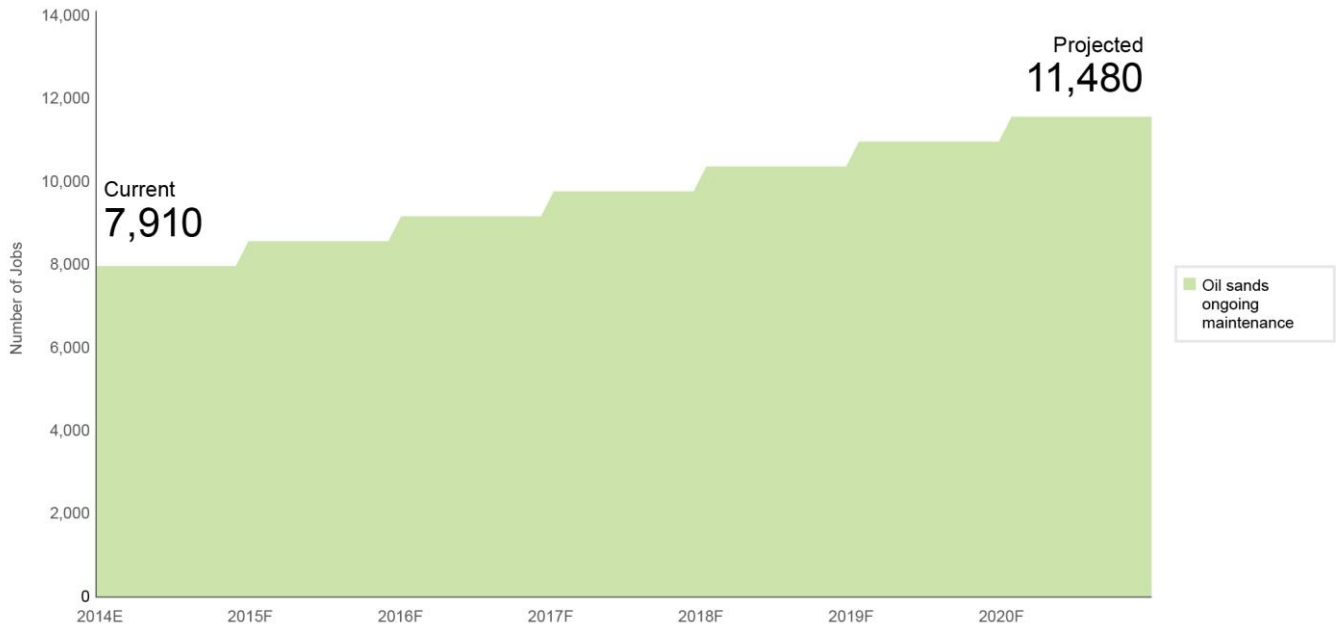
E = Estimated F = Forecasted
The two peaks represent spring and fall.

FIGURE 11 Source: OILMAP, 2014

ONGOING MAINTENANCE

OILMAP projects the workforce requirements for **ongoing or day-to-day maintenance of oil sands operations will grow from 7,910 jobs in 2014 to 11,480 jobs in 2020**, representing a 45 per cent increase. The projection illustrates a steady annual increase of about 500 jobs as new projects move from the construction phase into the operations phase across the projection period (Figure 12).

OILMAP – Oil Sands Ongoing Maintenance Employment to 2020



E = Estimated F = Forecasted

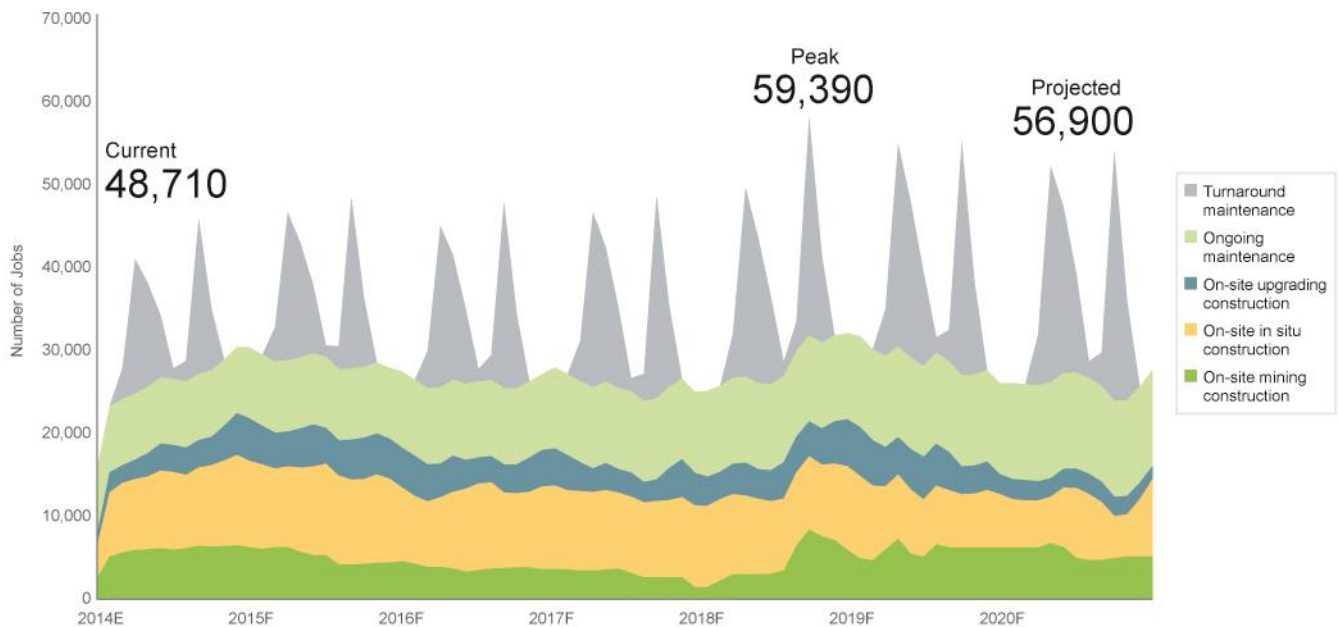
FIGURE 12 Source: OILMAP, 2014

COMBINED ON-SITE WORKFORCE REQUIREMENTS

In 2014, it is estimated that the combined workforce required for on-site oil sands construction, turnaround and ongoing maintenance will increase to about 48,710 workers. OILMAP's forecast shows that **jobs required to support on-site construction, turnaround and ongoing maintenance projects will grow to about 56,900 jobs in 2020** (accounting for a 17 per cent increase) with a peak of about 59,390 jobs in 2019 (Figure 13).

Turnaround and ongoing maintenance includes the workforce required for maintenance activities for existing oil sands facilities as well as those that are expected to become operational between 2014 and 2020.

OILMAP – Oil Sands On-site Construction, Turnaround and Ongoing Maintenance Employment to 2020



E = Estimated F = Forecasted
The two peaks represent spring and fall.

FIGURE 13 Source: OILMAP, 2014

DISTRIBUTION OF OCCUPATIONS

The distinct activities associated with on-site, turnaround and ongoing maintenance require a different mix of occupations with some overlap.

Table 6 shows the percentage distribution of each occupation by type of on-site oil sands construction and maintenance activity.

- Electricians, labourers, crane and hoisting equipment operators, welders and pipefitters constitute the bulk of the on-site construction workforce.
- The turnaround maintenance workforce includes boilermakers, pipefitters, labourers, carpenters and electricians. Boilermakers and pipefitters account for over 50 per cent of the turnaround maintenance workforce.²²
- The occupations hired in greatest numbers for ongoing maintenance include pipefitters, carpenters, boilermakers, labourers and electricians. Both turnaround and ongoing maintenance use the same trades.

OILMAP – DISTRIBUTION OF ON-SITE OIL SANDS CONSTRUCTION AND MAINTENANCE WORKFORCE BY CONSTRUCTION TYPE AND OCCUPATION			
Occupation	Percentage of 2014 Workforce		
	Construction	Turnaround	Ongoing Maintenance
Boilermakers	4.3%	27.0%	12.1%
Carpenters	2.6%	13.6%	19.4%
Cement masons	1.8%	0.2%	0.1%
Crane and hoisting equipment operators	13.6%	1.7%	2.5%
Electricians	14.7%	4.0%	7.7%
Heavy equipment operators	2.6%	n/a	n/a
Instrument mechanics	2.0%	n/a	n/a
Insulators	1.8%	3.0%	6.5%
Ironworkers	See Reinforcing and Structural Ironworkers	1.6%	3.2%
Labourers	15.6%	17.6%	16.7%
Millwrights	3.5%	3.5%	6.5%
Operators	n/a	1.7%	2.5%
Painters	n/a	2.1%	0.7%
Pipefitters	11.5%	24.9%	22.1%
Reinforcing ironworkers	2.3%	Included as Ironworkers	Included as Ironworkers
Scaffolders	5.6%	n/a	n/a
Sheet metal workers	n/a	0.1%	0.8%
Structural ironworkers	5.0%	Included as Ironworkers	Included as Ironworkers
Truck drivers	n/a	0.7%	1.8%
Welders	13.1%	Most welding completed by Boilermakers and Pipefitters	Most welding completed by Boilermakers and Pipefitters

TABLE 6 Source: OILMAP, 2014

OIL SANDS CONSTRUCTION WORKFORCE REQUIREMENTS

As the oil sands sector matures and current expansion projects move into the operations phase, a greater proportion of the occupations included in OILMAP's projections of on-site construction employment requirements will shift from constructing new capital projects to ongoing and turnaround maintenance projects (Figure 14).

Analysis of the on-site workforce by construction type in Table 6 provides some insights into potential shifts in occupational requirements:

- Electricians and ironworkers are heavily involved in on-site construction but less

involved in ongoing and turnaround maintenance work.

- Pipefitters and boilermakers are key trades for ongoing and turnaround maintenance, given the central processing and steam generation plants associated with in situ operations.
- Carpenters are more prevalent during turnaround and ongoing maintenance.
- Labourers are used consistently across all types of on-site construction activity.

OILMAP – On-site Oil Sands Construction Workforce Requirements by Construction Type

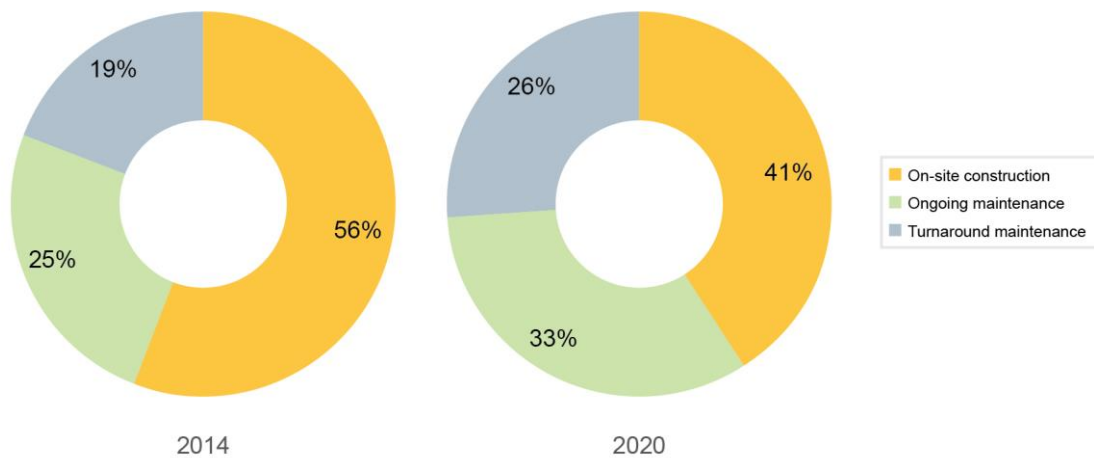


FIGURE 14 Source: OILMAP, 2014

OILMAP's workforce data also provides insight into the magnitude of trade labour demand when employment peaks for on-site construction, turnaround and ongoing maintenance trades in 2019. As Table 7 indicates, most of the occupations that are currently in the highest demand are also those that are expected to experience the largest growth over the projection period.

OILMAP – ON-SITE OIL SANDS CONSTRUCTION, TURNAROUND AND ONGOING MAINTENANCE LABOUR DEMAND AT PEAK (2019)				
Occupation	Estimated Employment in 2014	Estimated Employment at Peak (2019)	Increase in Number of Jobs (2015-2019)	Percentage Growth of 2014 Workforce
Total OILMAP Trades Occupations	37,680	58,840	21,160	56%
Pipefitters	6,480	11,265	4,785	74%
Boilermakers	5,045	9,670	4,625	92%
Carpenters	3,970	6,750	2,780	70%
Labourers	7,165	9,150	1,985	28%
Electricians	3,030	4,770	1,740	57%
Insulators	1,170	2,290	1,120	96%
Millwrights	1,450	2,420	970	67%
Reinforcing ironworkers	760	1,350	590	78%
Cement masons	475	1,020	545	115%
Instrumentation mechanics	285	820	535	188%
Scaffolders	805	1,245	440	55%
Structural iron workers	1,400	1,790	390	28%
Painters	320	650	330	103%
Welders ²³	1,830	2,075	245	13%
Truck drivers	220	380	160	73%
Crane and Heavy equipment operators	3,275	3,195	(80)	-2%

TABLE 7 Source: OILMAP, 2014

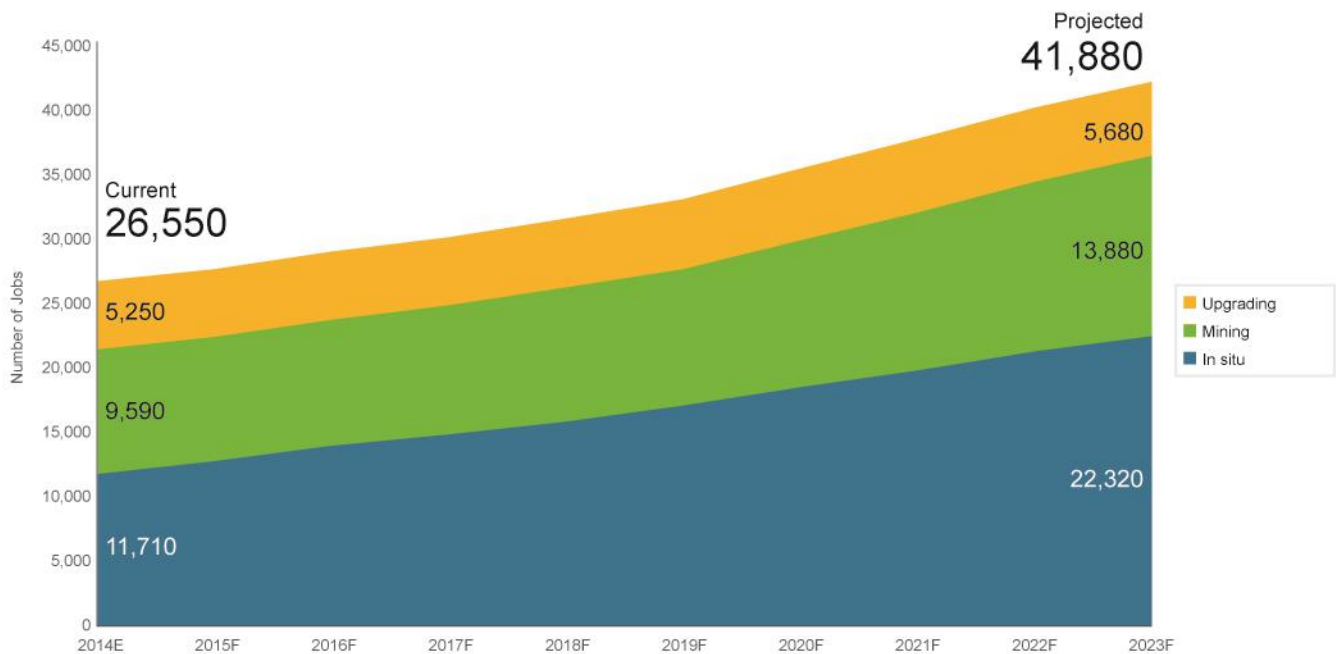
OIL SANDS OPERATIONS LABOUR DEMAND (PETROLEUM HR COUNCIL)

The following section is the labour demand analysis for direct oil sands operations based on the Petroleum HR Council's labour market model.

The **current oil sands operations workforce is estimated to be around 26,550**. The following is a breakdown of employment by operations type:

- In situ: 11,710 jobs or 44 per cent of the sector's employment.
- Mining: 9,590 jobs or 36 per cent of the sector's employment.
- Upgrading: 5,250 or 20 per cent of the sector's employment.

Petroleum HR Council – Oil Sands Operations Workforce Projections to 2023



E = Estimated F = Forecasted

FIGURE 15 Source: Petroleum HR Council, 2014

Oil sands operations workforce requirements increase steadily over the next decade: an average annual growth rate of five per cent. **By 2023, oil sands operations employment is projected to increase by 58 per cent, creating about 15,330 new operations jobs for total employment of about 41,880** (Figure 15).

As has been the trend in recent years, in situ operations add the most jobs over the forecast period:

- In situ: 10,610 additional jobs; 91 per cent increase over 2014 employment levels.
- Mining: 4,290 additional jobs; 45 per cent increase over 2014 employment levels.
- Upgrading: 430 additional jobs; 8 per cent increase over 2014 employment levels.

The oil sands sector relies heavily on a number of key occupations that are expected to grow significantly during the projection period. The top 10 jobs and their growth projections are summarized in Table 8.

PETROLEUM HR COUNCIL – TOP 10 OIL SANDS OPERATIONS OCCUPATIONS WITH GREATEST JOB INCREASES DUE TO INDUSTRY ACTIVITY TO 2023				
Occupation (NOC)		2014 Employment (Current)	Hiring due to Industry Activity to 2023	Growth (Percentage of 2014 Employment)
Total Oil Sands Operations Occupations		26,550	15,330	58%
1	Power engineers and power systems operators (9241)	4,715	2,895	61%
2	Heavy equipment operators (except crane) (7521)	3,305	1,470	44%
3	Petroleum engineers (2145)	1,025	825	80%
4	Engineering managers (0211)	1,035	660	64%
5	Facility operation and maintenance managers (0714)	1,125	555	49%
6	Heavy-duty equipment mechanics (7312)	1,105	495	45%
7	Managers in natural resources production and fishing (0811)	700	465	66%
8	Industrial instrument technicians and mechanics (2243)	680	405	60%
9	Mechanical engineers (2132)	690	375	54%
10	Geoscientists and oceanographers (2113)	440	325	74%

TABLE 8 Source: Petroleum HR Council, 2014

- Power engineers and heavy equipment operators account for 28 per cent of new oil sands operations jobs.
- Occupations requiring oil sands specific knowledge, including: petroleum engineers, engineering managers, production managers and geoscientists, account for another 15 per cent of total employment increases and are expected to grow faster than the sector average.

Industry also reports the need for operators and trade employees with commissioning and start-up experience to assist with bringing new operations on-stream. The requirement to find workers with specialized experience adds to the significant challenge of hiring for a large number of positions in an environment of skill shortages.

OIL SANDS OPERATIONS OCCUPATIONS WITH ABOVE-AVERAGE GROWTH

In addition to the top 10 listed above, other occupations in oil sands operations are growing faster than the sector average of 58 per cent. Reasons for the above average-growth vary according to the occupation:

- Increases have occurred within the technical and stakeholder relations occupations focused on environmental standards and obtaining social license.²⁴

- The rapid increase in supply chain occupations reflects the oil sands operations sector's heavy use of a contracted or contingent workforce and its focus on cost management during ongoing expansion.²⁵
- Scheduling and logistics specialists are becoming increasingly important for the transfer of people. Most oil sands operations need to move workers back and forth from their places of accommodation to their job sites.
- The continued shift towards in situ production drives increases in occupations such as water treatment operators, power engineers, petroleum engineers and geoscientists.
- The growth in technologist and technician occupations is attributed to the increasing number of oil sands operations projects that are transitioning from the start-up phase to the sustainable operations phase.

Although many of these occupational groupings are smaller, most require specialized skills and experience, and this will drive competition amongst oil sands companies. Table 9 provides a full list of occupations in oil sands operations with higher than average expected growth rates.

PETROLEUM HR COUNCIL – OIL SANDS OPERATIONS OCCUPATIONS WITH ABOVE-AVERAGE GROWTH			
Occupation (NOC)	2014 Employment (Current)	Hiring due to Industry Activity to 2023	Growth (Percentage of 2014 Employment)
Total Oil Sands Operations Occupations	26,550	15,330	58%
Water and waste treatment plant operators (9243)	140	125	89%
Geological and mineral technologists and technicians (2212)	335	295	88%
Purchasing agents and officers (1225)	335	295	88%
Professional occupations in advertising, marketing and public relations (1123)	55	45	82%
Petroleum engineers (2145)	1,025	825	80%
Industrial engineering and manufacturing technologists and technicians (2233)	45	35	78%
Purchasing managers (0113)	20	15	75%
Contractors and supervisors, machining, metal forming, shaping and erecting trades and related occupations (7201)	20	15	75%
Geoscientists and oceanographers (2113)	440	325	74%
Natural and applied science policy researchers, consultants and program officers (4161)	180	130	72%
Contractors and supervisors, mechanic trades (7301)	195	140	72%
Construction managers (0711)	380	265	70%
Industrial and manufacturing engineers (2141)	430	290	67%
Managers in natural resources production and fishing (0811)	700	465	66%
Purchasing and inventory control workers (1524)	85	55	65%
Shippers and receivers (1521)	100	65	65%
Inspectors in public and environmental health and occupational health and safety (2263)	270	175	65%
Contractors and supervisors, electrical trades and telecommunications occupations (7202)	130	85	65%
Supervisors, supply chain, tracking and scheduling co-ordination occupations (1215)	55	35	64%
Engineering managers (0211)	1,035	660	64%
Construction estimators (2234)	65	40	62%
Power engineers and power systems operators (9241)	4,715	2,895	61%
Drafting technologists and technicians (2253)	155	95	61%
Electrical and electronics engineering technologists and technicians (2241)	150	90	60%
Industrial instrument technicians and mechanics (2243)	680	405	60%
Mechanical engineering technologists and technicians (2232)	225	135	60%
Civil engineering technologists and technicians (2231)	185	110	59%

TABLE 9 Source: Petroleum HR Council, 2014

AGE-RELATED ATTRITION INCREASES HIRING REQUIREMENTS

Workforce demographics continue to affect Canada's labour market and available labour supply. Historically, roughly six persons in the workforce were available to replace each retiree. That number is expected to fall to 2.7 in 2031.²⁶

Oil sands companies are reporting anecdotally that workers are remaining in the workforce longer. This could be for a number of reasons:

- Companies have programs in place to entice experienced workers to remain working.
- Workers enjoy their work and are not ready to retire.
- Workers cannot afford to retire.

However, a high rate of retirement eligibility remains a risk as it is uncertain when these workers will begin their retirement.

Age-related attrition could potentially drive a significant number of job openings within oil sands operations over the next decade. **For the total sector, 24 per cent of 2014 employment or about 6,380 workers are eligible for retirement** during

the projection period. The following is a breakdown of retirement eligibility by operations type:

- In situ: 28 per cent of 2014 employment or about 3,340 workers.
- Mining: 21 per cent of 2014 employment or about 1,990 workers.
- Upgrading: 20 per cent of 2014 employment or about 1,050 workers.

NET HIRING REQUIREMENTS

Net hiring requirements are determined by adding the labour demand required to support industry expansion to age-related attrition demand. (Net hiring requirements for the oil sands sector described in the following section do not include non-retirement turnover.)

In a tight labour market, companies may choose to use their full-time workers for commissioning and start-up of operations, rather than contractors. In this case, recruitment starts well in advance of production coming on stream.

Figure 16 illustrates net hiring requirements for oil sands operations.

Petroleum HR Council – Net Hiring Requirements by Operations Type to 2023

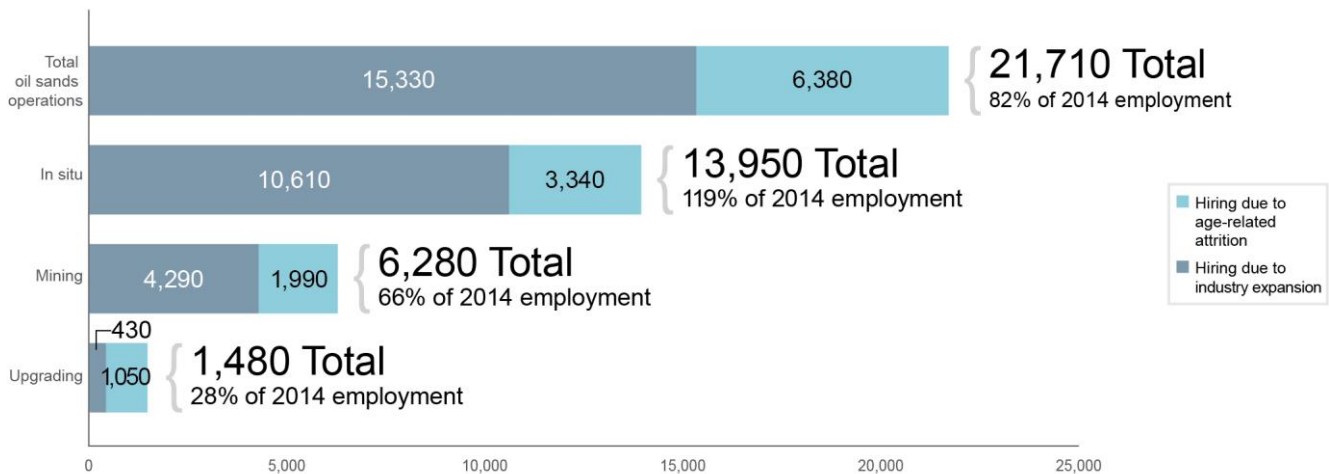
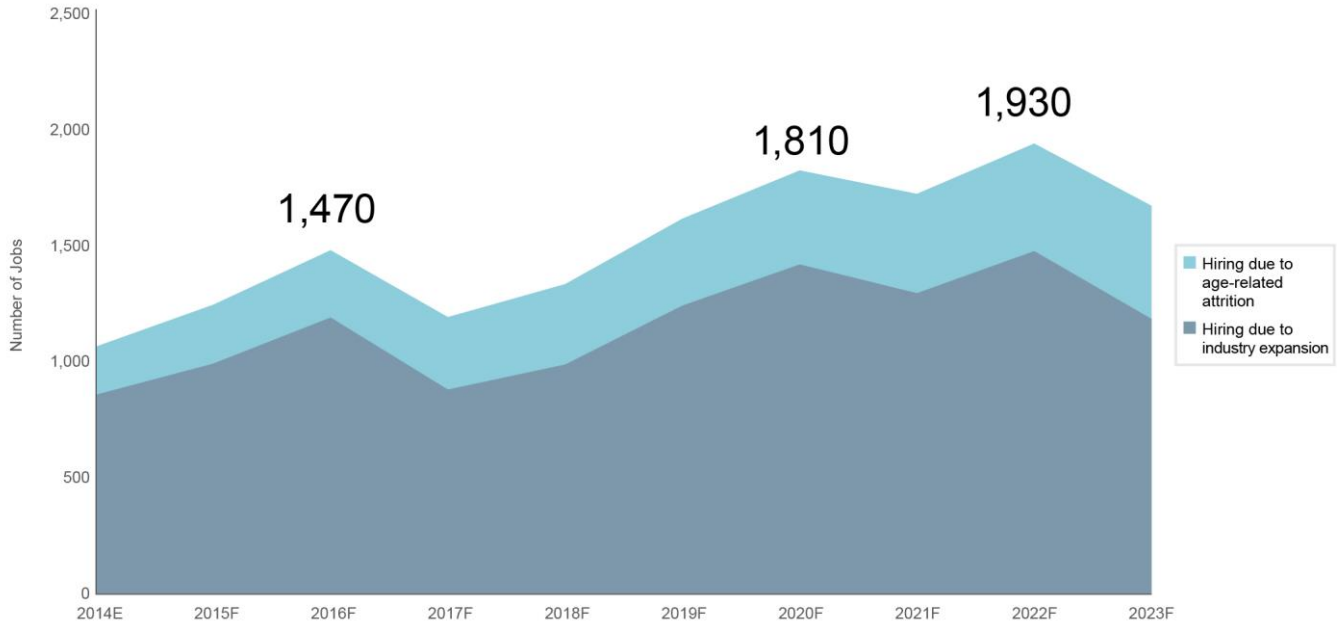


FIGURE 16 Source: Petroleum HR Council, 2014

IN SITU NET HIRING REQUIREMENTS

Hiring for in situ operations is expected to be ongoing and substantial throughout the projection period (Figure 17). Over the next decade, industry expansion will drive 76 per cent of in situ operations hiring while age-related attrition accounts for the remaining 24 percent.

Petroleum HR Council – In Situ Net Hiring Requirements to 2023



E = Estimated F = Forecasted

FIGURE 17 Source: Petroleum HR Council, 2014

Table 10 identifies the top 10 in situ occupations projected to have the greatest net hiring requirements over the projection period.

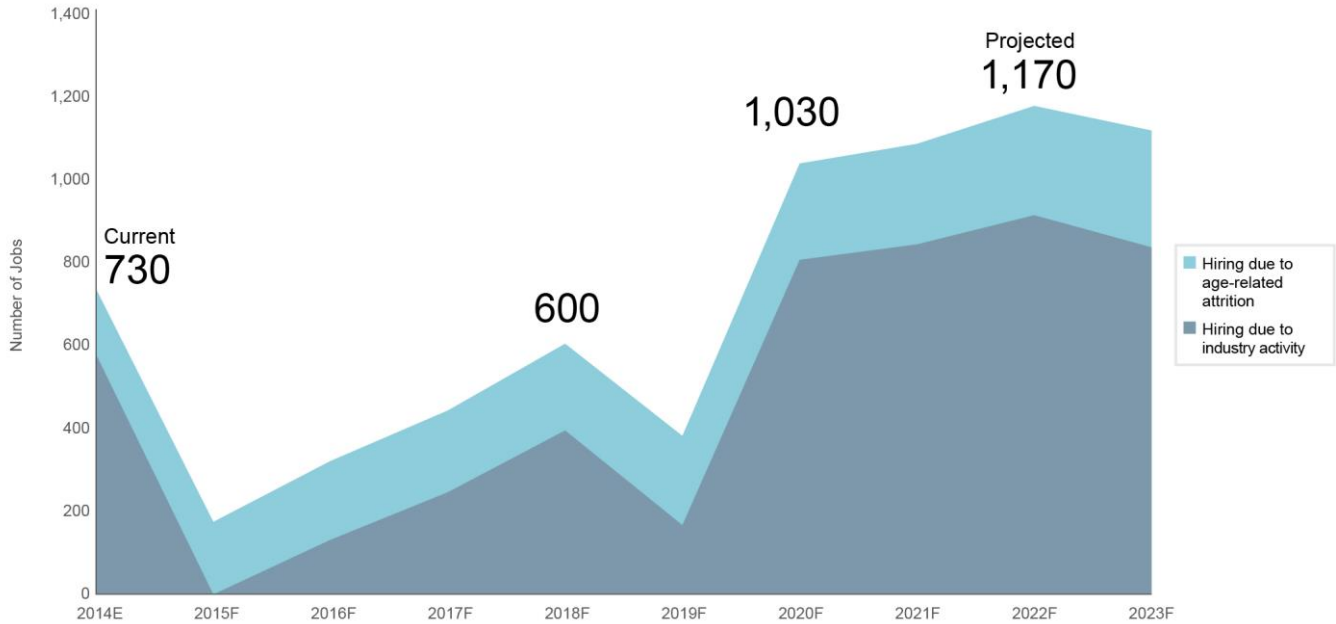
PETROLEUM HR COUNCIL – TOP 10 IN SITU OCCUPATIONS WITH GREATEST NET HIRING REQUIREMENTS TO 2023						
Occupation (NOC)		2014 Employment (Current)	Hiring Due to		Net Hiring Requirements to 2023	Hiring Rate (Percentage of 2014 Employment)
			Industry Expansion	Age- related Attrition		
Total In Situ Occupations		11,710	10,610	3,340	13,950	119%
1	Power engineers and power systems operators (9241)	2,815	2,550	830	3,380	120%
2	Petroleum engineers (2145)	870	790	200	990	114%
3	Engineering managers (0211)	585	530	200	730	125%
4	Managers in natural resources production and fishing (0811)	435	390	150	540	124%
5	Facility operation and maintenance managers (0714)	365	330	125	455	125%
6	Industrial instrument technicians and mechanics (2243)	355	325	85	410	115%
7	Purchasing agents and officers (1225)	320	290	100	390	122%
8	Geological and mineral technologists and technicians (2212)	320	290	90	380	119%
9	Geoscientists and oceanographers (2113)	305	280	100	380	125%
10	Mechanical engineers (2132)	300	270	65	335	112%

TABLE 10 Source: Petroleum HR Council, 2014

MINING HIRING REQUIREMENTS

Projected hiring requirements for mining operations vary over time as there are fewer, larger projects planned compared to in situ projects. Any new project announcements for mining operations will drive further increases in activity-related hiring. Over the next decade, industry expansion accounts for the majority of the hiring at 68 per cent, and age-related attrition drives 32 per cent of hiring for mining operations (Figure 18).

Petroleum HR Council – Mining Net Hiring Requirements to 2023



E = Estimated; F = Forecasted

FIGURE 18 Source: Petroleum HR Council, 2014



Photo Courtesy Syncrude Canada Ltd.

Table 11 identifies the top 10 mining occupations projected to have the greatest net hiring requirements over the projection period.

PETROLEUM HR COUNCIL – TOP 10 MINING OCCUPATIONS WITH GREATEST NET HIRING REQUIREMENTS TO 2023						
Occupation (NOC)		2014 Employment (Current)	Hiring Due to		Net Hiring Requirements to 2023	Hiring Rate (Percentage of 2014 Employment)
			Industry Expansion	Age- related Attrition		
Total Mining Occupations		9,590	4,290	1,990	6,280	66%
1	Heavy equipment operators (except crane) (7521)	3,260	1,460	590	2,050	63%
2	Heavy-duty equipment mechanics (7312)	775	350	165	515	66%
3	Power engineers and power systems operators (9241)	510	225	120	345	68%
4	Facility operation and maintenance managers (0714)	440	195	120	315	72%
5	Petroleum, gas and chemical process operator (9232)	325	145	70	215	66%
6	Industrial electricians (7242)	295	130	60	190	64%
7	Engineering managers (0211)	260	115	70	185	71%
8	Construction millwrights and industrial mechanics (7311)	270	120	55	175	65%
9	Welders and related machine operators (7237)	235	105	40	145	62%
10	Mechanical engineers (2132)	200	90	35	125	63%

TABLE 11 Source: Petroleum HR Council. 2014

UPGRADING HIRING REQUIREMENTS

For upgrading operations, age-related attrition accounts for 71 per cent of the net hiring to 2023, based on current plans for upgrading production. Expansion of upgrading operations accounts for 29 per cent; however, this growth-related hiring is not expected to occur until later in the projection period because new upgrading projects are still in the early stages of construction (Figure 19).

Petroleum HR Council – Upgrading Net Hiring Requirements to 2023

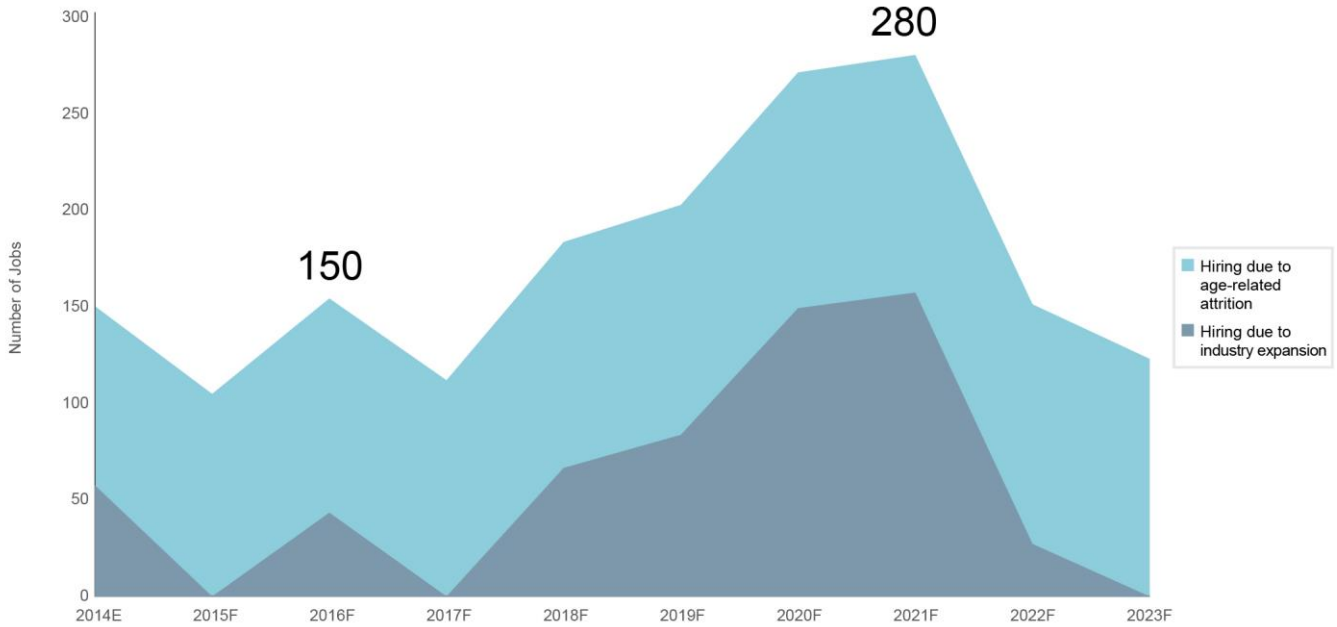


FIGURE 19 Source: Petroleum HR Council, 2014

Table 12 identifies the top 10 upgrading occupations projected to have the greatest net hiring requirements over the projection period.

PETROLEUM HR COUNCIL – TOP 10 UPGRADING OCCUPATIONS WITH GREATEST NET HIRING REQUIREMENTS TO 2023						
Occupation (NOC)		2014 Employment (Current)	Hiring Due to		Net Hiring Requirements to 2023	Hiring Rate (Percentage of 2014 Employment)
			Industry Expansion	Age- related Attrition		
Total Upgrading Occupations		5,245	430	1,050	1,480	28%
1	Power engineers and power systems operators (9241)	1,390	115	285	400	29%
2	Facility operation and maintenance managers (0714)	320	25	80	105	33%
3	Engineering managers (0211)	195	15	45	60	31%
4	Chemical engineers (2134)	225	20	35	55	24%
5	Heavy-duty equipment mechanics (7312)	185	15	35	50	27%
6	Industrial electricians (7242)	175	15	35	50	29%
7	Mechanical engineers (2132)	190	15	30	45	24%
8	Industrial instrument technicians and mechanics (2243)	180	15	30	45	25%
9	Electrical and electronics engineers (2133)	170	15	30	45	26%
10	Managers in natural resources production and fishing (0811)	120	10	30	40	33%

TABLE 12 Source: Petroleum HR Council, 2014

OVERVIEW OF POWER ENGINEER HIRING REQUIREMENTS

Over the next decade, the oil sands operations sector will have the greatest need for power engineers – operators who require power engineering certification or a steam ticket. Power engineers are hired across the sector. It is projected that this occupation will account for the following:

- Total oil sands: 19 per cent of total oil sands net hiring requirements.
- In situ: 24 per cent of in situ net hiring requirements.
- Mining: 5 per cent of mining net hiring requirements.
- Upgrading: 27 per cent of upgrading net hiring requirements.

Four levels of interprovincial power engineering certifications are recognized: the entry-level ticket is class four, and the most qualified power engineers possess a first-class ticket. Power engineers can advance levels by gaining work experience (firing time) and writing exams at each level. Provincial regulations govern the class of the ticket required to oversee and operate boilers and pressure vessels.

The previous survey of oil sands operators helped determine the distribution of the sector’s power engineering workforce in 2010, broken down by class/level (Figure 20). Assuming oil sands operators continue to maintain the 2010 distribution of power engineering certification to 2023, the hiring requirements for each level of power engineering ticket is summarized in Table 13.

Distribution of Power Engineering Workforce in 2010

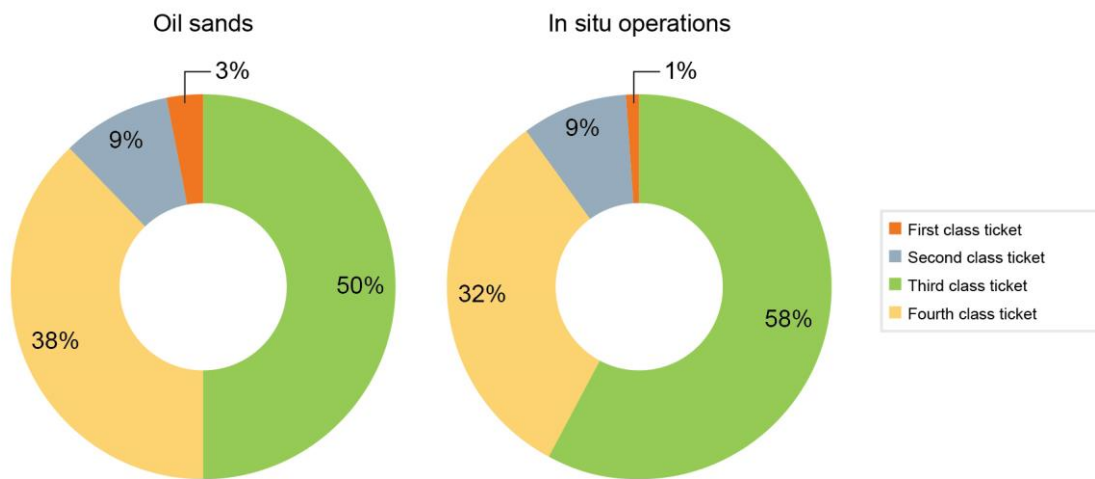


FIGURE 20 Source: Petroleum HR Council, 2011

PETROLEUM HR COUNCIL – POWER ENGINEER LABOUR DEMAND BY TICKET LEVEL TO 2023		
Power Engineering Level	Estimated Number of New Power Engineer Jobs to 2023	
	Total Oil Sands	In Situ
All tickets	2,895	2,550
1 st class	85	25
2 nd class	260	230
3 rd class	1,450	1,480
4 th class	1,100	815

TABLE 13 Source: Petroleum HR Council, 2014

OIL SANDS OPERATIONS OCCUPATIONS WITH ABOVE-AVERAGE NET HIRING REQUIREMENTS

Net hiring requirements across the oil sands sector are significant – an average of an additional 82 per cent of current employment levels is needed. If hiring for key oil sands operations occupations cannot keep pace with requirements, the viability of oil sands projects becomes uncertain. Succession planning for managerial roles, career development

for technical roles and strategic recruiting will be essential; given the high rates of net hiring for a number of critical oil sands operations occupations.

Table 14 outlines the managerial occupations for oil sands operations that have above-average net hiring requirements.

PETROLEUM HR COUNCIL – MANAGERIAL OCCUPATIONS WITH ABOVE-AVERAGE NET HIRING REQUIREMENTS TO 2023

Occupation (NOC)	2014 Employment (Current)	Hiring Due to		Net Hiring Requirements to 2023	Net Hiring Rate (Percentage of 2014 Employment)
		Industry Expansion	Age-related Attrition		
Total Oil Sands Operations Occupations	26,550	15,330	6,380	21,710	82%
Purchasing managers (0113)	20	15	10	25	125%
Contractors and supervisors, machining, metal forming, shaping and erecting trades, and related occupations (7201)	20	15	5	20	100%
Managers in natural resources production and fishing (0811)	700	465	215	680	97%
Contractors and supervisors, mechanic trades (7301)	195	140	45	185	95%
Engineering managers (0211)	1,035	660	315	975	94%
Construction managers (0711)	380	265	80	345	91%
Supervisors, supply chain, tracking and scheduling co-ordination occupations (1215)	55	35	15	50	91%
Contractors and supervisors, electrical trades and telecommunications occupations (7202)	130	85	30	115	88%

TABLE 14 Source: Petroleum HR Council, 2014

Table 15 lists oil sands technical occupations with above-average hiring requirements.

PETROLEUM HR COUNCIL – TECHNICAL OCCUPATIONS WITH ABOVE-AVERAGE NET HIRING REQUIREMENTS TO 2023					
Occupation (NOC)	2014 Employment (Current)	Hiring Due to		Net Hiring Requirements to 2023	Net Hiring Rate (Percentage of 2014 Employment)
		Industry Expansion	Age-related Attrition		
Total Oil Sands Operations Occupations	26,550	15,330	6,380	21,710	82%
Water and waste treatment plant operators (9243)	140	125	40	165	118%
Geological and mineral technologists and technicians (2212)	335	295	90	385	115%
Professional occupations in advertising, marketing and public relations (1123)	55	45	15	60	109%
Geoscientists and oceanographers (2113)	440	325	130	455	103%
Petroleum engineers (2145)	1,025	825	225	1,050	102%
Industrial engineering and manufacturing technologists and technicians (2233)	45	35	10	45	100%
Inspectors in public and environmental health and occupational health and safety (2263)	270	175	80	255	94%
Natural and applied science policy researchers, consultants and program officers (4161)	180	130	40	170	94%
Power engineers and power systems operators (9241)	4,715	2,895	1,235	4,130	88%
Construction estimators (2234)	65	40	15	55	85%
Drafting technologists and technicians (2253)	155	95	35	130	84%
Civil engineering technologists and technicians (2231)	185	110	45	155	84%
Industrial and manufacturing engineers (2141)	430	290	65	355	83%

TABLE 15 Source: Petroleum HR Council, 2014

Over the next decade, it is projected that oil sands operations will need to hire 645 supply chain professionals. Extended vacancies in supply chain occupations can create bottlenecks for construction and maintenance and have a negative impact on productivity if labour, materials and equipment are not on-site when required.

Table 16 outlines the supply chain occupations that have above average net hiring requirements.

PETROLEUM HR COUNCIL – SUPPLY CHAIN OCCUPATIONS WITH ABOVE AVERAGE NET HIRING REQUIREMENTS TO 2023					
Occupation (NOC)	2014 Employment (Current)	Hiring Due to		Net Hiring Requirements to 2023	Net Hiring Rate (Percentage of 2014 Employment)
		Industry Expansion	Age-related Attrition		
Total Oil Sands Operations Occupations	26,550	15,330	6,380	21,710	82%
Purchasing managers (0113)	20	15	10	25	125%
Purchasing agents and officers (1225)	335	295	100	395	118%
Shippers and receivers (1521)	100	65	30	95	95%
Purchasing and inventory control workers (1524)	85	55	25	80	94%
Supervisors, supply chain, tracking and scheduling co-ordination occupations (1215)	55	35	15	50	91%

TABLE 16 Source: Petroleum HR Council, 2014



SPOTLIGHT ON LABOUR PRODUCTIVITY AND OIL SANDS OPERATIONS HIRING REQUIREMENTS

The labour demand projections for oil sands operations are generated with an assumption that labour productivity²⁷ will grow one per cent per year. Sources suggest that labour productivity growth in the oil and gas industry may in fact be lower than one per cent due to the following factors:

- multiple projects coming on stream leading to increased hiring of inexperienced workers
- increased hiring of new graduates and workers from outside of the industry
- loss of experienced workers, including managers
- oil sands deposits are less efficient to extract than conventional oil

Table 17 illustrates how changes in labour productivity growth impacts oil sands operations' net hiring requirements. The Petroleum HR Council's labour demand model assumes a one per cent productivity increase.

PETROLEUM HR COUNCIL – POTENTIAL PRODUCTIVITY IMPACTS ON OIL SANDS OPERATIONS HIRING REQUIREMENTS TO 2023	
Productivity Growth Rate	Net Hiring Requirements to 2023
1%	21,710
0%	27,075
- 1%	33,190

TABLE 17 Source: Petroleum HR Council, 2014



SPOTLIGHT ON LABOUR TURNOVER AND OIL SANDS OPERATIONS HIRING REQUIREMENTS

In tight labour market conditions, workforce competition is strong among oil sands companies as well as other industries. This type of workforce turnover is referred to as “non-retirement turnover.”

The oil sands operations model does not include hiring due to non-retirement turnover. Generally, based on feedback from industry, the oil sands sector does not experience a significant loss of workers to other industries. In fact, the oil sands sector, with its attractive compensation and employment growth has been successful at recruiting workers from other industries. Competition for workers with oil sands experience and the pace of growth, however, creates a fair amount of employee movement between oil sands operating companies. Although this does not increase net hiring requirements within the sector, it can have a significant impact on hiring activity, compensation escalation and loss of productivity due to position vacancies.

Table 18 quantifies the additional hiring activity that would result from vacancies created by non-retirement turnover in scenarios of one to six per cent.

PETROLEUM HR COUNCIL – POTENTIAL HIRING DUE TO NON-RETIREMENT TURNOVER TO 2023	
Non-Retirement Turnover Rate	Hiring Due to Non-Retirement Turnover to 2023
0%	0
1%	2,985
3%	8,955
6%	17,915

TABLE 18 Source: Petroleum HR Council, 2014

WORKFORCE CHALLENGES FOR OIL SANDS CONSTRUCTION, MAINTENANCE AND OPERATIONS

CONSTRUCTION

Alberta's unemployment rate of 4.9 per cent²⁸ is an indicator that its labour market is experiencing a significant labour demand challenge. The following section, prepared by the Petroleum HR Council, examines how a tough labour market can impact labour demand for oil sands construction, maintenance and operations.

Construction spending and labour demand requirements are up across most markets adding to the challenges of meeting workforce requirements for the foreseeable future. As oil sands capacity grows, there is a need for supporting infrastructure, including transportation, utilities, pipelines, roads and highways and other downstream oil and gas developments that add to the growth in labour requirements. In addition, institutional and commercial building construction picks up across the outlook period in line with increased business activity and population growth. BuildForce Canada projects that commercial and institutional spending will increase from \$6.6 billion in 2013

(adjusted for inflation in 2007 dollars) to \$9.3 billion by 2023; a 40 per cent increase. Residential construction is predicted to be robust with new people moving to Alberta in large numbers. BuildForce reports a 22 per cent increase in new residential and renovations spending over the next decade increasing from \$18 billion (2007 dollars) in 2013 to \$22 billion by 2023, with annual new housing starts averaging over 40,000 units.

Labour supply shortages are compounded by the fact that maintenance and sustaining capital projects on Alberta's existing major industrial facilities now demand a workforce that is equal to or greater than the worker demands for new engineering construction. According to BuildForce Canada, Alberta is likely to experience a significant loss of skilled workers due to retirement: 24 per cent of the current labour force or an estimated 37,500 workers between 2014 and 2023.

As Figure 21 illustrates, industrial construction planned across Canada is significant, further creating a tight labour market.

Cross Canada Industrial Construction

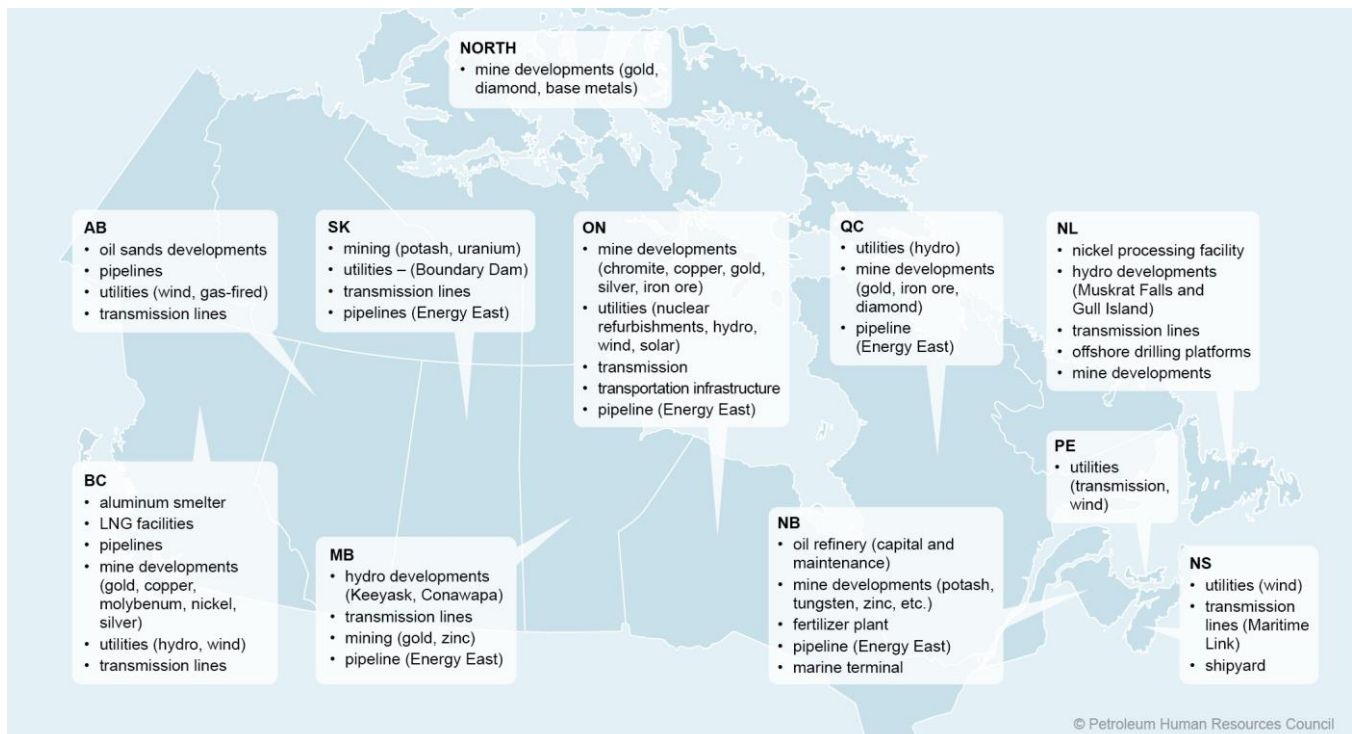


FIGURE 21 Source: BuildForce Canada

OPERATIONS

On top of the risk to oil sands expansion associated with construction labour shortages, oil sands operations will require 58 per cent more workers, about 15,330 new jobs, over the next decade. For oil sands operations, shortages will be particularly acute for occupations requiring specialized training in the sector as well as occupations that are also coveted by construction and other industries. An aging workforce also adds to the challenges associated with a competitive labour environment and shortages of specific skills. According to the Petroleum HR Council, 24 per cent or 6,380 of 2014 oil sands employment will be eligible for retirement over the next decade.

Operations are located in relatively remote locations, with lack of available housing, where the cost of

living tends to be higher than in other parts of Canada. These factors make recruiting difficult for remote locations. The use of rotational work arrangements (for example fly-in/fly-out) is one solution enabling oil sands companies' to draw more workers from across the country.

WORKING TOWARDS A SOLUTION

Addressing labour challenges is a shared concern amongst many employers, industry associations, labour groups, education and training providers, and government. Many oil sands project owners have multiple projects planned (e.g., oil sands, LNG, offshore) and they are susceptible to the cumulative risks of labour shortages.



Photo Courtesy Suncor Energy Inc.

MEETING FUTURE WORKFORCE DEMANDS – OIL SANDS CONSTRUCTION AND OPERATIONS

Labour shortages are costly from a quality, time and capital perspective. A significant benefit can be gained from investing in growing the pool of qualified construction and operations workers, rather than competing for workers within and across companies.

Collaborative action is required in the construction and oil and gas industries to increase the workforce and address labour supply challenges.

The insights below demonstrate initiatives that are aimed at increasing the supply of skilled workers to support the future hiring needs of oil sands construction and operations.

ATTRACTING AND RETAINING UNDER-REPRESENTED WORKERS

Workforce groups that are under-represented in the construction and oil sands operations sectors are potential sources of talent to meet future demands. The following includes a selection of initiatives aimed to attract under-represented workers:

- **Association for Construction Worker Acquisition (ACWA)** is an organization of eight oil sands construction company owners who work with government agencies to address the shortage of skilled workers in Alberta's oil sands region.²⁹
- **Women Building Futures** is an organization that delivers programs and services that enable women to enter careers in construction trades. Services include assessment, training, coaching, and job search and retention support.³⁰
- **The Aboriginal Programs Project** was initiated by the Alberta Chamber of Resources (ACR) and enables its members to share the benefits of their experiences of working with Aboriginal communities.³¹

ALTERNATIVE SOURCES OF LABOUR SUPPLY

Alberta companies, governments and associations are engaged in the recruitment of workers from across Canada and internationally to augment local labour supply.

Helmets to Hardhats (H2H)

This program provides an opportunity for those who have served in the Canadian Armed Forces (Regular or Reserve Force components) to access

apprenticeship training in order to achieve journeyman status in any of the applicable trades within the construction industry.³²

PRODUCTIVITY IMPROVEMENT

The efficiency of the construction workforce has improved by utilizing the most modern and efficient pipe and steel fabrication facilities and modular assembly yards in North America. The development of these processes and technologies, along with other advances in construction workforce procurement, training, and productivity will help meet the challenges that face Alberta's construction workforce demands.

- **Workforce Planning (WFP)** is a partnership initiative of the Alberta construction industry and oil sands project owners. The partnership aims to increase productivity on worksites and mitigate some of the labour challenges by sharing best practices and developing workforce planning training programs.³³
- Individual companies are also implementing practices to enhance oil sands construction productivity, including implementing a **"cookie-cutter" or manufacturing approach** by constructing large projects in smaller, repeatable phases and pre-building sites for future expansion. Using Alberta-based modular yards to pre-build, mitigates the challenges associated with the following:
 - equipment and materials logistics
 - weather
 - attracting workers to remote locations and worker turnover
 - importing/transporting modules from outside the province or country

TRAINING AND DEVELOPMENT

- **Industrial Construction Crew Supervisor** is a designated occupation developed by industry and administered and certified by

the Government of Alberta to certify the knowledge and capabilities of construction supervisors and foremen. The occupation involves a combination of approved training and specific experience to meet certification requirements.³⁴

- **The Government of Alberta** has increased training facilities for apprentices and is taking in record numbers into a system that already trains more apprentices than any other Canadian jurisdiction.
- **The Oil Sands Learning Network** is a consortium of oil sands operators and labour supply stakeholders coming together to address workforce issues that impact the oil sands. The Network's key areas of focus include
 - increasing awareness of occupations in demand
 - establishing a framework for sharing information between secondary and post-secondary education
 - increasing the supply of skilled trade professionals
 - ensure enough operators are available to meet demand
- Individual oil sands companies are leading the way on **investing in talent**

management. This includes a variety of activities: gathering internal metrics and intelligence through workforce planning, company branding, and strong career development and succession planning programs. Companies are also investing in competency-based programs to assist with shortening the “time to productivity” for new hires, including those that are either new graduates or from other industries.

- While “Canadians first” should be top priority, **temporary foreign workers (TFW)** are a solution for filling temporary or shorter-term work assignments. In addition, economic immigration programs can be utilized to address labour and skill shortages within industry-specific occupations. Industry and government need to continue working together to ensure that the TFW and economic immigration programs are meeting the needs of the oil and gas industry.

COMBINING EFFORTS

Analysis of future workforce demands has led to an understanding on the part of oil sands construction and operations companies that labour and skills constraints are not temporary. Rather, they recognize that effective workforce planning requires innovative and collaborative approaches that deliver talent for both short-term and long-term timeframes.

CONCLUSION

Canada's oil sands sector is a key contributor to the country's economy by generating income, investment, business opportunities and employment. While the industry continues to face obstacles to market diversification, the sector is growing, and the outlook for employment is strong both in industrial construction and operations. Each of these sectors share common needs and challenges when it comes to finding skilled workers in a competitive employment environment. Examining construction and operations together enables a closer investigation of both the magnitude of the hiring challenges and the occupations and skills that are important for each sector.

With expansion-related hiring for both construction and oil sands operations expected to reach approximately 98,380 jobs over the next decade, not accounting for age-related attrition and other turnover, it's no surprise that companies, industry groups and several collaborative entities are making efforts to address labour demand challenges.

Evidently, a focus on recruiting and competing for workers is not enough to address the skilled worker

requirements for oil sands construction and operations. Cross-sector partnerships are growing and this trend towards collaboration needs to continue to address the most difficult labour supply challenges such as attracting Aboriginal workers, trades completions rates, skills mobility, and youth unemployment.

APPENDIX 1: BUILDFORCE OIL SANDS CONSTRUCTION SECTOR LABOUR DEMAND METHODOLOGY

BuildForce Canada has been producing construction forecasts since 2004, using the most advanced and detailed industry model available in Canada to accurately forecast the future demand and supply for 33 construction trades and occupations.

BuildForce's LMI program consists of a database and model, annual reports, PowerPoint presentations and a website (www.constructionforecasts.ca). The system uses a scenario-based forecasting model and consults with industry, including labour groups, contractors and owners, to validate the scenario assumptions and construction project lists. Stakeholder feedback improves the outlook accuracy and provides information on the context in which the data is interpreted. This approach offers efficient access to project information and detailed first-hand assessments of labour supply and demand by province for individual construction trades and occupations.

The LMI system takes into account such factors as the economic environment, demographics and major construction projects, in order to access by province:

- construction investment by sector
- labour market demand requirements by trade and occupation
- changes in labour supply by trade and occupation (new entrants, retirements and mobility)
- labour market conditions by trade and occupation

This and other information is used annually to generate national, provincial and regional *Construction and Maintenance Looking Forward* reports that are used by industry and government to help assess labour market challenges and training requirements. The reports can be found online at www.constructionforecasts.ca.

Summary outlook data is also available at www.constructionforecasts.ca. Data is available for 10 provinces from 2006 to 2023 including the following:

- Construction labour market statistics, by trade and occupation.
- Residential investment (new, renovation and maintenance).
- Non-residential investment (industrial, commercial, institutional, engineering and roads/highways/bridges, maintenance).
- Key economic indicators (GDP, exchange rate, population growth, CPI, etc.).
- Commodity prices (WTI, Henry Hub, Agriculture, Other Non-Energy).

LMI SYSTEM

The LMI model is a computer based system that links economic conditions, major projects information and demographics to assess construction labour market conditions by province. The system starts with provincial macroeconomic models that incorporate global, national and provincial economic assumptions that are reviewed by the provincial LMI Committee. Information on select major construction projects developed by the provincial LMI Committees is added to the system. Based on the economic assumptions and major projects data the provincial construction investment outlook, by sector, is estimated.

To estimate labour demand requirements (**expansion demand**) the forecast system uses custom trade requirements coefficients (labour requirements by trade per million dollars of construction investment) developed by BuildForce to convert construction investment into demand requirements for each of the 33 trades and occupations by province. An increase in investment increases the demand on construction tradespersons. Large expenditures will increase demand on the workforce, which leads to tighter labour markets not only in the region where the project is taking place, but also in other Canadian provinces as workers move to where employment opportunities exist.

For labour supply, the LMI system breaks down the annual change in the labour supply into key components:

Retirements (including mortality): The estimated number of persons permanently leaving the labour force. Persons that leave a trade as they grow older and move to another trade or occupation are not included in this concept as they are still in the labour force. Mortality is the estimated number of persons in the local labour force who become deceased during the year based on age-specific mortality rates. Retirements plus mortality measure permanent losses to the workforce.

New entrants: The number of residents aged 30 and younger estimated to enter the labour force for the first time. People in this age group are typically in a transition from school to permanent positions in the labour force, including apprentices that are first-time entrants to the labour force. New apprentices that previously worked in construction or non-construction are not included in this concept. Each trade gets its share of total new entrants based on historical patterns across all trades and occupations tracked by BuildForce.

Mobility: Recruiting required by the construction industry from other industries, other trades or occupations outside construction and/or other provinces or countries to meet labour requirements. Requirements are measured by the change employment (**expansion demand**) plus the loss of workers due to retirements (**replacement demand**) minus new entrants.

Mobility acts as the residual source of labour, meeting labour requirements after accounting for first-time new entrants. This means that when construction activity increases and the available new entrants are not sufficient to meet demand, in-mobility will measure recruiting from outside the industry or province. Alternatively, when markets weaken, out-mobility will track the potential movement of the workforce out to other industries or other provinces. Thus, in periods of rising construction, when local new entrants fall below requirements, in-mobility is the only supply-side option.

Labour market conditions are assessed based on changes in supply and demand. Conditions are summarized through a ranking system where an annual rank from 1 (very weak conditions where workers will seek jobs in other markets) to 5 (where labour shortages will force recruiting from distant markets) is assigned to each trade and occupations. Rankings are calculated as a summary that combines measures of employment growth, unemployment and changes in supply (retirements, new entrants and in-mobility). Industry stakeholders contribute their experience and expectations to the rankings to ensure they capture market realities.

OIL SANDS MARKET ANALYSIS

BuildForce publishes the report *Construction and Maintenance Looking Forward*, which assesses labour market conditions unique to oil sands investment. The first step in BuildForce's methodology is to compare CAPP's annual *Crude Oil Forecast, Markets & Transportation* outlook with other industry data sources, such as the Alberta Government's *Oil Sands Quarterly* which details start dates and expected production by projects. The final review is by BuildForce's Alberta LMI Committee. If required, the production outlook is revised to reflect industry's feedback. Based on projected production levels BuildForce estimates the increased oil sands construction investment necessary to meet the production targets and the associated construction labour requirements. The analysis focuses on a select group of trades and occupations specific (with specializations noted in parenthesis) to oil sands projects:

- boilermakers
- bricklayers (in refractory work)

- carpenters (often as scaffolders)
- construction estimators
- construction managers
- construction millwrights
- crane operators
- electricians
- heavy equipment operators
- heavy-duty equipment mechanics
- insulators
- ironworkers
- steamfitters and pipefitters
- trades helpers and labourers
- truck drivers

Labour demand for this group spans off-site prefabrication and modular construction, on-site construction, maintenance and sustaining capital work. Sustaining production from the oil sands deposits requires regular and large-scale shutdowns for maintenance and equipment replacement. Maintenance and sustaining capital work will sustain a very large workforce in the key construction trades and occupations long after construction projects are complete.

The rankings system in the BuildForce LMI analysis was adapted to track labour markets specific to the oil sands.

The key driver that distinguishes this market from the overall provincial rankings is employment growth. Each labour market is assigned an annual ranking from 1 (very weak markets where job search is difficult) to 5 (where labour shortages will force recruiting from distant markets). Rankings are offered as a summary that combines the measures of employment growth, unemployment and net in-mobility requirements.

Rankings for the oil sands markets are generally higher than the equivalent rankings for the province because employment is growing more rapidly across the scenario period. For example, employment in the oil sands construction workforce grows by almost 40 percent from 2014 to 2023, while the overall non-residential construction workforce in Alberta grows by just 10 percent. Higher rankings in the oil sands markets suggest movement of the workforce from projects and jobs elsewhere in the province and from other provinces to the oil sands.

The BuildForce Canada data and reports are available online at www.constructionforecasts.ca.

APPENDIX 2: OILMAP METHODOLOGY FOR WORKFORCE PROJECTIONS FOR OIL SANDS CONSTRUCTION AND MAINTENANCE

The Government of Alberta's Ministry of Jobs, Skills, Training and Labour has partnered with the Construction Owners Association of Alberta to develop a comprehensive labour market information tool called *Oil Sands Information, Labour Market Analysis and Projection (OILMAP)*. The model projects workforce requirements for Alberta's oil sands sector (mining, in situ, upgrading, turnaround and ongoing maintenance) at an individual and aggregate level.

OILMAP provides insight into the labour force requirements for heavy industrial construction projects, enabling industry, government and other stakeholders to better prepare for workforce planning and policy development.

An outstanding feature of OILMAP is its capability to capture the occupational breakdown of the projected demand and the specific workforce needs for the different sub-sectors of oil sands construction and maintenance projects (in situ, mining, upgrading, turnaround and ongoing maintenance) over the timeframe of the projection.

This numerical workforce projection model is driven by current and announced (planned) oil sands construction projects and incorporates the size, timing and different types of oil sands construction projects to capture occupational labour force demand for 16 key trades over the projection horizon.

In order to project workforce requirements for oil sands construction projects, data sets on current and planned construction projects (size, project start and end dates, type of project and project regulatory approval status) were obtained from oil sands companies.

Through regression analysis, a relationship is established between the project size (capacity) and trade hours to estimate the hours per barrel by project type (in situ, mining and upgrading) for the various trades type (electricians, carpenters, e.tc.). With the estimated hours per barrel, a projection of work hour requirements is developed using the list of planned projects with their design capacities and durations.

By factoring in trades timing (per cent of trade hours used at per cent of project schedule), the estimated tradespersons' hours are distributed per project across the project duration.

By dividing the tradespersons' hours per project by the average number of hours that construction trade workers put in per month, the workforce requirements (persons) per project are obtained. By aggregating the workforce requirements per project and by project type, the total workforce requirements for all the planned oil sands construction projects are obtained.

Workforce demand projections for turnaround and ongoing maintenance projects rely on aggregate Alberta data from the General Presidents' Maintenance Committee for Canada and the National Maintenance Council for Canada with adjustments to account for the role of non-union contractors in maintenance.

The methodology and results of the model were validated by industry groups including Alberta Council of Turnarounds and Industry Maintenance Stakeholders, Rose Committee³⁵, COAA, and individual oil sands companies.

OILMAP projections are based on a list of planned oil sands projects, some of which have yet to receive regulatory approval or board sanction. As such, the projections may not be matched if initially planned projects are cancelled or postponed.

Additional information about OILMAP can be obtained by contacting:

Lance Wilson, Branch Head, Labour Market Information and Intelligence Workforce Strategies Division, Jobs, Skills, Training and Labour

Lance.Wilson@gov.ab.ca

APPENDIX 3: PETROLEUM HR COUNCIL OIL SANDS OPERATIONS SECTOR LABOUR DEMAND METHODOLOGY

The Petroleum HR Council's labour demand projections are produced using a modelling system developed in consultation with industry and labour market forecasting economists.

The model produces projections for the petroleum industry's:

- **Employment:** the number of workers required to support the activity levels in a given year (direct employment only).
 - **Hiring due to industry expansion:** also referred to as “expansion demand,” this is the projected change in the number of workers required to support industry activity levels.
 - **Hiring due to age-related attrition:** also referred to as “replacement demand,” this is the number of jobs that will be vacated due to retirements and natural deaths among industry's workforce.
- contractors and supervisors, mechanic trades
 - contractors and supervisors, electrical trades and telecommunications occupations
 - contractors and supervisors, heavy equipment operator crews
 - contractors and supervisors, pipefitting trades
 - contractors and supervisors, machining, metal forming, shaping and erecting trades and related occupations

DETERMINING OIL SANDS WORKFORCE

In 2011, the Petroleum HR Council enhanced oil sands labour market information by conducting a headcount/workforce survey as of December 31, 2010. Respondents represented:

- 100 per cent of mining production
- 100 per cent of upgrading production
- 73 per cent of in situ production

Companies were asked to report their headcount by occupation, operation-type and location of work and to include only those positions that are 100 per cent dedicated to oil sands operations. Both on-site and off-site workers (head-office roles) were included in the workforce survey.

DETERMINING OCCUPATIONAL SCOPE

Based on oil sands headcount information, the occupational scope for oil sands labour demand was determined by identifying the occupations/job titles that were most prominent within each company.

- Most prominent occupations/job titles were then mapped to the 56 National Occupational Classifications (NOC) 2011. An “other occupations” category is used to capture any residual occupations and ensure total oil sands workforce is accounted for.
- For purpose of analysis and reporting, some occupations were grouped resulting in 52 occupational groups. The grouped occupations include:
 - contractors and supervisors, trades and related occupations, includes:

HIRING DUE TO INDUSTRY EXPANSION

The model projects an oil sands occupation's employment growth using an oil sands production forecast. The production forecast used to develop the projections in this report was taken from CAPP's *Crude Oil and Market Outlook*³⁶, published in June 2013. In the outlook, there was only one scenario developed to forecast oil sands production, i.e., the “Growth” or “Expected” Case.

- The oil sands production forecast is available by operation-type: in situ, mining and upgrading. Therefore, the Petroleum HR Council's labour market modelling can also project demand by each of those operation-types.
- The timing of oil sands employment growth aligns with new production being realized, i.e., oil sands production coming on-stream. It is important to note the hiring of workers often precedes the employment driver—particularly in a tight labour market. Oil sands companies will ramp up hiring to meet production goals. If the labour market is particularly tight and there are labour shortages, a company may start hiring six to 12 months in advance of when additional production is scheduled to come on stream.

HIRING DUE TO AGE-RELATED ATTRITION

The Petroleum HR Council's model also compares the ages of retirement for each occupation to the age demographic of industry's core occupations to calculate age-related attrition of the oil sands workforce. Net hiring requirements are determined by adding the labour demand required to support industry expansion to age-related attrition demand.

APPENDIX 4: OIL SANDS OPERATIONS WORKFORCE REQUIREMENTS TO 2023

TOTAL OIL SANDS OPERATIONS LABOUR DEMAND PROJECTIONS							
Occupation (NOC)	2014 Estimated Employment	Hiring due to				Net Hiring Requirements to 2023	% of 2014 Employment
		Industry Expansion	% of 2014 Employment	Age-related Attrition	% of 2014 Employment		
Oil Sands Total	26,548	15,333	58%	6,377	24%	21,710	82%
Purchasing managers (0113)	20	17	85%	8	38%	25	123%
Engineering managers (0211)	1,037	722	70%	317	31%	1,039	100%
Construction managers (0711)	381	289	76%	79	21%	368	96%
Facility operation and maintenance managers (0714)	1,126	611	54%	324	29%	935	83%
Managers in natural resources production and fishing (0811)	700	510	73%	216	31%	726	104%
Professional occupations in advertising, marketing and public relations (1123)	54	48	89%	14	26%	62	115%
Supervisors, supply chain, tracking and scheduling co-ordination occupations (1215)	56	39	70%	16	28%	55	98%
Purchasing agents and officers (1225)	337	320	95%	102	30%	422	125%
Shippers and receivers (1521)	101	71	70%	29	28%	100	99%
Production logistics co-ordinators (1523)	6	2	33%	-	0%	2	33%
Purchasing and inventory control workers (1524)	86	62	72%	24	28%	86	100%
Geoscientists and oceanographers (2113)	439	352	80%	132	30%	484	110%
Civil engineers (2131)	77	47	61%	15	19%	62	80%
Mechanical engineers (2132)	688	411	60%	129	19%	540	79%
Electrical and electronics engineers (2133)	528	306	58%	104	20%	410	78%
Chemical engineers (2134)	558	306	55%	111	20%	417	75%
Industrial and manufacturing engineers (2141)	428	315	74%	66	15%	381	89%
Metallurgical and materials engineers (2142)	43	20	47%	9	22%	29	68%
Mining engineers (2143)	169	78	46%	26	15%	104	62%
Geological engineers (2144)	55	28	51%	9	17%	37	68%
Petroleum engineers (2145)	1,024	893	87%	225	22%	1,118	109%
Chemical technologists and technicians (2211)	175	105	60%	35	20%	140	80%
Geological and mineral technologists and	335	321	96%	91	27%	412	123%

TOTAL OIL SANDS OPERATIONS LABOUR DEMAND PROJECTIONS							
Occupation (NOC)	2014 Estimated Employment	Hiring due to				Net Hiring Requirements to 2023	% of 2014 Employment
		Industry Expansion	% of 2014 Employment	Age-related Attrition	% of 2014 Employment		
technicians (2212)							
Civil engineering technologists and technicians (2231)	183	118	64%	44	24%	162	89%
Mechanical engineering technologists and technicians (2232)	227	148	65%	42	19%	190	84%
Industrial engineering and manufacturing technologists and technicians (2233)	47	40	85%	10	20%	50	105%
Construction estimators (2234)	67	44	66%	17	25%	61	91%
Electrical and electronics engineering technologists and technicians (2241)	148	99	67%	30	20%	129	87%
Industrial instrument technicians and mechanics (2243)	679	442	65%	143	21%	585	86%
Drafting technologists and technicians (2253)	155	102	66%	37	24%	139	90%
Land survey technologists and technicians (2254)	33	16	48%	9	28%	25	77%
Non-destructive testers and inspection technicians (2261)	228	146	64%	47	21%	193	85%
Inspectors in public and environmental health and occupational health and safety (2263)	271	191	70%	80	30%	271	100%
Natural and applied science policy researchers, consultants and program officers (4161)	181	142	78%	38	21%	180	100%
Contractors and supervisors, trades and heavy construction (7201, 7202, 7203, 7301, 7302)	425	306	72%	93	22%	399	94%
Machinists and machining and tooling inspectors (7231)	7	3	43%	-	0%	3	43%
Welders and related machine operators (7237)	363	180	50%	64	18%	244	67%
Industrial electricians (7242)	659	350	53%	145	22%	495	75%
Power system electricians (7243)	33	8	24%	9	28%	17	52%
Electrical power line and cable workers (7244)	6	1	17%	-	0%	1	17%
Steamfitters, pipefitters and sprinkler system installers (7252)	166	69	42%	30	18%	99	60%
Construction millwrights and industrial mechanics (7311)	609	344	56%	131	22%	475	78%

TOTAL OIL SANDS OPERATIONS LABOUR DEMAND PROJECTIONS							
Occupation (NOC)	2014 Estimated Employment	Hiring due to				Net Hiring Requirements to 2023	% of 2014 Employment
		Industry Expansion	% of 2014 Employment	Age-related Attrition	% of 2014 Employment		
Heavy-duty equipment mechanics (7312)	1,106	554	50%	241	22%	795	72%
Automotive service technicians, truck and bus mechanics and mechanical repairers (7321)	51	15	29%	9	18%	24	48%
Crane operators (7371)	41	21	51%	9	23%	30	74%
Heavy equipment operators (except crane) (7521)	3,303	1,668	50%	597	18%	2,265	69%
Other automotive mechanical installers and servicers (7535)	108	53	49%	20	18%	73	67%
Supervisors, mining and quarrying (8221)	46	24	52%	9	20%	33	73%
Oil and gas drilling, servicing, and related labourers (8615)	4	2	50%	-	0%	2	50%
Petroleum, gas, and chemical process operator (9232)	398	217	55%	90	23%	307	77%
Power engineers and power systems operators (9241)	4,717	3,147	67%	1,233	26%	4,380	93%
Water and waste treatment plant operators (9243)	139	135	97%	40	29%	175	126%
Other Occupations	3,725	2,361	63%	1,077	29%	3,438	92%

APPENDIX 5: GLOSSARY

Aggregated oil sands construction: Includes off-site prefabrication and modular construction, on-site construction, ongoing and turnaround maintenance.

Age-related attrition: Workers leaving their jobs because of retirements and deaths.

Bitumen: Heavy, viscous form of crude oil, often found in oil sand deposits.

Conventional: Process of recovering petroleum from a well using standard drilling production methods.

Expansion demand: Hiring due to industry activity levels. May be a negative number.

In situ: Technique using steam to recover oil from the sand in oil sands extraction.

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

Labour market information (LMI): Powerful tool to assist oil sands partners with workforce development planning.

Labour shortage: Situation where there is not enough labour supply to meet labour demand.

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

Maintenance and sustaining capital work: Occurs at the operations site and involves the large-scale shutdown or “turnarounds” of plants for maintenance and equipment replacement to ensure the operations are as efficient as possible.

National Occupational Classification: 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 due to industry expansion and age-related attrition.

Non-retirement employee turnover: Ratio of the number of workers that have to be replaced in a given time period to the average number of workers. Turnover includes: Employees moving from one company to another (churn) and employees leaving the industry (leakage) but excludes age-related attrition.

Off-site prefabrication and modular construction: Building oil sands operations modules in a plant setting where construction, assembly, testing and pre-commissioning occurs in a controlled environment. Modules are then transported to the operations site for final assembly.

Oil and gas services sector: Contracted exploration, extraction and production services to the E&P sector. This sector includes:

- Drilling and completions services – Include drilling and service rigs activities.
- Geophysical services (also known as seismic) – Include survey, permitting and reclamation, line construction, drilling and data acquisition.
- Petroleum services – Include well services, oilfield construction and maintenance, production and transportation services.

Oil sands sector: The petroleum industry sector involved in the extraction and upgrading of bitumen.

On-site construction: Assembly and construction work that needs to be completed in the field. In Alberta, on-site oil sands construction takes place in the same locations as ongoing operations.

Operations phase: Defined as the extraction, production and upgrading of bitumen, which consists of three operation types: mining, in situ and upgrading.

Open-pit mine: An excavation or cut made at the surface of the ground for the purpose of extracting bitumen and remains open to the surface for the duration of the mine’s life.

Petroleum industry: Global processes of exploration extraction, refining, transporting and marketing petroleum products.

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

Sector: Distinct subset of an industry whose components share similar characteristics. Seven sectors operate in Canada’s petroleum industry.

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

Turnaround Maintenance: Scheduled shutdown of oil sands processing units or plants for overhaul and repairs.

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

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

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

LIST OF ABBREVIATIONS

ACR	Alberta Chamber of Resources
ACWA	Association for Construction Worker Acquisition
CAPP	Canadian Association of Petroleum Producers
COAA	Construction Owners Association of Alberta
CPI	Consumer Price Index
JSTL	Government of Alberta's Ministry of Jobs, Skills, Training and Labour
GDP	Gross Domestic Product
H2H	Helmets to Hardhats
LMI	Labour market information
NOC	National Occupation Classifications
OILMAP	Oil Sands Information, Labour Market Analysis and Projection
PHRC	Petroleum Human Resources Council
SAGD	Steam-assisted gravity drainage
TFWs	Temporary foreign workers
WFP	Workforce planning
WTI	World Trade Institute

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- ¹ The Conference Board of Canada. (2012, October). *Fuel for Thought: The Economic Benefits of Oil Sands Investment for Canada's Regions*. Retrieved from <http://www.conferenceboard.ca/e-library/abstract.aspx?did=5148>
- ² Canadian Association of Petroleum Producers. (2013). *Crude Oil Forecasts, Markets and Transportation Report*. Retrieved from <http://www.capp.ca/getdoc.aspx?DocId=227308&DT=NTV>
- ³ Peak is defined as the highest annual average value (point) in the projection period due to the ramp up of workers required to meet production goals.
- ⁴ Statistics Canada. (2014, April 4). Labour Force Characteristics, seasonally adjusted, by province. Retrieved from <http://www.statcan.gc.ca/tables-tableaux/sum-som/l01/cst01/lfs01c-eng.htm>
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- ¹¹ Canadian Association of Petroleum Producers. (2014, February 12). *Oil and natural gas industry supports budget measures for improved access to skilled trades training and building future workforce*. Retrieved from <http://www.capp.ca/aboutUs/mediaCentre/NewsReleases/Pages/Oilandnaturalgasindustrysupportsbudgetmeasuresforimprovedaccesstoskilledtradesandbuildingfutureworkforce.aspx>
- ¹² BuildForce Canada is formerly the Construction Sector Council.
- ¹³ Labour demand projections for the in-scope occupations have been mapped to the corresponding National Occupational Classification (NOC) 2011. For more information about NOC 2011, visit <http://www5.hrsdc.gc.ca/NOC/English/NOC/2011/Welcome.aspx>
- ¹⁴ Sustaining capital are the expenditures required to sustain/maintain existing assets. This includes ensuring that assets retain their design value in terms of productive capacity and enhancing assets to minimum standards for reliability, safety and environmental security.
- ¹⁵ Estimated to be 75 per cent of the workforce involved in off-site prefabrication and modular construction, on-site construction, maintenance and sustaining capital work. (BuildForce)
- ¹⁶ Estimated to be 90 per cent of the on-site oil sands construction workforce. (OILMAP)
- ¹⁷ Estimated to be 86 per cent of the oil sands workforce hired by oil sands companies. (Petroleum HR Council)
- ¹⁸ Includes Contractors and supervisors, electrical trades and telecommunications occupations (7202), heavy equipment operator crews (7302), machining, metal forming, shaping and erecting trades and related occupations (7201), mechanic trades (7301), and pipefitting trades (7203).
- ¹⁹ Government of Alberta. *Alberta Oil Sands Industry Quarterly Update (Spring 2014)*. Retrieved from <https://albertacanada.com/business/statistics/oil-sands-quarterly.aspx>
- ²⁰ Government of Alberta. *Alberta Oil Sands Industry Quarterly Update (Spring 2014)*. Retrieved from <https://albertacanada.com/business/statistics/oil-sands-quarterly.aspx>
- ²¹ BuildForce Canada. (2014, April). *Construction and Maintenance Looking Forward Alberta Oil Sands 2014 – 2023 Highlights*. Retrieved from <http://www.buildforce.ca/en/products/alberta-oil-sands-2014-highlights>
- ²² Due to the seasonal nature of the work, construction workers that focus on turnaround maintenance need to be prepared to move between turnaround/shutdown projects, work seasonally and be away from home for long periods of time.

²³ Welders do not include sub- specialties like pipefitter welders, boilermaker welders, etc.; these are included under the respective trades (pipefitters, boilermakers, etc.).

²⁴ Social license to operate is defined as the ongoing approval and/or broad social acceptance with the local community and other stakeholders. <http://sociallicense.com/definition.html>

²⁵ Supply chain professionals play a key role in the procurement of contractors and vendor management as well as the administration of associated contracts. They are also responsible for finding cost-saving opportunities for the company. Supply chain occupations also help to enable timely and cost-effective turnaround maintenance by ensuring the right equipment, materials and skills are available at the right time.

²⁶ Statistics Canada. (2011, August 17). Study: Projected Trends to 2031 for the Canadian labour force. Retrieved from <http://www.statcan.gc.ca/daily-quotidien/110817/dq110817b-eng.htm>

²⁷ Labour productivity measures the amount of output produced per hour worked. The Petroleum HR Council's labour demand model assumes a one per cent productivity rate.

²⁸ Statistics Canada. Labour Force Characteristics, seasonally adjusted, by province. Released April 4, 2014.

²⁹ Suncor Energy Oil Sands Question and Response Blog. (2012, July). *Oil Sands Growth: Solving Worker Shortages*. Retrieved from <http://osqar.suncor.com/2012/07/oil-sands-growth-solving-worker-shortages.html>

³⁰ *Women Building Futures*, <http://www.womenbuildingfutures.com/>

³¹ Alberta Chamber of Resources, *Aboriginal Programs Project*, <http://www.acr-alberta.com/AboriginalProgramsProject/tabid/229/Default.aspx>

³² *Helmets To Hardhats*, <http://www.helmetstohardhats.ca/en/home.htm>

³³ WorkFace Planning (WFP) is a best practice that emphasizes the development of small, manageable work packages in construction projects so that construction crews can perform their work safely, effectively, and efficiently.

³⁴ Alberta's Apprenticeship and Industry Training. *Industrial Construction Crew Supervisor Job Profile*. Retrieved from <http://tradesecrets.alberta.ca/trades-occupations/profiles/208/>

³⁵ The Rose Committee is comprised of Managers of Turnaround projects in Alberta's oil sands and non-oil sands companies

³⁶ Canadian Association of Petroleum Producers (2013) *Crude Oil Forecasts, Markets and Transportation report*. Retrieved from <http://www.capp.ca/forecast/Pages/default.aspx>

ACKNOWLEDGEMENTS

The Petroleum Human Resources Council (a division of Enform Canada) gratefully acknowledges the Government of Alberta for the funding to undertake and complete this study.

The Petroleum HR Council is grateful for the time and expertise provided by BuildForce Canada, Construction Owners Association of Alberta, and the Government of Alberta's Ministry of Jobs, Skills, Training and Labour and also by oil sands company representatives and Canadian Association of Petroleum Producers staff.

Last but not least, the Petroleum HR Council acknowledges the contributions of Creative Links International Inc., Cheryl Knight and Associates and Clay Graphic Design Inc. for assisting in the production of this report.

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Published May 2014

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