Petroleum Labour Market Information

The Decade Ahead:

Oil Sands Labour Demand Outlook to 2022

Petroleum Human Resources Council of Canada | Conseil canadien des ressources humaines de l'industrie du pétrole

Part of ENFORM The Safety Association for Canada's Upstream Oil and Gas Industry

Canada

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THE DECADE AHEAD: OIL SANDS LABOUR DEMAND OUTLOOK TO 2022

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EXECUTIVE SUMMARY

Canada's oil sands surpassed growth expectations in 2012 due to stable oil prices and strong investment. Optimism continued into 2013 but was somewhat tempered by ongoing business concerns that could impact the sector's growth and sustainability. The urgent need to increase pipeline capacity and diversify markets remains top of mind for the industry. Cost management continues to be a key priority as less expensive conventional and shale oil projects are competing effectively with oil sands for production markets and investment dollars.

Addressing labour and skill shortages is now firmly embedded as a key business requirement for oil sands companies, along with controlling costs, diversifying markets, obtaining the social license to operate and minimizing environmental impacts. Oil sands companies, industry associations, government and training institutes are coming together to develop and implement innovative workforce solutions.

The *Oil Sands Labour Demand Outlook to 2022* presents labour demand projections and analyses for the coming decade and outlines some of industry's most recent—and successful—strategies to address workforce concerns. Additional industry-wide strategies are also recommended for further consideration and action.

CURRENT OIL SANDS OPERATIONS WORKFORCE

OIL SANDS EMPLOYMENT IN 2012, BY OPERATIONS TYPE

22,340[1]

Number of jobs in Canada's oil sands operations in 2012

9,080 In situ operations jobs (40%)

8,880 Mining operations jobs (40%)

4,380 Upgrading jobs (20%)

FIG. 1

TOP 10 OIL SANDS OCCUPATIONS BASED ON 2012 EMPLOYMENT LEVELS

1	Power engineers (steam-ticketed operators)	**3,860**
2	Heavy equipment operators	**3,055**
3	Heavy-duty equipment mechanics	**985**
4	Facility operation and maintenance managers	**960**
5	Engineering managers	**855**
6	Petroleum engineers	**810**
7	Mechanical engineers	**575**
8	Primary production managers	**570**
9	Industrial electricians	**565**
10	Millwrights and machinists	**565**

FIG. 3

EMPLOYMENT GROWTH IN OIL SANDS OPERATIONS FROM 2011 TO 2012

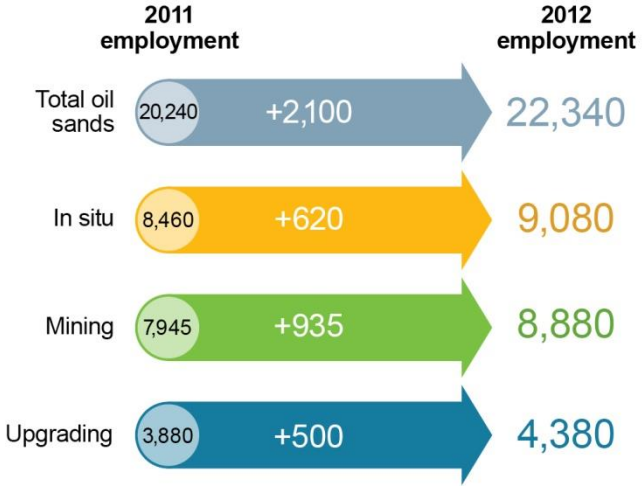

FIG. 2

EMPLOYMENT GROWTH TO 2022

Over the coming decade, the oil sands operations workforce is projected to grow by 71 per cent over current levels, adding **16,000 direct new jobs** and increasing employment to **38,300 workers by 2022**.

In the short-term, employment in 2013 is expected to continue to grow, and the sector will add 2,850 new jobs. Mining and upgrading employment will increase by 14 per cent, adding 1,270 and 615 new jobs respectively. In situ employment is projected to grow by 11 per cent or 965 new jobs.

In the longer term, the majority of investment and production increases are attributed to in situ operations. As a result, in situ operations will more than double today's workforce, adding 10,210 new jobs by 2022 and employing half of the oil sands workforce with 19,290 jobs. Mining employment is expected to be relatively flat until 2018 but will eventually increase to 13,400 jobs by 2022 – adding 4,480 new jobs over the next decade. Upgrading operations will add another 1,300 jobs, for a total workforce of approximately 5,640 by 2022.

OIL SANDS EMPLOYMENT OUTLOOK TO 2022 BY TOTAL AND BY OPERATIONS TYPE

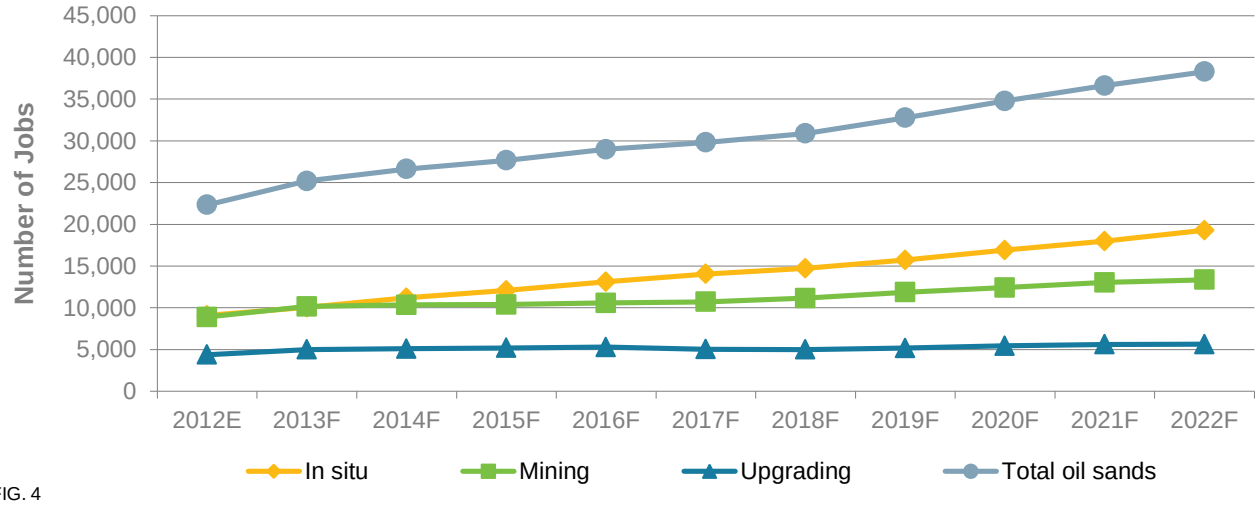

FIG. 4

The benefits of oil sands investment go well beyond growth in direct operations employment. There are also thousands of workers providing contract services to oil sands operators such as those in construction, oil and gas services and supply chain sectors across Canada.

All told, approximately 380,000 direct and indirect jobs will be supported by investment in the oil sands sector over the next decade. Although the majority of jobs are expected to be in Alberta, jobs will be sustained across Canada particularly in Ontario, British Columbia, Quebec, Saskatchewan, Manitoba and Atlantic Canada.

ADDITIONAL HIRING REQUIREMENTS DUE TO AGE-RELATED ATTRITION

Workforce retirements could create an **additional 6,500 job vacancies,** which, when combined with the number of jobs created due to industry expansion, leads to the oil sands operations sector needing to fill **22,500 job openings over the next decade, or over 100 per cent of its 2012 employment levels.**

OIL SANDS NET HIRING REQUIREMENTS TO 2022, BY OPERATIONS TYPE

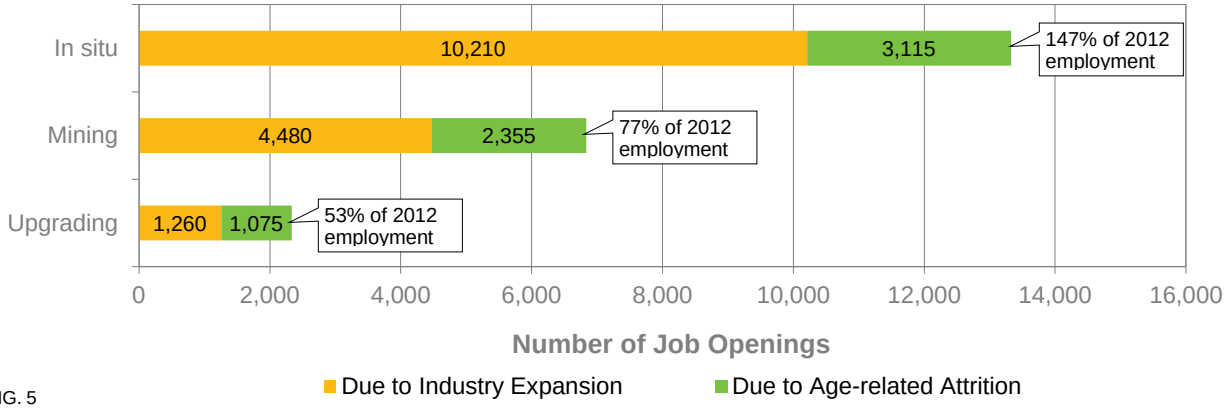

FIG. 5

Oil sands operations are very technical and require a highly skilled workforce. As demonstrated by Figure 6 below, the top ten occupations with the greatest net hiring requirements account for over 55 per cent of the oil sands sector's job openings – all of which require post-secondary education.

Power engineers and heavy equipment operators make up a significant portion of the oil sands operations workforce. These occupations will require a significant number of new workers, with 3,985 and 2,295 job openings respectively. Together, the two occupations account for 28 per cent of the sector's net hiring requirements over the next decade.

TOP 10 OIL SANDS OCCUPATIONS WITH GREATEST NET HIRING REQUIREMENTS TO 2022		
1	Power engineers (steam-ticketed operators)	**3,985**
2	Heavy equipment operators	**2,295**
3	Petroleum engineers	**1,090**
4	Engineering managers	**1,025**
5	Facility operation and maintenance managers	**975**
6	Heavy-duty equipment mechanics	**785**
7	Primary production managers	**710**
8	Instrumentation technicians	**575**
9	Mechanical engineers	**550**
10	Industrial electricians	**500**

FIG. 6

COMPETITION WILL INCREASE HIRING ACTIVITY

Hiring due to industry expansion plus age-related attrition[2] should be regarded as a minimum hiring requirement, as it does not consider any hiring due to employee turnover. Strong competition for workers and employee turnover will drive additional hiring activity beyond the 22,500 net hiring requirements.[3] Figure 7 shows an additional 9,350 job openings will be created if the sector sees a three per cent non-retirement turnover rate overall. This brings **total hiring requirements for the sector to approximately 31,850 over the next ten years.**

OIL SANDS TOTAL HIRING REQUIREMENTS 10-YEAR OUTLOOK

FIG. 7

Shortages for some occupations pose a greater risk than others.

- Power engineers will be in the highest demand in the oil sands sector over the next decade. Power engineers make up almost 25 per cent of both in situ and upgrading operations hiring.
- Sustainability-related occupations, such as stakeholder relations, environmental, health and safety roles, will experience above-average employment growth. Workers in these types of occupations ensure a balanced approach to business development and obtaining the social license to operate.
- Human resources professionals will be in high demand, as organizational effectiveness and recruiting, retaining and developing human capital continue to be key business concerns.
- Shortages of supply chain, logistics, procurement and contract management workers could create bottlenecks and impact expansion schedules. These types of workers are responsible for securing or coordinating required materials, equipment, products and services.
- Retirements amongst managers and supervisors will lead to a loss of knowledge, experience and mentoring capacity and will have a negative impact on workforce development and productivity.
- Retirement of industry-specific workers, such as petroleum engineers and geoscience professionals, are more difficult to address because of the limited labour supply pool. Workers in these occupations are typically hired as new graduates and developed within the industry.

WORKFORCE STRATEGIES FOR CONSIDERATION

Collaborative efforts, many of them driven by industry, are helping to increase the pool of qualified workers for the oil sands sector. Innovative solutions look to apply new approaches to chronic skill shortages and challenge the established methods for developing Canada's labour force.

Mitigating the risks associated with labour and skill shortages, such as escalating labour costs, productivity issues and project delays, needs to stay top of mind. Additional strategies or opportunities that should be considered include:

- **Managing labour costs.** Oil and gas industry wages are increasing at a rate of 3.9 per cent, which is faster than the Canadian average of 2.9 per cent.[4] Less reliance on recruiting from within the industry may curtail rising labour costs.
- **Increasing energy literacy.** The lack of understanding of the industry, its career opportunities and its value to the Canadian economy continues to be a barrier to attracting talent.
- **Attracting workers beyond Western Canada.** Most of the programs designed to increase the pool of qualified workers are implemented in Western Canada, where competition for workers is already fierce. Further, rotational work assignments continue to operate from Western Canadian transportation hubs and are not attractive to potential workers from eastern locations.
- **Recruiting internationally for some skill sets.** Recent changes to federal immigration policy and programs provide an opportunity to target internationally trained workers to fill in-demand jobs. Not all oil sands jobs lend themselves to international recruitment because of the unique nature of work and/or qualifications. However, occupations such as mining engineers, petroleum process engineers and trades are likely to have transferable experience and qualifications.

Canada's oil sands sector entered 2013 poised to lead the nation's economy by leveraging ongoing investment to accelerate project plans and expansions. However, the sector's future is not without its challenges. With sustainability as a top concern, the sector must continue to be innovative in addressing market constraints, managing costs, gaining public support and, of course, ensuring a productive, skilled and available workforce.

INTRODUCTION

Canada's oil sands sector continues to be a solid economic performer. The year 2012 marked accelerated growth for the sector as a result of joint ventures, foreign investment and relatively stable oil prices. In situ operations were the benefactor of the majority of investment, and as a result:

> In situ production is now forecasted to overtake mining production by 2015 rather than 2016 – a full year earlier than previously anticipated.

There are still challenges ahead, as oil sands producers are faced with a number of business constraints. The technologies[5] that revolutionized the natural gas industry are now being applied to shale oil. As a result, North American conventional oil production is increasing, while decreasing oil demand from the United States has created an urgent need for solutions to constraints of both Canada's petroleum industry's pipeline capacity and international market exposure. However a number of proposed pipeline projects designed to target overseas markets have not yet been approved.

Cost management will continue to be the top priority for existing, under-construction and planned oil sands projects. Less expensive conventional and shale oil projects are competing effectively with oil sands for production markets and investment dollars.

Addressing labour and skill shortages is now firmly embedded as a key business requirement for oil sands companies, along with controlling costs, diversifying markets, obtaining the social license to operate and minimizing environmental impacts.

> In the face of adversity, the oil sands sector has shown resilience.

Business challenges have led to innovative solutions. For example, the sector is exploring potential modifications to existing pipelines which could deliver more oil sands production to Eastern Canada, decreasing that region's reliance on imported oil and growing oil sands benefits beyond Alberta. Refineries in Ontario, Quebec and the Atlantic provinces, currently operating on less than optimal capacity, could be reconfigured to efficiently process bitumen and heavy oil. Eastern refineries could become a gateway for oil exports to Europe and Asia.

Trucking and rail are also options for dealing with short-term pipeline capacity constraints. These modes for transporting oil and gas have proven to be more economical for smaller producers who cannot compete effectively for pipeline capacity.

Innovative solutions are also being implemented to address workforce challenges. The *Oil Sands Labour Demand Outlook to 2022* presents and analyzes labour demand projections, and outlines industry's most recent – and successful – strategies to address workforce concerns. Additional industry-wide strategies are presented at the end for stakeholder consideration and action.

OVERVIEW OF SCOPE AND METHODOLOGY

This outlook explores the current state (2012) and the next decade (2013 to 2022) for the oil sands operations workforce and provides industry, government and education and training institutions with the information and insight needed to develop and implement effective workforce strategies resulting from:

- job creation due to continued oil sands expansion
- hiring due to shifting demographics and projected age-related attrition
- hiring due to non-retirement employee turnover
- occupations with the greatest demand for workers

To produce year-over-year employment numbers for the oil sands sector, the Petroleum HR Council gathered occupational employment information directly from oil sands operators. As a result of this data-gathering process, the Petroleum HR Council's oil sands labour demand outlook is built on the most comprehensive employment data available. The data collected was for direct oil sands operations employment only and includes workers located on-site (i.e., based at the operations site) as well as head office roles (i.e., in Calgary). For the purposes of this study, the data covers only those employees who work full-time in the oil sands sector.[6]

The Petroleum HR Council defines the oil sands operations sector as the extraction, production and upgrading of bitumen[7], 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

The labour demand projections in this report were generated based on oil sands production forecast from the Canadian Association of Petroleum Producer's Canadian Crude Oil and Market Outlook, published in June 2012. The oil and gas industry can go through an astounding amount of change in a very short period and therefore, the Petroleum HR Council will update its outlook if new production forecasts are available.

There are 56 occupations considered as core to the oil sands representing 86 per cent of the workforce employed in the sector. Labour demand projections have been detailed for these occupations, which have been mapped to corresponding National Occupations Classifications (NOC) 2006. Additionally, an "other occupations" category captures any residual occupations and ensures the total oil sands workforce is incorporated.

CORE OIL SANDS OCCUPATIONS INCLUDED IN THIS STUDY	
OCCUPATIONAL TITLE (NOC)	***COMMON JOB TITLES***
Automotive mechanical installers and servicers (7443)	Lube technician, tire technician, bay technician
Automotive technicians (7231)	Automotive technician, mechanic
Chemical engineers (2134)	Chemical engineer, process engineer
Chemical technologists and technicians (2211)	Process technician, chemical engineering technologist, quality assurance analyst, lab technician
Civil engineering technologist (2231)	Civil engineering technologist, civil technician, CADD operator, structural engineering technologist, survey technologist
Civil engineers (2131)	Civil engineer, geotechnical engineer, piping engineer, project engineer
Construction estimators (2234)	Construction estimator, project estimator
Construction managers (0711)	Construction manager, project manager
Crane operators (7371)	Crane operator, mobile crane operator
Drafting technologists and technicians (2253)	Drafting technologist, CAD technologist
Electrical power line and cable workers (7244)	Power linesman, power line technician
Electrical/instrumentation engineers (2133)	Electrical/instrumentation engineer, project engineer, electrical/instrumentation reliability engineer, control systems specialist

CORE OIL SANDS OCCUPATIONS INCLUDED IN THIS STUDY	
OCCUPATIONAL TITLE (NOC)	*COMMON JOB TITLES*
Engineering managers (0211)	Managers for a variety of engineering disciplines
Environmental technicians (4161)	Environmental technician
Facility operation and maintenance managers (0721)	Maintenance manager, facilities manager, operations manager, maintenance scheduler, maintenance planner, plant manager
Geological engineers (2144)	Geological engineer, geotechnical engineer
Geologists and geophysicists (2113)	Geologist, geophysicist
Heavy equipment operators (7421)	Heavy equipment operator
Heavy-duty equipment mechanics (7312)	Heavy-duty mechanic
Industrial electricians (7242)	Industrial electrician, electrician, electrical technician
Industrial engineering and manufacturing technologists and technicians (2233)	Rotating equipment technician, industrial technician
Inspectors in public and environmental health and safety (2263)	Health & safety inspector, EH&S specialist
Instrumentation engineering technologists (2241)	DCS Specialist, DCS technician, instrumentation technologist/ technician, instrumentation reliability technician
Instrumentation technicians (2243)	
Land surveyors (2254)	Land surveyor
Landmen/purchasing agents (1225)	Contract administrator, contract manager, contract specialist, procurement specialist
Machinists and machining and tooling inspectors (7231)	Machinist
Mechanical engineering technologists (2232)	Mechanical engineering technologist, rotating equipment technician/ technologist
Mechanical engineers (2132)	Plant engineer, facilities engineer, rotating equipment engineer, mechanical reliability engineer
Metallurgy & materials engineers (2142)	Corrosion engineer, materials engineer, quality assurance engineer
Millwrights (7311)	Millwright, mechanical reliability technician
Mining engineers (2143)	Mining engineer
Petroleum engineers (2145)	Petroleum engineer, reservoir engineer, drilling and completions engineer
Petroleum/mining/geological engineering technologists (2212)	Mining engineering technologist, petroleum engineering technologist
Power engineers (steam-ticketed operators) (7351)	Control room operator, process operator, bitumen plant operator, SAGD operator, in situ operator, production technician, unit operator, 1st, 2nd, 3rd and 4th class power engineer
Power system electricians (7243)	Power electrician, power system electrician
Primary production managers (0811)	Production manager, drilling manager
Process operators (non-steam operators) (9232)	Petroleum, gas, chemical process operators
Production clerks (1473)	Production accountant, production technician
Professional occupations in public relations and	Stakeholder relations advisor, public relations advisor, communications advisor, public affairs advisor, community

CORE OIL SANDS OCCUPATIONS INCLUDED IN THIS STUDY	
OCCUPATIONAL TITLE (NOC)	*COMMON JOB TITLES*
communications (5124)	engagement specialist
Project/cost control engineers (2141)	Project engineer, quality control engineer, optimization engineer
Purchasing agent and inventory clerks (1475)	Buyer, procurement coordinator, inventory coordinator, purchasing agent, inventory control, sourcing specialist, expeditor, materials control coordinator
Purchasing managers (0113)	Purchasing manager, sourcing manager, procurement manager, expediting manager, material manager
Quality assurance analysts (2261)	Quality assurance analyst, NDT technician, NDT analyst
Shippers and receivers (1471)	Shipper/receiver
Steamfitters and pipefitters (7252)	Steamfitter, pipefitter
Supervisors, electrical trades and telecommunications occupations (7212)	Supervisor, electrical trades
Supervisors, heavy construction equipment crews including oil field construction (7217)	Wellpad construction supervisor, pipeline supervisor, supervisors, heavy equipment operators
Supervisors, mechanic trades (7216)	Supervisor, mechanical trades
Supervisors, metal forming, shaping and erecting trades (7214)	Welding supervisor
Supervisors, mining and quarrying (8221)	Mining supervisor
Supervisors, pipefitting trades (7213)	Supervisor, piping trades
Supervisors, recording, distributing and scheduling occupations (1215)	Supervisor, pipeline scheduler, supervisor, railcar coordinator
Water and waste plant operators (9424)	Water plant operator, water treatment operator
Welders (7265)	Welder
Other occupations	Includes occupations in human resources, accounting and finance, IT, administrative assistance, legal and other corporate services.

FIG. 8

For the purpose of analysis and reporting, some of the occupations have been grouped together resulting in 50 occupations detailed in this report. The groupings are:

- millwrights and machinists
- supervisors, trades and heavy construction, including: mechanic trades, electrical trades and telecommunications occupations, heavy construction equipment crews including oil field construction, pipefitting trades, and metal forming, shaping and erecting trades

For detailed data for all 56 core and “other” occupations, including year-over-year employment and hiring numbers, please refer to the *Oil Sands Labour Demand Outlook to 2022 Detailed Spreadsheets* available for download on www.petrohrsc.ca.

The labour demand numbers presented in the executive summary and main body of the report have been rounded to improve readability.

Appendix 1 further details the scope of this study, and includes an overview of the methodology and data sources.

CANADA'S OIL SANDS AND ITS WORKFORCE

The majority of Canada's oil sands deposits and all of its current operations are located in Alberta. The Athabasca deposit near Fort McMurray is the largest and the most well-known. However, the Cold Lake deposit has undergone significant development in recent years.

OIL SANDS KEY OPERATING AREAS

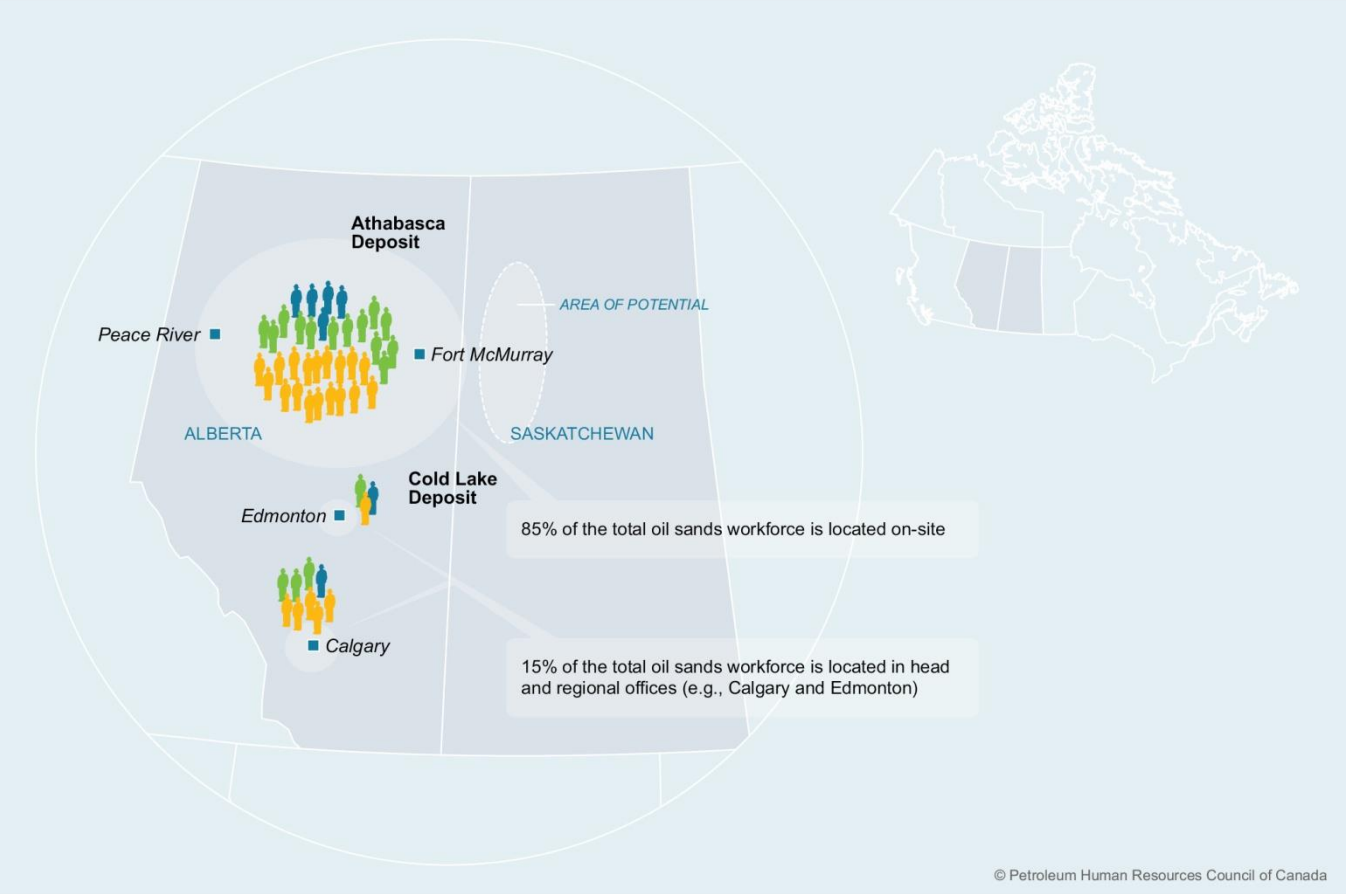

FIG. 9

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.[8]

The other 80 per cent of Canada's oil sands resource is deeper or in situ[9] 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.

OIL SANDS MINING, IN SITU AND UPRGRADING OPERATIONS

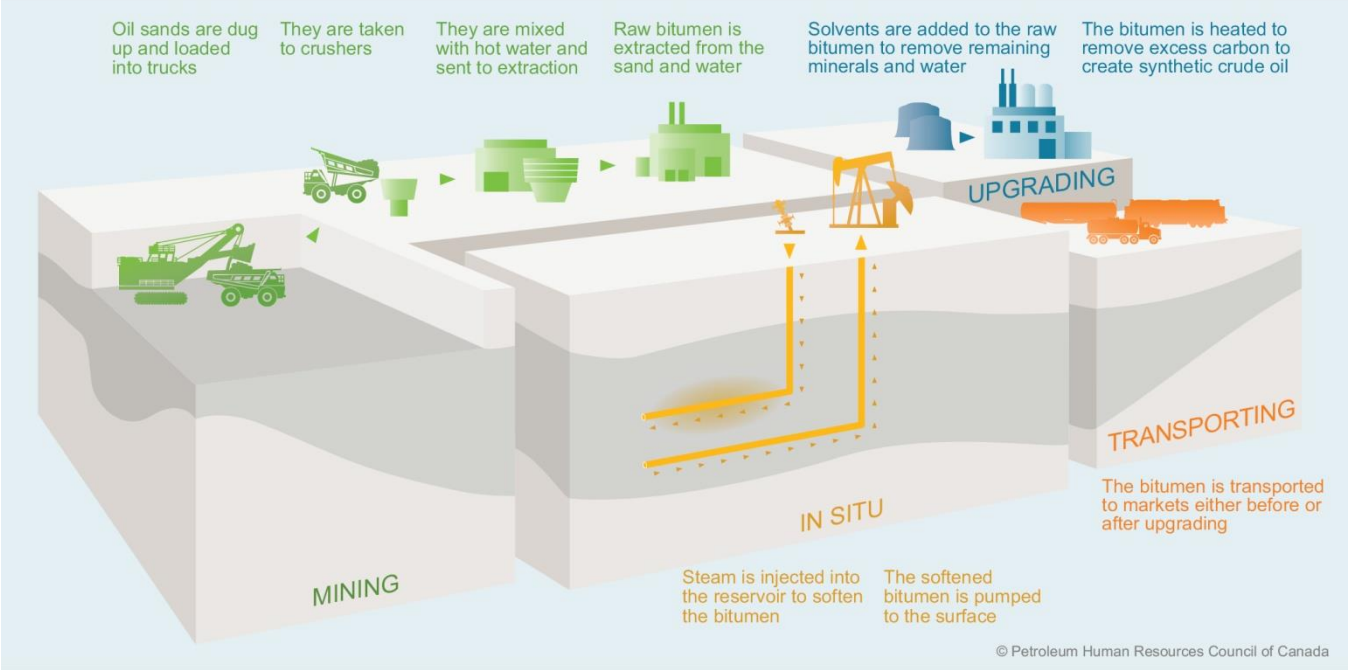

FIG. 10

EACH TYPE OF OIL SANDS OPERATIONS REQUIRES A SLIGHTLY DIFFERENT MIX OF OCCUPATIONS

In situ operations are closely related to conventional oil and gas because of the need to drill wells to access deep reserves of bitumen. For this reason, in situ operations hire petroleum engineers, petroleum engineering technologists and geoscience professionals. Steam generation, water treatment and recycling are important components of the SAGD techniques used by the majority of in situ operations, which drive the greatest need for power engineers.

Mining operations are focused on hiring employees to operate and maintain the heavy equipment used for open-pit mining and the plant operations that separate the bitumen from sand. As a result, occupations heavily required by oil sands mining operations include heavy equipment operators, heavy-duty mechanics and trades, such as industrial electricians, millwrights and welders. The separation of bitumen from sand occurs within plants operated by power engineers and process operators.[10]

Upgrading operations involve processing bitumen into other petroleum products and therefore, occupations are primarily concentrated on plant operations and maintainance. Since the upgrading process involves the use of boilers and pressure vessels, plant operators are certified steam-ticketed operators (i.e., power engineers). Chemical engineers also play a key role in monitoring the upgrading process. Trades workers are required to maintain plant equipment.

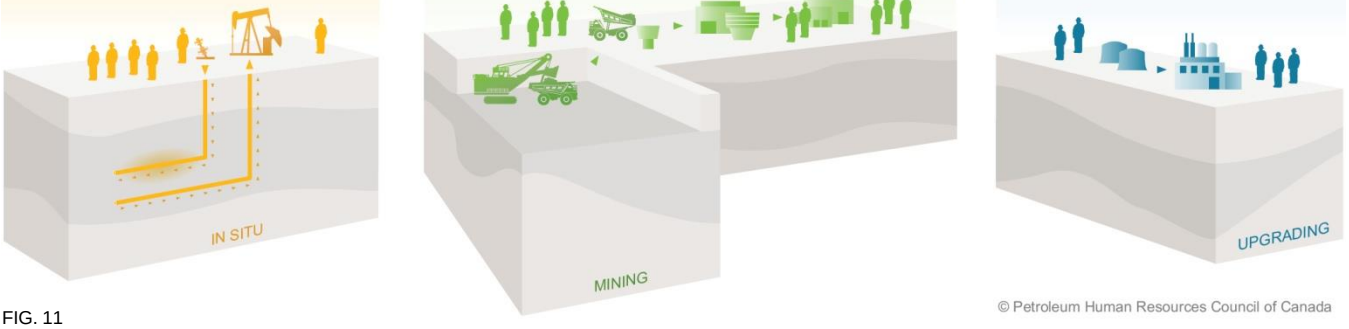

FIG. 11

CURRENT OIL SANDS WORKFORCE

In 2012, Canada's **oil sands operations directly employed 22,340 workers,**[11] an increase of 10 per cent or approximately 2,100 direct new jobs over 2011 levels. The expansion of mining operations created 935 new jobs, in situ operations created 620 new jobs and upgrading operations added 500 new jobs. Currently, mining and in situ operations each employ about 40 per cent of the oil sands total direct workforce. The other 20 per cent of the workforce are employed within upgrading operations.

OIL SANDS EMPLOYMENT IN 2012, BY OPERATIONS TYPE

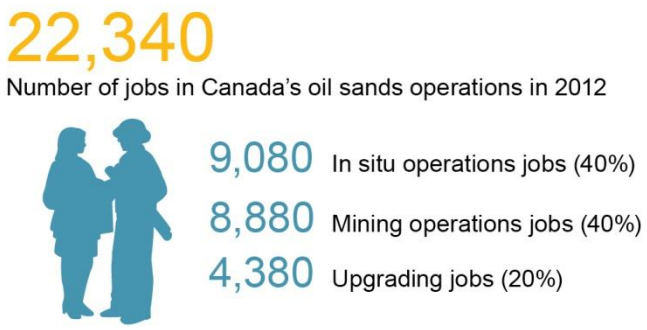

FIG. 12

TOP 10 OIL SANDS OCCUPATIONS EMPLOYED IN 2012

1	Power engineers (steam-ticketed operators)	**3,860**
2	Heavy equipment operators	**3,055**
3	Heavy-duty equipment mechanics	**985**
4	Facility operation and maintenance managers	**960**
5	Engineering managers	**855**
6	Petroleum engineers	**810**
7	Mechanical engineers	**575**
8	Primary production managers	**570**
9	Industrial electricians	**565**
10	Millwrights and machinists	**565**

FIG. 13

The top ten occupations listed in the table above comprise 60 per cent of the total oil sands direct operations workforce. The top two occupations, power engineers and heavy equipment operators, make up over 30 per cent of the current workforce.

Appendix 2 contains 2012 workforce data as well as ten year (2013-2022) employment and hiring projections for each core occupation in the oil sands operations sector overall and for each operation type.

SPOTLIGHT: EMPLOYMENT IMPACTS OF DEVELOPMENT IN ALBERTA'S OIL SANDS

The benefits of oil sands investment go well beyond growth in direct employment. There are also thousands of workers providing contract services to oil sands operators such as those in construction and supply chain sectors across Canada, including turnaround maintenance, manufacturing, trucking, rail, pipeline, refineries, air services, camp management and operations, and a variety of professional and technical services. The indirect workforce also includes workers employed by the oil and gas services sector involved in drilling and completions of SAGD wells, oil field construction and maintenance, production and transportation services.

Additional jobs are also created or 'induced' in the broader economy largely through a general increase in consumer spending by direct employees and contracted (or indirect) workers.

In summary, the investment in oil sands development and operations over the next decade is estimated to support **more than half a million jobs across Canada** (direct, indirect and induced). Although the **majority of jobs are expected to be in Alberta**, more than 20 per cent, or **112,000 will be in other Canadian provinces – such as Ontario, British Columbia, Quebec, Saskatchewan and Manitoba.**[12]

The contracted services to oil sands development and operations are critical to the overall extraction, production, manufacturing and transportation of bitumen-related products. Over the next decade, there will be approximately 380,000 jobs sustained in the direct and indirect oil sands workforce. Labour and skill shortages anywhere along the supply chain are likely to hinder sustainable growth of the sector.

KEY FINDINGS: LABOUR DEMAND OUTLOOK TO 2022

Between 2012 and 2022, direct employment in the oil sands operations sector is projected to increase by 71 per cent or approximately **16,000 new jobs.** The average annual growth rate is about 6 per cent. By the end of the projection period, employment is estimated at **38,300 workers**.

OIL SANDS EMPLOYMENT OUTLOOK TO 2022, BY OPERATIONS TYPE

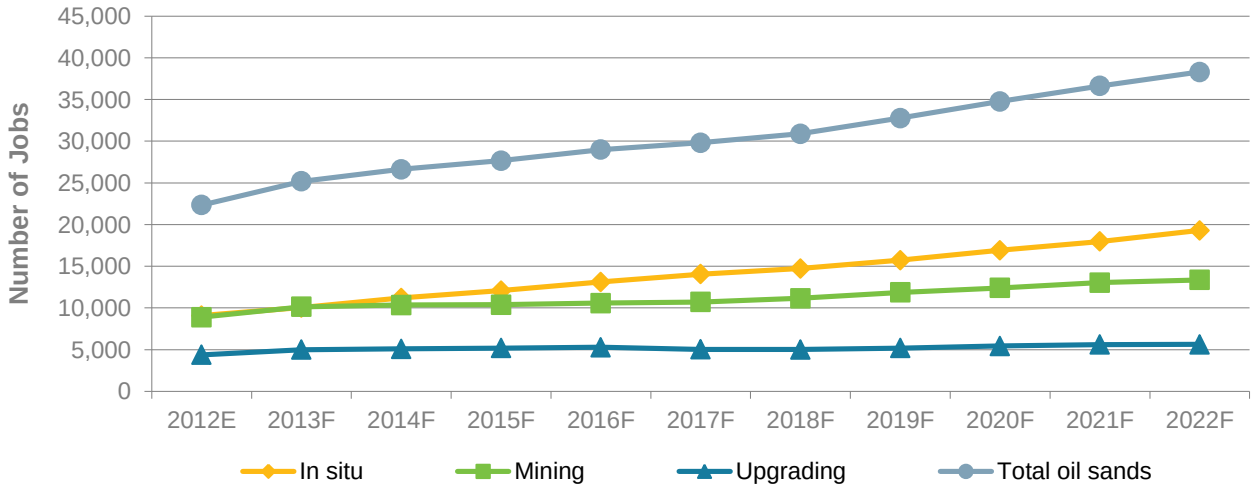

FIG. 14

Rapid Growth Expected for Mining and Upgrading Workforce in the Short-Term

In 2013, employment is expected to increase by 2,850 jobs, a 12 per cent increase over 2012 employment levels. New and expanded mining operations and expanded upgraders will create 1,270 and 615 new jobs respectively—a 14 per cent increase from 2012 employment levels for both sectors. In situ operation employment is projected to grow by 11 per cent or create 965 new jobs in 2013.

Growth of In situ Workforce to Outpace Mining and Upgrading in the Long-Term

Between 2014 and 2022 however, the growth rate of the in situ workforce significantly outpaces mining and upgrading as the majority of investment and production increases are attributed to in situ operations.

OIL SANDS MINING, IN SITU AND UPRGRADING EXPECTED JOB GROWTH

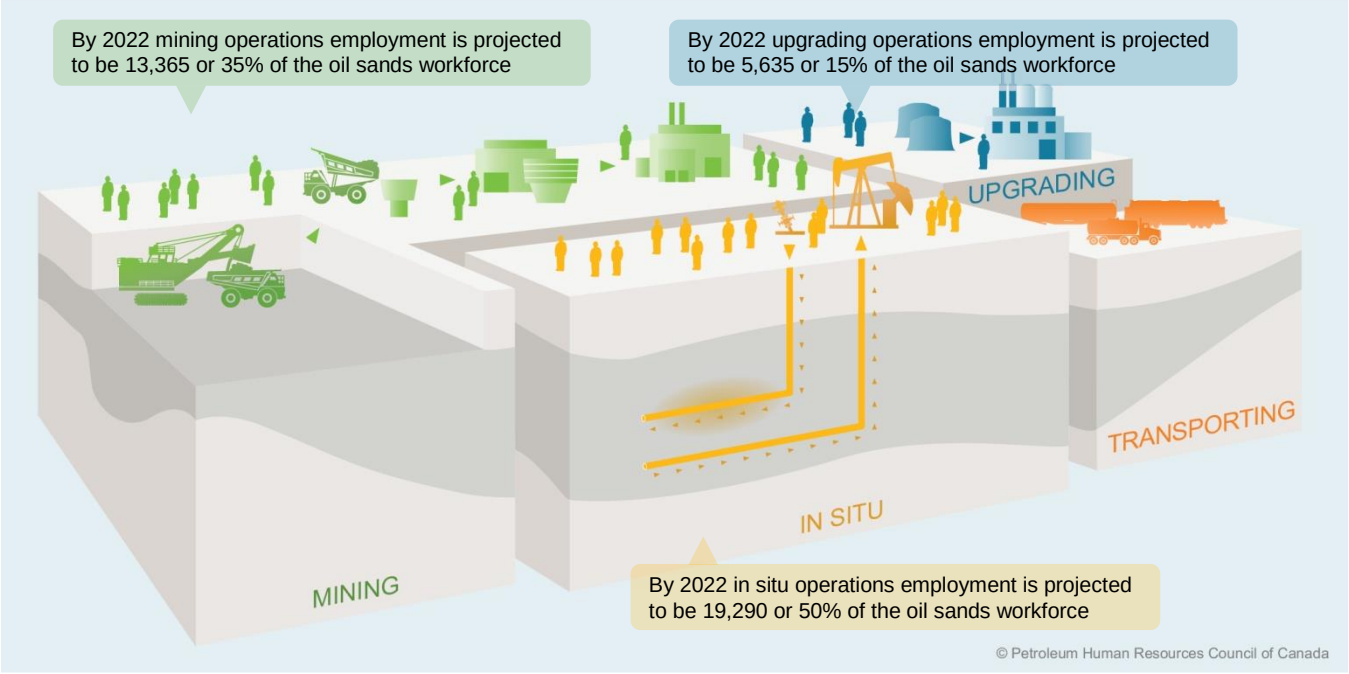

FIG. 15

OIL SANDS OCCUPATIONS WITH THE GREATEST EMPLOYMENT GROWTH

Oil sands operations are very technical and require a highly skilled workforce. Virtually all of the occupations needed to support oil sands operations require post-secondary training, and this trend will continue through the next decade.

OIL SANDS OCCUPATIONS WITH GREATEST EMPLOYMENT GROWTH TO 2022

	Total Oil Sands (15,950)	
1	Power engineers (steam-ticketed operators)	**3,025**
2	Heavy equipment operators	**1,540**
3	Petroleum engineers	**810**
4	Engineering managers	**680**
5	Facility operation and maintenance managers	**600**
6	Heavy-duty equipment mechanics	**535**
7	Primary production managers	**475**
8	Instrumentation technicians	**425**
9	Mechanical engineers	**400**
10	Millwrights and machinists	**350**

FIG. 16

QUALIFICATION REQUIREMENTS OF NEW JOBS CREATED IN OIL SANDS TO 2022 [13]

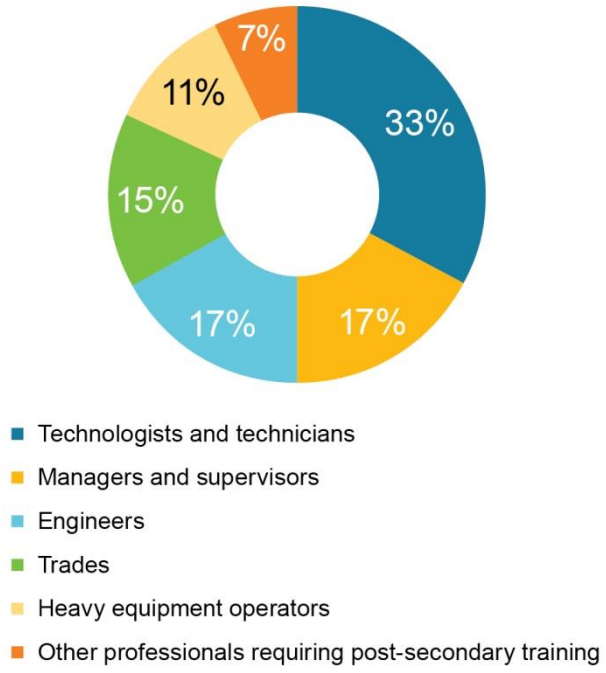

FIG. 17

OIL SANDS OCCUPATIONS WITH GREATEST EMPLOYMENT GROWTH TO 2022, TOTAL OIL SANDS AND BY OPERATION TYPE

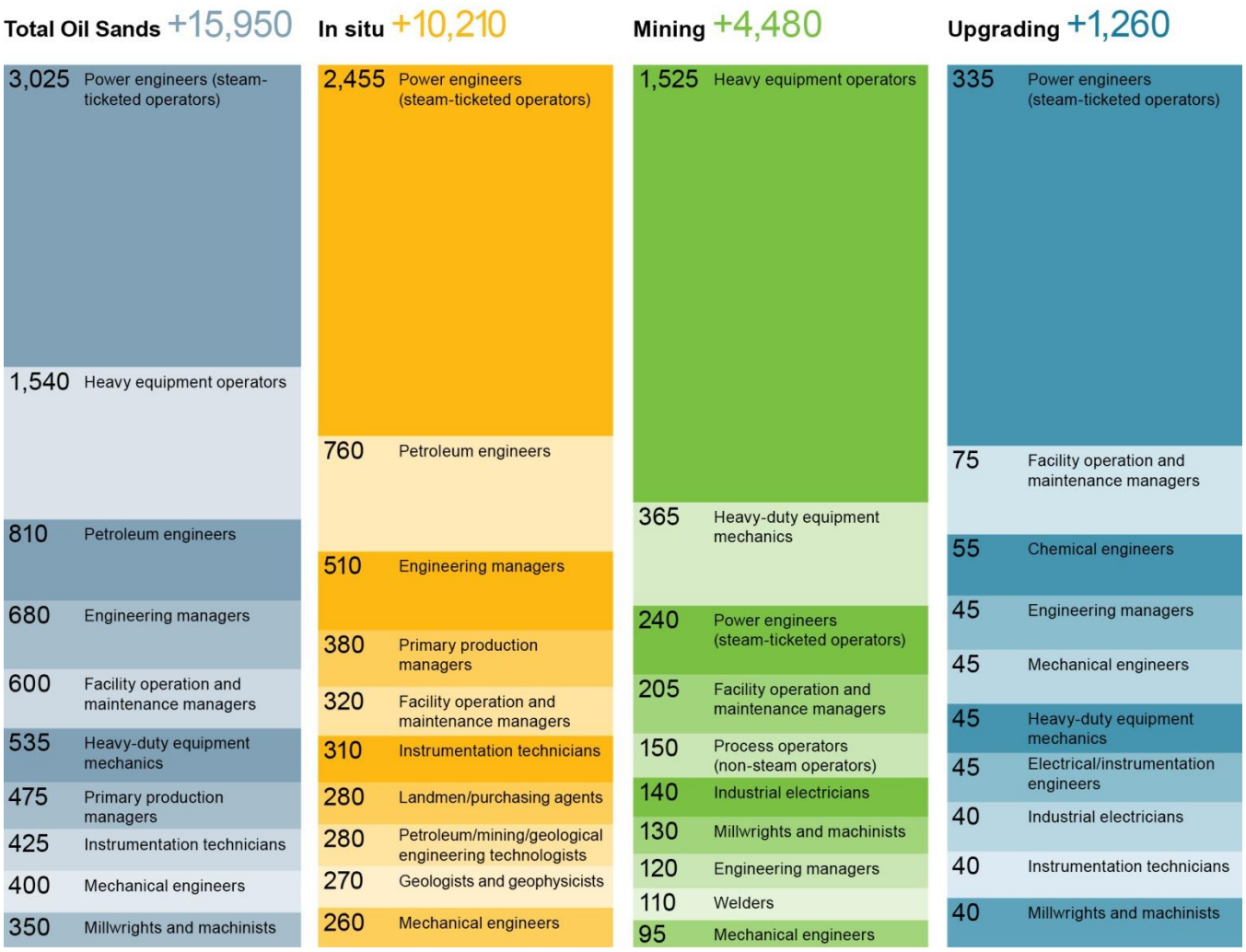

FIG. 18

AN AGING WORKFORCE DRIVES ADDITIONAL HIRING NEEDS

Close to 30 per cent of the current oil sands operations workforce will be eligible to retire during the projection period. Workforce retirements could create 6,500 additional job vacancies, and, when combined with hiring requirements due to employment growth, increases the **total number of job openings to approximately 22,500 over the next decade.** This hiring number is over 100 per cent of the current oil sands employment levels and should be regarded as a minimum hiring requirement as it only accounts for hiring due to industry expansion and age-related attrition and does not consider any hiring due to employee turnover.

The in situ workforce has the oldest demographics with 34 per cent eligible for retirement over the next decade; mining with 26 per cent and upgrading with 25 per cent. The folllowing chart summarizes hiring requirements due to industry expansion and age-related attrition for each type of oil sands operation. The chart also identifies the number of job openings to 2022 as a percentage of 2012 employment, providing insight into the magnitude of hiring required by each oil sands sector.

OIL SANDS NET HIRING REQUIREMENTS TO 2022, BY OPERATIONS TYPE

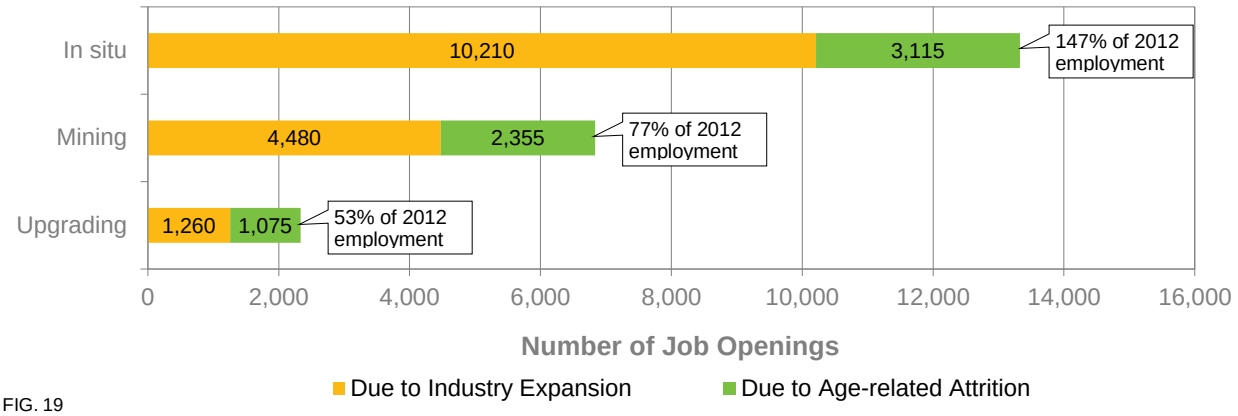

FIG. 19

COMPETITION FOR WORKERS WILL ESCALATE HIRING ACTIVITY

Strong competition for workers and employee turnover will drive additional hiring activity beyond the 22,500 net hiring requirements referenced earlier. We can expect to see increased movement of oil sands operations workers within the sector[14] as companies intensify their efforts to attract experienced talent. This is especially true for companies looking for workers to support operations start-up and commissioning. The following chart illustrates the impact of three per cent non-retirement turnover. If three per cent[15] of the oil sands workforce changes companies or leaves the industry during each year of the projection period, hiring activity will increase by approximately 9,350 positions. This would bring **total hiring requirements[16] for the sector to 31,850 over the next decade.**

OIL SANDS TOTAL HIRING OUTLOOK TO 2022

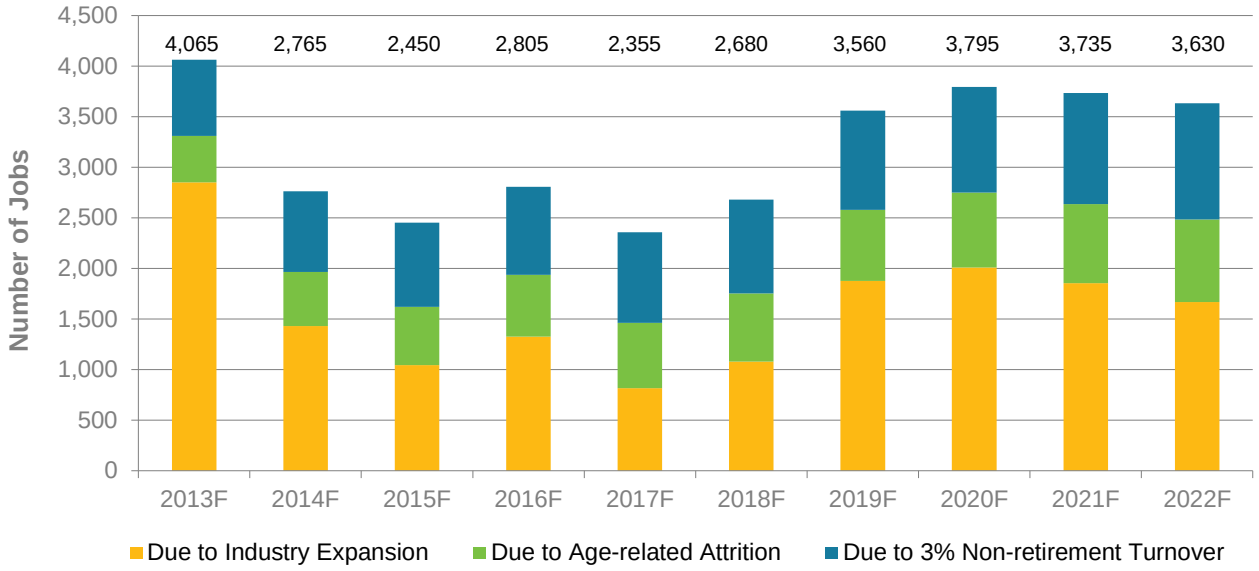

FIG. 20

Oil Sands Occupations with the Greatest Net Hiring Requirements

The sheer volume of hiring required for some occupations will create significant challenges for oil sands operators. Ten occupations account for over 55 per cent of the oil sands sector's net hiring requirements.

OCCUPATIONS WITH GREATEST NET HIRING REQUIREMENTS TO 2022, TOTAL OIL SANDS AND BY OPERATIONS TYPE

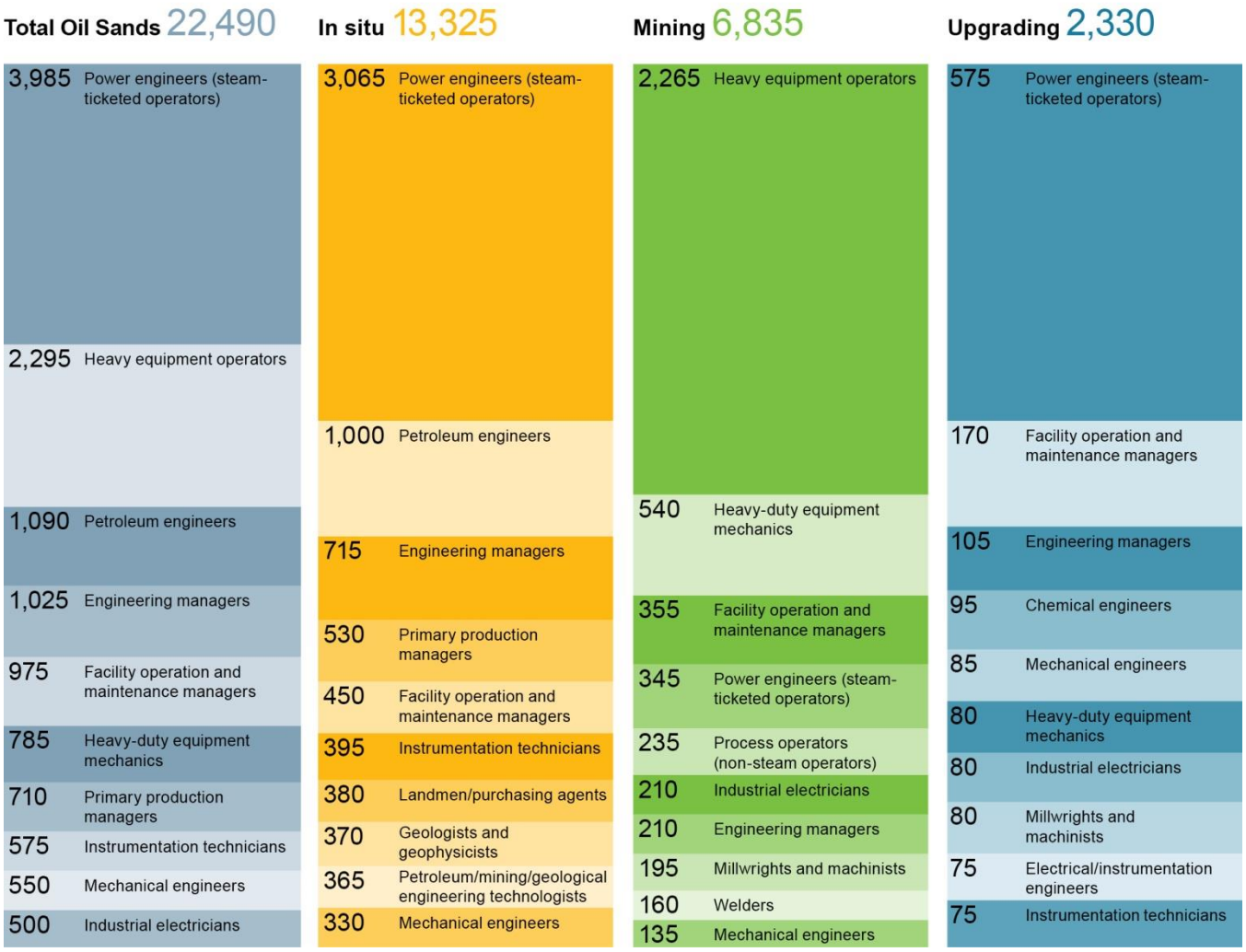

FIG. 21

Power Engineers

The greatest demand in the oil sands sector over the next decade will be for power engineers—operators who require power engineering certification or what is also known as a steam ticket. Although power engineers are hired across the sector, growth of in situ operations and, more specifically, the use of SAGD is the driver behind 77 per cent of this occupation's hiring requirements. Power engineers make up 25 per cent of the hiring requirements for in situ and upgrading operations.

There are four levels of interprovincially recognized power engineering certification. A fourth class is the entry-level ticket; a first class ticket is the highest classification. Power engineers can progress through the certifications by gaining work experience—also known as "firing time"—and writing exams at each level. Provincial regulations govern the class of ticket required to oversee and operate boilers and pressure vessels. The previous survey of oil sands operators helped determine the makeup of the sector's power engineering workforce in 2010, broken down by class/level.

MAKEUP OF POWER ENGINEERING WORKFORCE IN 2010

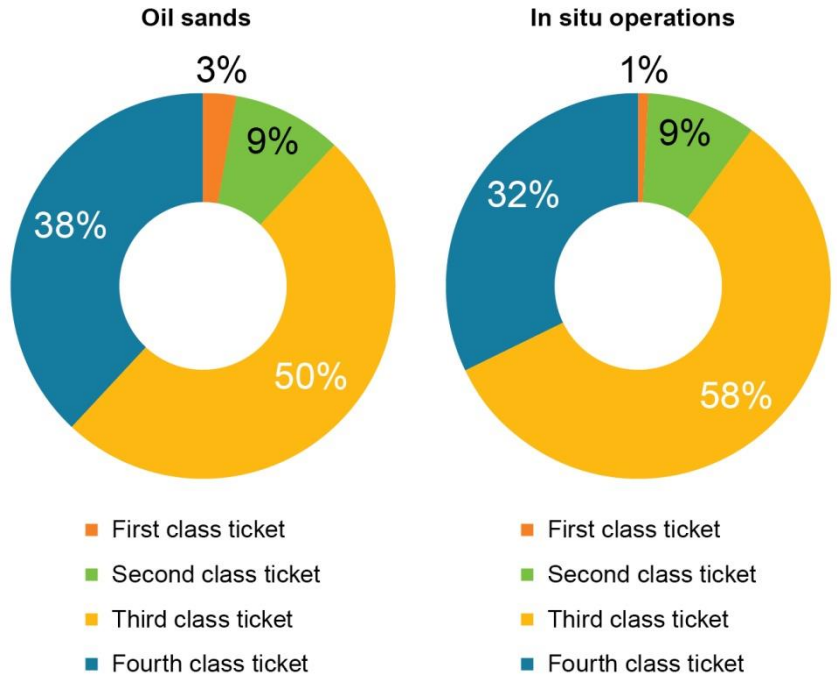

FIG. 22

Assuming oil sands operators maintain this workforce distribution over the next decade, net hiring requirements for each power engineering level have been estimated, and are summarized on the following table:

ESTIMATED POWER ENGINEER HIRING REQUIREMENTS TO 2022
(includes hiring due to industry expansion and age-related attrition)

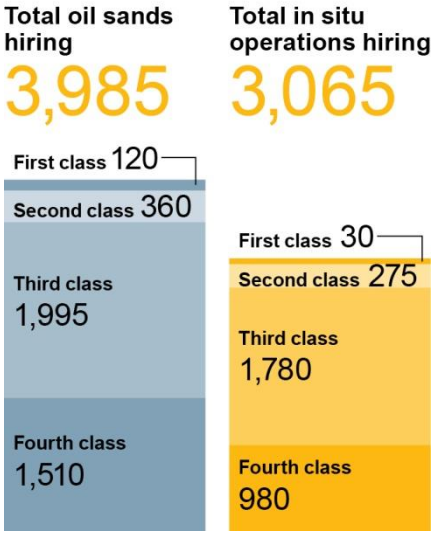

FIG. 23

"Power engineers play an important role in our oil sands operations, but the demand for power engineers is greater than what our educators can currently supply. Cenovus is proactively working with representatives from government, the education sector and industry to ensure 3rd class power engineers, the biggest supply risk, are being used where they're needed."

Stewart Adams, Manager, Operations Training, Cenovus Energy

Occupations that Support Stewardship of Environment, Communities and Employees

Industry's focus on obtaining the social license to operate and minimizing environmental impacts is driving higher-than-average growth in sustainability-related occupations. While not included in the list of core occupations, human resources professionals[17] will also be in high demand, as organizational effectiveness and recruiting, retaining and developing human capital continue to be key business concerns.

SUSTAINABILITY-RELATED OCCUPATIONS WITH ABOVE-AVERAGE EMPLOYMENT GROWTH RATES
(from 2012 employment levels)

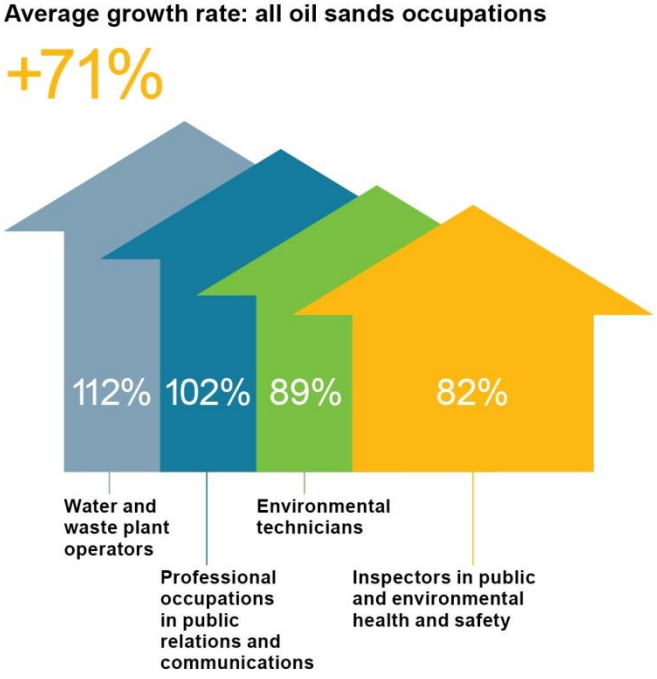

FIG. 24

Supply Chain Occupations Needed for Expansion and Production

Oil sands investment and accelerated growth are driving demand for all types of materials, products, equipment and professional and technical services. Supply chain, logistics, procurement and contract management workers are responsible for securing or coordinating required materials, equipment, products and services. Shortages within these occupations can create bottlenecks and impact expansion schedules.

SUPPLY CHAIN OCCUPATIONS WITH ABOVE-AVERAGE EMPLOYMENT GROWTH RATES
(from 2012 employment levels)

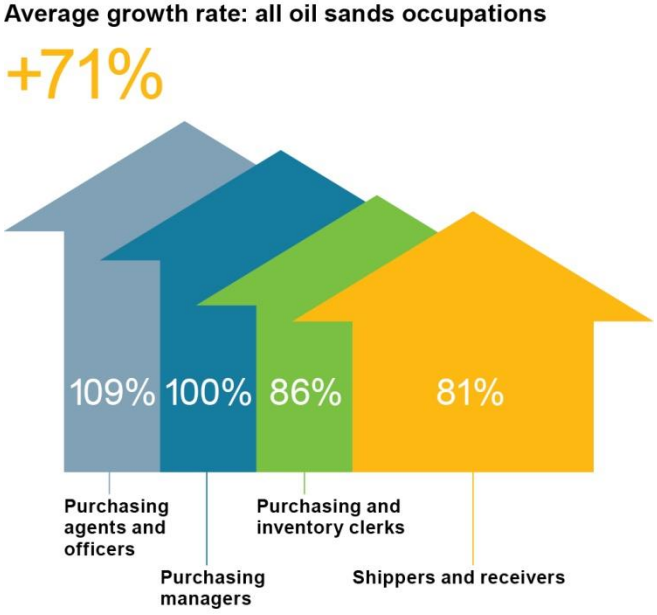

FIG. 25

Occupations Facing the Greatest Retirement Rates

As previously mentioned, close to 30 per cent of the oil sands workforce is eligible to retire over the next decade. While the loss of experienced workers will have a significant impact on oil sands across the majority of occupations, there are two groups where retirements pose significant risks to the sector:

1. **Manager/supervisor positions**. Retirements amongst managers/supervisors can result in the loss of mentoring capacity and advanced knowledge and experience levels, which will negatively impact workforce development and productivity. Examples are trades occupations that rely on an apprentice's ability to work with journeyman-certified trades to progress through the apprenticeship program. Knowledge management/transfer and succession planning can help mitigate the risks associated with retirements amongst managers/supervisors.

OCCUPATIONAL AGE-RELATED ATTRITION RATES (AS A % OF 2012 EMPLOYMENT)				
OCCUPATION	***TOTAL OIL SANDS***	***IN SITU***	***MINING***	***UPGRADING***
All occupations	**29%**	**34%**	**26%**	**25%**
Purchasing managers	50%	62%	n/a	n/a
Primary production managers	41%	45%	37%	33%
Engineering managers	41%	45%	36%	35%
Facility operation and maintenance managers	39%	46%	37%	34%
Construction managers	31%	35%	28%	21%
Supervisors, trades and heavy construction	30%	34%	29%	22%

FIG. 26

2. **Industry-specific occupations.** The challenge with the loss of experienced workers from this group is that they are typically developed within the industry and therefore, have a limited labour supply pool. It is not easy to replace workers moving out of these roles as they tend to be sourced from other industry companies rather than outside the sector.

OCCUPATIONAL AGE-RELATED ATTRITION RATES (AS A % OF 2012 EMPLOYMENT)				
OCCUPATION	***TOTAL OIL SANDS***	***IN SITU***	***MINING***	***UPGRADING***
All occupations	**29%**	**34%**	**26%**	**25%**
Geologists and geophysicists	39%	42%	35%	32%
Inspectors in public and environmental health and safety	38%	41%	31%	37%
Petroleum engineers	35%	36%	30%	27%
Petroleum/mining/geological engineering technologists	33%	35%	n/a	n/a

FIG. 27

WORKFORCE CHALLENGES DRIVE INNOVATION

Oil sands companies have played a key role in developing labour demand projections for the sector. Not only has this helped identify the sector's most pressing workforce issues, this has also been a catalyst for multi-stakeholder collaboration in developing and implementing solutions.

The following table outlines some of these innovative workforce solutions:

FIG. 28

Additional Strategies for Consideration

The oil sands sector needs to continue to develop and grow the labour supply pool in order to mitigate the risks and costs associated with labour and skill shortages. The following are additional strategies or opportunities that should be considered:

- **Managing labour costs.** There is evidence that the oil and gas industry continues to over-rely on compensation as an attraction and retention tool. In 2012, industry wages increased 3.9 per cent compared to the Canadian average of 2.9 per cent.[18] Less reliance on recruiting from within the industry may curtail rising labour costs.
- **Increasing energy literacy.** There is also a need to increase energy literacy across Canada. The lack of understanding of the industry, its career opportunities and its value to the Canadian economy continues to be a barrier to attracting talent. This opportunity should be addressed in a concerted way by industry, government and education.
- **Attracting workers beyond Western Canada.** There is opportunity for the oil sands sector to broaden its reach within Canada. There are regions across Canada where the economy continues to struggle and the labour force is looking for opportunities to secure employment in a growing industry. Most of the programs designed to increase the pool of qualified workers are implemented in Western Canada, where competition for workers is already fierce. Rotational work assignments continue to operate from Western Canadian transportation hubs and are not for a duration that attracts workers from eastern locations.
- **Recruiting internationally for some occupations.** Recent changes to federal immigration policy and programs provide an opportunity to target internationally trained workers to fill in-demand jobs. While not all oil sands jobs lend themselves to international recruitment because of the unique nature of work and/or qualifications, occupations such as mining engineers, petroleum process engineers and trades are likely to have transferable experience and qualifications.

Innovative solutions and multi-stakeholder collaboration are essential to closing the labor and skill gaps in the oil sands sector.

Conclusion

Canada's oil sands sector entered 2013 poised to lead the nation's economy by leveraging ongoing investment to accelerate project plans and expansions. However, the sector's future is not without its challenges. With sustainability as a top concern, the sector must continue to be innovative in addressing market constraints, managing costs, gaining public support and, of course, growing a skilled workforce.

Labour and skill shortages are now firmly embedded as a key business concern for companies across the oil sands sector, with good reason. The sector's rapid growth will continue to accelerate the demand for highly skilled labour. At the same time, the sector will be impacted by age-related attrition and thus risks the loss of not only knowledge and experience, but also the mentoring capacity required to develop younger workers. Competition amongst oil sands companies and with other natural resource sectors will also contribute to labour attraction, retention and cost-management challenges going forward.

On the positive side, just as industry has been working together on innovative solutions to business constraints, they have joined forces to tackle workforce issues. Companies have made progress on innovative workforce solutions by collaborating with each other and with training providers, looking beyond traditional labour pools for workers, uniting as a common voice with government and local communities, and challenging the established ways of developing Canada's labour force.

But the work is not done. Even greater levels of collaborative effort are needed for the sector to increase its pool of qualified workers, recognized as the only way to maintain the workforce levels needed for energy sustainability in Canada.

APPENDIX 1: OIL SANDS LABOUR DEMAND METHODOLOGY

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

The modelling system 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.

While not part of the modelling system, the Council also computes **hiring due to non-retirement turnover**, or the number of positions vacated due to existing oil sands workers moving between companies or to other industries. For the oil sands sector, a **three per cent non-retirement turnover rate** was used to estimate this hiring requirement and was determined through consultation with select oil sands companies.

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% of mining production
- 100% of upgrading production
- 73% 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% dedicated to oil sands operations. Both on-site and off-site workers (i.e., 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 (NOCs) 2006.[19] 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 50 occupational groups. These are listed in Appendix 2, together with the corresponding NOCs. The grouped occupations include:
  - millwrights and machinists
  - supervisors, trades and heavy construction, includes:
    - supervisors, mechanic trades
    - supervisors, electrical trades and telecommunications occupations
    - supervisors, heavy construction equipment crews including oil field construction
    - supervisors, pipefitting trades
    - supervisors, metal forming, shaping and erecting trades

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 the Canadian Association of Petroleum Producers' (CAPP) *Canadian Crude Oil and Market Outlook*[20], published in June 2012. 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.

CAPP'S OIL SANDS PRODUCTION FORECAST IN GROWTH/EXPECTED CASE (PUBLISHED JUNE 2012)

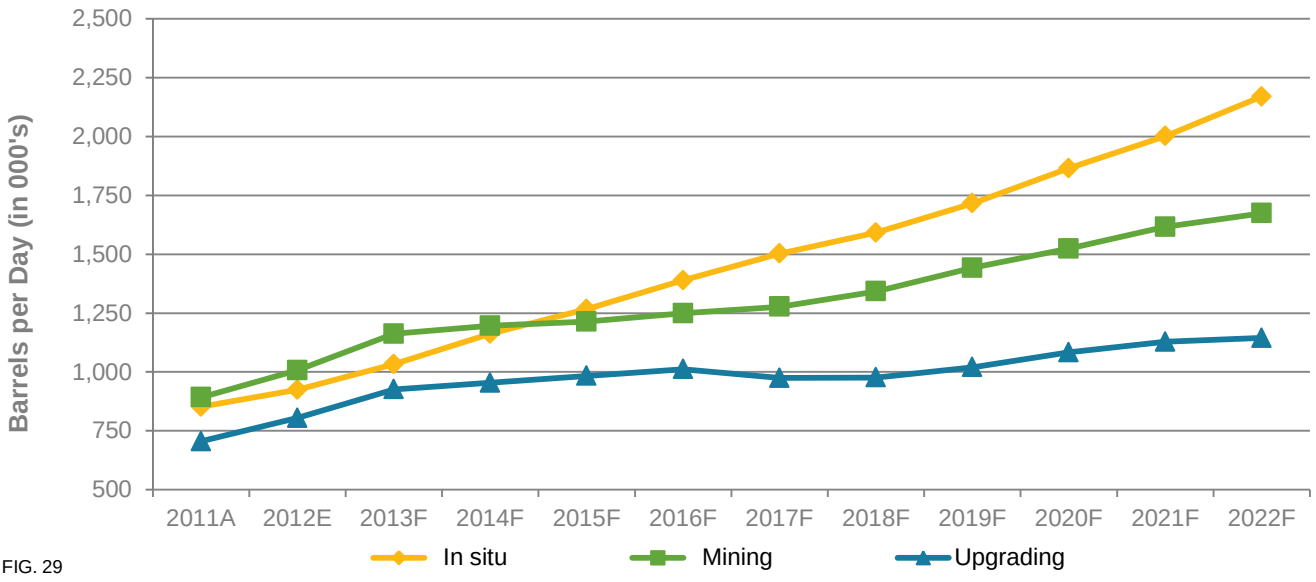

FIG. 29

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 labour modelling system also compares occupation-specific age of retirement to the age demographic of industry's core occupations to calculate age-related attrition of the oil sands workforce. The number of vacancies created due to age-related attrition is added to the number of positions created due to industry expansion to determine net hiring requirements.

Hiring Due to Non-retirement Turnover[21]

In a tight labour market, oil sands companies lose a portion of its workforce to other companies and industries. The Petroleum HR Council refers to this type of workforce turnover as "non-retirement." To quantify the number of positions and additional hiring activity the oil sands sector may need to undertake due to turnover unrelated to retirement, three per cent of total projected year-over-year employment is added to net hiring requirements.

APPENDIX 2: OIL SANDS LABOUR DEMAND PROJECTIONS 2013-2022

Occupation (NOC)	TOTAL OIL SANDS OPERATIONS LABOUR DEMAND PROJECTIONS						
	2012 Estimated Employment	Hiring due to				Net Hiring Requirements	% of 2012 Employment
		Industry Expansion	% of 2012 Employment	Age-related Attrition	% of 2012 Employment		
Oil Sands Total	**22,342**	**15,951**	**71%**	**6,541**	**29%**	**22,492**	**101%**
Automotive mechanical installers and servicers (7443)	93	53	57%	26	28%	79	85%
Automotive technicians (7231)	43	17	40%	10	23%	27	63%
Chemical engineers (2134)	458	311	68%	114	25%	425	93%
Chemical technologists and technicians (2211)	145	102	70%	38	26%	140	97%
Civil engineering technologist (2231)	154	112	73%	49	32%	161	105%
Civil engineers (2131)	65	44	68%	18	28%	62	95%
Construction estimators (2234)	57	40	70%	14	25%	54	95%
Construction managers (0711)	308	269	87%	97	31%	366	119%
Crane operators (7371)	37	20	54%	10	27%	30	81%
Drafting technologists and technicians (2253)	128	97	76%	38	30%	135	105%
Electrical power line and cable workers (7244)	5	2	40%	0	0%	2	40%
Electrical/instrumentation engineers (2133)	438	302	69%	113	26%	415	95%
Engineering managers (0211)	854	678	79%	347	41%	1,025	120%
Environmental technicians (4161)	147	131	89%	37	25%	168	114%
Facility operation and maintenance managers (0721)	959	602	63%	371	39%	973	101%
Geological engineers (2144)	52	25	48%	10	19%	35	67%
Geologists and geophysicists (2113)	357	322	90%	141	39%	463	130%
Heavy equipment operators (7421)	3,055	1,540	50%	753	25%	2,293	75%
Heavy-duty equipment mechanics (7312)	986	534	54%	252	26%	786	80%
Industrial electricians (7242)	566	343	61%	159	28%	502	89%
Industrial engineering and manufacturing technologists and technicians (2233)	38	36	95%	15	39%	51	134%
Inspectors in public and environmental health and safety (2263)	220	181	82%	84	38%	265	120%
Instrumentation engineering technologists (2241)	123	94	76%	40	33%	134	109%
Instrumentation technicians (2243)	559	423	76%	150	27%	573	103%
Land surveyors (2254)	29	16	55%	10	34%	26	90%
Landmen/purchasing agents (1225)	263	286	109%	101	38%	387	147%
Mechanical engineering technologists (2232)	189	141	75%	48	25%	189	100%

Occupation (NOC)	TOTAL OIL SANDS OPERATIONS LABOUR DEMAND PROJECTIONS						
	2012 Estimated Employment	Hiring due to				Net Hiring Requirements	% of 2012 Employment
		Industry Expansion	% of 2012 Employment	Age-related Attrition	% of 2012 Employment		
Mechanical engineers (2132)	574	399	70%	151	26%	550	96%
Metallurgy & materials engineers (2142)	37	20	54%	0	0%	20	54%
Millwrights and machinists (7311, 7231)	564	349	62%	150	27%	499	88%
Mining engineers (2143)	153	76	50%	30	20%	106	69%
Oil and gas drilling, servicing, and related labourers (8615)	4	2	50%	0	0%	2	50%
Petroleum engineers (2145)	808	812	100%	280	35%	1,092	135%
Petroleum/mining/geological engineering technologists (2212)	263	285	108%	88	33%	373	142%
Power engineers (steam-ticketed operators) (7351)	3,816	3,027	79%	957	25%	3,984	104%
Power system electricians (7243)	28	12	43%	10	36%	22	79%
Primary production managers (0811)	571	475	83%	234	41%	709	124%
Process operations (non-steam operators) (9232)	359	201	56%	98	27%	299	83%
Production clerks (1473)	4	4	100%	0	0%	4	100%
Professional occupations in public relations and communications (5124)	43	44	102%	13	30%	57	133%
Project/cost control engineers (2141)	350	293	84%	92	26%	385	110%
Purchasing and inventory clerks (1475)	69	59	86%	23	33%	82	119%
Purchasing managers (0113)	16	16	100%	8	50%	24	150%
Quality assurance analysts (2261)	188	141	75%	52	28%	193	103%
Shippers and receivers (1471)	83	67	81%	33	40%	100	120%
Steamfitters and pipefitters (7252)	144	73	51%	31	22%	104	72%
Supervisors, mining and quarrying (8221)	43	21	49%	13	30%	34	79%
Supervisors, recording, distributing and scheduling occupations (1215)	46	35	76%	10	22%	45	98%
Supervisors, trades and heavy construction (7216, 7212, 7217, 7213, 7214)	350	285	81%	106	30%	391	112%
Water and waste plant operators (9424)	108	121	112%	37	34%	158	146%
Welders (7265)	321	175	55%	76	24%	251	78%
Other occupations	3,072	2,238	73%	1,004	33%	3,242	106%

Occupation (NOC)	IN SITU LABOUR DEMAND PROJECTIONS						
	2012 Estimated Employment	Hiring due to				Net Hiring Requirements	% of 2012 Employment
		Industry Expansion	% of 2012 Employment	Age-related Attrition	% of 2012 Employment		
Total In Situ	**9,079**	**10,211**	**112%**	**3,113**	**34%**	**13,324**	**147%**
Automotive mechanical installers and servicers (7443)	18	20	111%	4	22%	24	133%
Automotive technicians (7231)	5	6	120%	0	0%	6	120%
Chemical engineers (2134)	192	217	113%	55	29%	272	142%
Chemical technologists and technicians (2211)	61	69	113%	18	30%	87	143%
Civil engineering technologist (2231)	66	75	114%	24	36%	99	150%
Civil engineers (2131)	26	28	108%	9	35%	37	142%
Construction estimators (2234)	24	27	113%	7	29%	34	142%
Construction managers (0711)	199	224	113%	70	35%	294	148%
Crane operators (7371)	6	6	100%	0	0%	6	100%
Drafting technologists and technicians (2253)	60	68	113%	18	30%	86	143%
Electrical power line and cable workers (7244)	0	0	n/a	0	n/a	0	n/a
Electrical/instrumentation engineers (2133)	184	206	112%	55	30%	261	142%
Engineering managers (0211)	453	510	113%	204	45%	714	158%
Environmental technicians (4161)	97	109	112%	27	28%	136	140%
Facility operation and maintenance managers (0721)	283	319	113%	130	46%	449	159%
Geological engineers (2144)	2	1	50%	0	0%	1	50%
Geologists and geophysicists (2113)	237	268	113%	100	42%	368	155%
Heavy equipment operators (7421)	8	10	125%	0	0%	10	125%
Heavy-duty equipment mechanics (7312)	114	127	111%	36	32%	163	143%
Industrial electricians (7242)	146	163	112%	48	33%	211	145%
Industrial engineering and manufacturing technologists and technicians (2233)	28	31	111%	15	54%	46	164%
Inspectors in public and environmental health and safety (2263)	130	147	113%	53	41%	200	154%
Instrumentation engineering technologists (2241)	62	69	111%	20	32%	89	144%
Instrumentation technicians (2243)	277	311	112%	84	30%	395	143%
Land surveyors (2254)	5	5	100%	0	0%	5	100%
Landmen/purchasing agents (1225)	248	279	113%	101	41%	380	153%
Mechanical engineering technologists (2232)	87	98	113%	26	30%	124	143%
Mechanical engineers (2132)	231	260	113%	70	30%	330	143%
Metallurgy & materials engineers (2142)	9	9	100%	0	0%	9	100%
Millwrights and machinists (7311, 7231)	158	177	112%	48	30%	225	142%
Mining engineers (2143)	3	3	100%	0	0%	3	100%
Oil and gas drilling, servicing, and related labourers (8615)	1	1	100%	0	0%	1	100%

Occupation (NOC)	IN SITU LABOUR DEMAND PROJECTIONS						
	2012 Estimated Employment	Hiring due to				Net Hiring Requirements	% of 2012 Employment
		Industry Expansion	% of 2012 Employment	Age-related Attrition	% of 2012 Employment		
Petroleum engineers (2145)	675	760	113%	242	36%	1,002	148%
Petroleum/mining/geological engineering technologists (2212)	248	278	112%	88	35%	366	148%
Power engineers (steam-ticketed operators) (7351)	2,184	2,456	112%	611	28%	3,067	140%
Power system electricians (7243)	1	2	200%	0	0%	2	200%
Primary production managers (0811)	336	378	113%	151	45%	529	157%
Process operators (non-steam operators) (9232)	40	44	110%	14	35%	58	145%
Production clerks (1473)	1	2	200%	0	0%	2	200%
Professional occupations in public relations and communications (5124)	36	40	111%	13	36%	53	147%
Project/cost control engineers (2141)	208	234	113%	62	30%	296	142%
Purchasing and inventory clerks (1475)	41	47	115%	16	39%	63	154%
Purchasing managers (0113)	13	15	115%	8	62%	23	177%
Quality assurance analysts (2261)	91	103	113%	30	33%	133	146%
Shippers and receivers (1471)	45	51	113%	20	44%	71	158%
Steamfitters and pipefitters (7252)	21	24	114%	7	33%	31	148%
Supervisors, mining and quarrying (8221)	0	0	n/a	0	n/a	0	n/a
Supervisors, recording, distributing and scheduling occupations (1215)	25	28	112%	10	40%	38	152%
Supervisors, trades and heavy construction (7216, 7212, 7217, 7213, 7214)	194	219	113%	65	34%	284	146%
Water and waste plant operators (9424)	106	120	113%	37	35%	157	148%
Welders (7265)	43	48	112%	13	30%	61	142%
Other occupations	1,351	1,519	112%	504	37%	2,023	150%

Occupation (NOC)	MINING LABOUR DEMAND PROJECTIONS						
	2012 Estimated Employment	Hiring due to				Net Hiring Requirements	% of 2012 Employment
		Industry Expansion	% of 2012 Employment	Age-related Attrition	% of 2012 Employment		
Total Mining	**8,884**	**4,482**	**50%**	**2,354**	**26%**	**6,836**	**77%**
Automotive mechanical installers and servicers (7443)	51	26	51%	14	27%	40	78%
Automotive technicians (7231)	7	3	43%	0	0%	3	43%
Chemical engineers (2134)	77	39	51%	18	23%	57	74%
Chemical technologists and technicians (2211)	42	21	50%	10	24%	31	74%
Civil engineering technologist (2231)	57	28	49%	15	26%	43	75%
Civil engineers (2131)	24	12	50%	9	38%	21	88%
Construction estimators (2234)	21	10	48%	7	33%	17	81%
Construction managers (0711)	61	31	51%	17	28%	48	79%
Crane operators (7371)	24	12	50%	10	42%	22	92%
Drafting technologists and technicians (2253)	41	21	51%	10	24%	31	76%
Electrical power line and cable workers (7244)	0	0	n/a	0	n/a	0	n/a
Electrical/instrumentation engineers (2133)	105	53	50%	25	24%	78	74%
Engineering managers (0211)	239	121	51%	87	36%	208	87%
Environmental technicians (4161)	36	18	50%	10	28%	28	78%
Facility operation and maintenance managers (0721)	408	206	50%	149	37%	355	87%
Geological engineers (2144)	48	24	50%	10	21%	34	71%
Geologists and geophysicists (2113)	89	45	51%	31	35%	76	85%
Heavy equipment operators (7421)	3,021	1,523	50%	743	25%	2,266	75%
Heavy-duty equipment mechanics (7312)	719	363	50%	179	25%	542	75%
Industrial electricians (7242)	273	138	51%	72	26%	210	77%
Industrial engineering and manufacturing technologists and technicians (2233)	10	5	50%	0	0%	5	50%
Inspectors in public and environmental health and safety (2263)	39	20	51%	12	31%	32	82%
Instrumentation engineering technologists (2241)	34	17	50%	10	29%	27	79%
Instrumentation technicians (2243)	139	70	50%	34	24%	104	75%
Land surveyors (2254)	19	10	53%	10	53%	20	105%
Landmen/purchasing agents (1225)	13	6	46%	0	0%	6	46%
Mechanical engineering technologists (2232)	62	32	52%	12	19%	44	71%
Mechanical engineers (2132)	184	93	51%	44	24%	137	74%
Metallurgy & materials engineers (2142)	14	7	50%	0	0%	7	50%
Millwrights and machinists (7311, 7231)	257	130	51%	64	25%	194	75%
Mining engineers (2143)	132	67	51%	30	23%	97	73%
Oil and gas drilling, servicing, and related labourers (8615)	2	1	50%	0	0%	1	50%

Occupation (NOC)	MINING LABOUR DEMAND PROJECTIONS						
	2012 Estimated Employment	Hiring due to				Net Hiring Requirements	% of 2012 Employment
		Industry Expansion	% of 2012 Employment	Age-related Attrition	% of 2012 Employment		
Petroleum engineers (2145)	60	31	52%	18	30%	49	82%
Petroleum/mining/geological engineering technologists (2212)	12	6	50%	0	0%	6	50%
Power engineers (steam-ticketed operators) (7351)	471	238	51%	105	22%	343	73%
Power system electricians (7243)	11	6	55%	0	0%	6	55%
Primary production managers (0811)	134	67	50%	50	37%	117	87%
Process operators (non-steam operators) (9232)	302	152	50%	84	28%	236	78%
Production clerks (1473)	2	1	50%	0	0%	1	50%
Professional occupations in public relations and communications (5124)	4	3	75%	0	0%	3	75%
Project/cost control engineers (2141)	85	43	51%	20	24%	63	74%
Purchasing and inventory clerks (1475)	17	9	53%	7	41%	16	94%
Purchasing managers (0113)	2	1	50%	0	0%	1	50%
Quality assurance analysts (2261)	47	24	51%	12	26%	36	77%
Shippers and receivers (1471)	23	12	52%	10	43%	22	96%
Steamfitters and pipefitters (7252)	66	33	50%	14	21%	47	71%
Supervisors, mining and quarrying (8221)	43	21	49%	13	30%	34	79%
Supervisors, recording, distributing and scheduling occupations (1215)	8	4	50%	0	0%	4	50%
Supervisors, trades and heavy construction (7216, 7212, 7217, 7213, 7214)	96	48	50%	28	29%	76	79%
Water and waste plant operators (9424)	0	0	n/a	0	n/a	0	n/a
Welders (7265)	216	109	50%	52	24%	161	75%
Other occupations	1,037	522	50%	309	30%	831	80%

Occupation (NOC)	UPGRADING LABOUR DEMAND PROJECTIONS						
	2012 Estimated Employment	Hiring due to				Net Hiring Requirements	% of 2012 Employment
		Industry Expansion	% of 2012 Employment	Age-related Attrition	% of 2012 Employment		
Total Upgrading	**4,379**	**1,258**	**29%**	**1,074**	**25%**	**2,332**	**53%**
Automotive mechanical installers and servicers (7443)	24	7	29%	8	33%	15	63%
Automotive technicians (7231)	31	8	26%	10	32%	18	58%
Chemical engineers (2134)	189	55	29%	41	22%	96	51%
Chemical technologists and technicians (2211)	42	12	29%	10	24%	22	52%
Civil engineering technologist (2231)	31	9	29%	10	32%	19	61%
Civil engineers (2131)	15	4	27%	0	0%	4	27%
Construction estimators (2234)	12	3	25%	0	0%	3	25%
Construction managers (0711)	48	14	29%	10	21%	24	50%
Crane operators (7371)	7	2	29%	0	0%	2	29%
Drafting technologists and technicians (2253)	27	8	30%	10	37%	18	67%
Electrical power line and cable workers (7244)	5	2	40%	0	0%	2	40%
Electrical/instrumentation engineers (2133)	149	43	29%	33	22%	76	51%
Engineering managers (0211)	162	47	29%	56	35%	103	64%
Environmental technicians (4161)	14	4	29%	0	0%	4	29%
Facility operation and maintenance managers (0721)	268	77	29%	92	34%	169	63%
Geological engineers (2144)	2	0	0%	0	0%	0	0%
Geologists and geophysicists (2113)	31	9	29%	10	32%	19	61%
Heavy equipment operators (7421)	26	7	27%	10	38%	17	65%
Heavy-duty equipment mechanics (7312)	153	44	29%	37	24%	81	53%
Industrial electricians (7242)	147	42	29%	39	27%	81	55%
Industrial engineering and manufacturing technologists and technicians (2233)	0	0	n/a	0	n/a	0	n/a
Inspectors in public and environmental health and safety (2263)	51	14	27%	19	37%	33	65%
Instrumentation engineering technologists (2241)	27	8	30%	10	37%	18	67%
Instrumentation technicians (2243)	143	42	29%	32	22%	74	52%
Land surveyors (2254)	5	1	20%	0	0%	1	20%
Landmen/purchasing agents (1225)	2	1	50%	0	0%	1	50%
Mechanical engineering technologists (2232)	40	11	28%	10	25%	21	53%
Mechanical engineers (2132)	159	46	29%	37	23%	83	52%
Metallurgy & materials engineers (2142)	14	4	29%	0	0%	4	29%
Millwrights and machinists (7311, 7231)	149	42	28%	38	26%	80	54%
Mining engineers (2143)	18	6	33%	0	0%	6	33%
Oil and gas drilling, servicing, and related labourers (8615)	1	0	0%	0	0%	0	0%

Occupation (NOC)	UPGRADING LABOUR DEMAND PROJECTIONS						
	2012 Estimated Employment	Hiring due to				Net Hiring Requirements	% of 2012 Employment
		Industry Expansion	% of 2012 Employment	Age-related Attrition	% of 2012 Employment		
Petroleum engineers (2145)	73	21	29%	20	27%	41	56%
Petroleum/mining/geological engineering technologists (2212)	3	1	33%	0	0%	1	33%
Power engineers (steam-ticketed operators) (7351)	1,161	333	29%	241	21%	574	49%
Power system electricians (7243)	16	4	25%	10	63%	14	88%
Primary production managers (0811)	101	30	30%	33	33%	63	62%
Process operators (non-steam operators) (9232)	17	5	29%	0	0%	5	29%
Production clerks (1473)	1	1	100%	0	0%	1	100%
Professional occupations in public relations and communications (5124)	3	1	33%	0	0%	1	33%
Project/cost control engineers (2141)	57	16	28%	10	18%	26	46%
Purchasing and inventory clerks (1475)	11	3	27%	0	0%	3	27%
Purchasing managers (0113)	1	0	0%	0	0%	0	0%
Quality assurance analysts (2261)	50	14	28%	10	20%	24	48%
Shippers and receivers (1471)	15	4	27%	3	20%	7	47%
Steamfitters and pipefitters (7252)	57	16	28%	10	18%	26	46%
Supervisors, mining and quarrying (8221)	0	0	n/a	0	n/a	0	n/a
Supervisors, recording, distributing and scheduling occupations (1215)	13	3	23%	0	0%	3	23%
Supervisors, trades and heavy construction (7216, 7212, 7217, 7213, 7214)	60	18	30%	13	22%	31	52%
Water and waste plant operators (9424)	2	1	50%	0	0%	1	50%
Welders (7265)	62	18	29%	11	18%	29	47%
Other occupations	684	197	29%	191	28%	388	57%

APPENDIX 3: GLOSSARY

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

Attraction
Activities with the goal of attracting workers to a company, organization or industry.

Balanced labour market
Point at which the supply of workers meets labour market demand.

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.

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

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

Exploration and production (E&P) sector
Activity for conventional and unconventional oil and gas reserves, including oil sands.

Hydraulic fracturing
Process involving pumping fluid, sand and chemicals at a high pressure down a well hole to open a previously opened oil and gas deposit vein to access more oil and gas.

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

Key job family
A series of related jobs distinguished by levels of knowledge, skills, abilities and other factors. e.g., field workers, operators, trades, technologists and technicians.

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

Labour shortage
When there is not enough labour supply to meet labour demand.

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

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

Labour surplus
When there is more labour supply available than is required to meet labour demand.

Lagging indicator
An indicator that a change has already occurred. In this report, a production increase in an indicator that employment increase has already occurred.

Load-levelling
Rearranging of demand for drilling and services equipment and contractors so that it is more evenly distributed throughout the year. It is considered a key strategy for addressing the seasonality associated with drilling and services work.

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.

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
Sector of the petroleum industry involved in the extraction and upgrading of bitumen.

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. There are seven sectors in Canada's petroleum industry.

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

Steam-assisted gravity drainage (SAGD)
In situ method of producing heavy oil 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.

Thermal oil recovery
The use of heat energy to enhance and facilitate the recovery of oil.

Total hiring requirements
Sum of positions created due to industry expansion, replacement due to age-related attrition and replacement due to non-retirement turnover.

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

Unconventional
Process of recovering petroleum using techniques other than the conventional method, e.g., oil shale extraction.

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.

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

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

ENDNOTES

[1] 2012 employment numbers are estimated using the Petroleum HR Council's oil sands operations labour demand model. See Appendix 1 for overview of the model and methodology.

[2] For the purposes of this report, hiring due to industry expansion plus hiring due to age-related attrition equates to net hiring requirements.

[3] To quantify the number of positions and additional hiring activity the oil sands sector may need to undertake due to non-retirement turnover, three per cent of projected employment was used as an arbitrary assumption. This assumption was validated with oil sands companies and has been deemed to be reasonable for the sector.

[4] Hay Group. September 2012.

[5] Horizontal drilling and hydraulic fracturing are two technologies that helped unlock previously inaccessible reserves of shale gas.

[6] It should be noted that there may be additional Calgary-based employees with a portion of their work supporting oil sands.These employees are most likely employed within the larger integrated exploration and production (E&P) companies and their duties are shared across oil sands and the conventional sector. These workers have been counted under the Petroleum HR Council's employment numbers for the conventional E&P sector.

[7] Bitumen and heavy oil is distinguished by its API gravity. API gravity is a scale developed by the American Petroleum Institute for measuring the density or gravity of crude oil. The higher the API gravity number, the lighter the oil. Bitumen is a solid or semi-solid petroleum that cannot be pumped without being heated or diluted and has an API gravity of less than 10°. Heavy oil is often found in close proximity to bitumen also often requires heat or dilution to flow to a well or through a pipeline but is does have some flow. Heavy oil has an API gravity of less than 22.3°.

[8] Source: Canadian Association of Petroleum Producers (CAPP)

[9] Latin for "in place."

[10] 2012 employment numbers are estimated using the Petroleum HR Council's oil sands operations labour demand model. See Appendix 1 for overview of the model and methodology.

[11] This employment impact was estimated using Statistics Canada's input-output model which is based on industry I-O tables for 2008.

Oil sands production output and expenditures from 2012 to 2022 provided by CAPP and FirstEnergy Capital Corp. respectively were used as basis or inputs into the model.

[12] Chart illustrates qualification requirements for the 56 NOCs included in the oil sands labour demand model, focusing only on each occupation's employment growth (by number of new jobs). The "other occupations" are excluded from this chart, as this group is comprised of occupations from various job families.

[13] Process operators refer to plant operators that do not require power engineering certification/steam ticket. Process operators typically require a technical certificate/diploma.

[14] Movement of workers from one company to another is called "churn."

[15] To quantify the number of positions and additional hiring activity the oil sands sector may need to undertake due to non-retirement, three per cent of projected employment was used as an arbitrary assumption. This assumption was validated with oil sands companies and has been deemed to be reasonable for the sector.

[16] For the purposes of this report, hiring due to industry expansion + hiring due to age-related attrition + hiring due to three per cent turnover = total hiring requirements.

[17] Human resources professionals fall under the "Other Occupations" category.

[18] Hay Group. September 2012.

[19] The National Occupational Classifications is the nationally accepted reference for occupations in Canada. www5.hrsdc.gc.ca/noc/english/noc/2006/AboutNOC.aspx

[20] http://www.capp.ca/forecast/Pages/default.aspx

[21] Three per cent employee turnover to other companies and/or industries is an arbitrary assumption. The Mining Industry Human Resources Sector Council uses two per cent non-retirement separation rate, based on input from industry in its labour market information. The Petroleum HR Council validated with sector companies that three per cent was a reasonable assumption.

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