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ENGINEERING LABOUR MARKET in Canada

Projections to 2025

JUNE 2015

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Prepared by:

C4SE

MESSAGE FROM THE CHIEF EXECUTIVE OFFICER

Dear colleagues:

Engineers Canada is pleased to publish its *Engineering Labour Market in Canada: Projections to 2025*. This report includes province-level projections of supply and demand for engineers and serves to highlight the continued importance of engineers to the Canadian economy.

There is a large and growing need to replace retiring engineers. This is particularly relevant for civil, mechanical, electrical/electronic and computer engineers. It is a theme that will be important for the decade covered in this report. Moreover, inter-provincial mobility, inclusion of diverse engineers and immigration will be paramount in filling the positions left by retiring engineers.

This report also highlights the critical role of Canadian universities in training tomorrow's engineers. Universities are granting an increasing number of engineering degrees to Canadian and international students, creating new entrants to meet growing supply requirements.

Engineers Canada stresses the importance inter-provincial migration as economic activity shifts to western Canada, which will generate strong demand for engineers. The introduction of internationally educated engineers will be of even greater importance as economic growth and retirement creates tight labour markets in various engineering fields across Canada. Federal government policies, such as the Express Entry program, will most likely help to streamline international migration of engineers to meet future workforce requirements.

Altogether, this report highlights a bright future for engineering in Canada.

Sincerely,

Kim Allen, FEC, P.Eng.
Chief Executive Officer

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EXECUTIVE SUMMARY

The 2015 Engineers Canada Labour Market Study provides supply and demand projections for 14 engineering occupations. The report highlights a large and growing need to replace retiring engineers as they exit the workforce. This is particularly relevant for civil, mechanical, electrical and electronic engineers as well as computer engineers. Replacement demand for engineers is an important theme that will be relevant for the next decade as the baby boom generation retires.

Canadian universities are granting an increasing number of engineering degrees to Canadian and international students and creating new entrants to these occupations. Ontario and Quebec universities are granting many of these degrees. However, economic activity is shifting to western Canada and shifting the demand for engineers in that direction. Engineers Canada would like to highlight the growing importance of inter-provincial migration for engineers. In addition, federal government immigration policy such as the new Express Entry program is important to help streamline international migration of engineers to meet the country's future workforce requirements.

A summary of the results of the study by category of engineer are provided next.

Civil Engineers

The forecast for civil engineers is for an average of 2,500 job openings annually over the next five years. Growth in industries that employ civil engineers will generate about 1,000 of these openings each year. Another 1,500 of these job openings will be related to the replacement of retiring workers given the high average age of civil engineers (as high as 50 years old in British Columbia). Total job openings for civil engineers will taper off during the last five years of the forecast (2020-2025) to about 1,800 annually. This is primarily because industry demand for civil engineers is diminished.

Canadian universities are granting over 2,700 civil engineering degrees each year. It is estimated that there will be about 1,300 new entrants to the occupation annually over the five year period. It is expected that there will be some mobility between provinces. Specifically, civil engineers will leave Manitoba, Ontario and Quebec to fill job openings in British Columbia and Alberta. Weighted labour market tightness ranking shows some persistent tightness in both British Columbia and Manitoba over the next few years. International in-migration requirements for civil engineers over the next five years will be very high at over 800 annually.

Mechanical Engineers

There will be about 2,100 job openings for mechanical engineers annually over the next five years. The economic forecast generates expansion demand[1] for mechanical engineers that is expected to average about 825 job openings each year – only 40 percent of total openings. Replacement demand for mechanical engineers will contribute 1,270 of these job openings annually over the 5 year period. The average annual number of job openings will taper off sharply to 1,400 during the latter five years of the forecast primarily due to diminished expansion demand from industry.

Canadian universities are granting over 3,000 mechanical engineering degrees annually. It is estimated that there will be about 1,200 new entrants to the occupation over the next five years and net in-migration[2] will have to average about 680 annually to meet supply requirements over that period. The expectation is that international in-migration will be high – averaging about 620 per year. During the latter 5 year period the pressures on international in-migration will be reduced sharply to just 175 annually.

1 See Appendix A for definition.
2 See Appendix A for definition.

Electrical and Electronics Engineers

It is expected that there will be about 1,800 job openings annually for electrical and electronic engineers over the next five years – nearly 1,200 of these openings per year will be due to retirements from the workforce. Total job openings will taper off to about 1,350 per year during the latter 5 year period as demand from industry falls off. Replacement demand will continue to average 1,200 annually and will become relatively more important during the latter 5 year period.

Canadian universities grant over 2,000 degrees to electrical and electronic engineers annually. This would appear to be adequate to meet supply requirements however it is estimated that new entrants to the occupation will average about 1,100 annually over the five years. Net in-migration will have to average about 640 annually to meet supply requirements as inter-occupation mobility will be limited. It is expected that international in-migration for electrical and electronic engineers will provide the majority of these workers - about 590 per year. During the latter 5 year period the pressures on international in-migration will be reduced to about 420 annually.

Chemical Engineers

Canadian universities grant about 1,300 chemical engineering degrees each year which should generate a strong flow of new entrants into the chemical engineering occupation. Job openings for chemical engineers will average about 400 annually over the next five years. The projection is for net in-migration to average about 95 annually over that period to meet total supply requirements. The international in-migration component is limited for this occupation – only about 90 annually over the period and a reduction to about 25 annually during the latter 5 years.

Industrial and Manufacturing Engineers

Job openings for industrial and manufacturing engineers will average just less than 600 per year over the next five years. Nearly 70 per cent of these openings will be driven by replacement demand. Canadian universities grant about 360 degrees in industrial and manufacturing engineering, annually. It is expected that the flow of new entrants to average about 400 per year with international in-migration requirements of about 140 per year.

Metallurgical and Materials Engineers

There will be a small number of jobs openings for metallurgical and materials engineers over the next five years – about 100 annually. Ontario has the highest concentration of the occupation and is expected to produce about 70 per cent of these openings. Canadian universities grant over 200 degrees in metallurgical and materials engineering per year and the expectation is that new entrants will fill about half of the jobs openings. There will be very little need for international in-migration to meet total supply requirements.

Mining Engineers

Job openings for mining engineers will average about 175 annually over the next five years. The university system grants just over 200 degrees to mining engineers annually and it is expected that the flow of new entrants to the occupation will average about 90 per year. The average wage paid to mining engineers is very high and may result in more new entrants than expected. There will be recurring periods of relatively tight labour markets in British Columbia, Ontario and New Brunswick reflecting a number of major mining projects that are scheduled for construction. Net in-migration requirements are estimated to be about 70 annually. The international in-migration requirement for mining engineers averages 66 annually.

Geological Engineers

There will be about 135 job openings per year for geological engineers over the next five years. It is anticipated that about 70 percent of these openings will be related to retirements from the occupation. Openings are likely to taper off to 85 annually over the latter five years primarily due to diminished expansion demand from industry.

Canadian universities grant about 165 degrees to geological engineers annually. It is estimated that new entrants will generate about half of total supply requirements but it could be more given the relatively high average wage paid to geological engineers. Net in-migration will have to average about 55 annually and all of this will come from international in-migration. In the near term there will be a period of persistent labour market tightness in British Columbia and Manitoba from major projects that will put pressure on the demand for these workers.

Petroleum Engineers

Alberta's conventional oil industry is the largest employer of petroleum engineers in Canada. Job openings over the next 5 years will average only about 60 per year. The flow of new entrants will exceed supply requirements and international in-migration requirements for petroleum engineers will be negative over the period.

Aerospace Engineers

Job openings for aerospace engineers are expected to average 235 over the next five years – most of these positions are in the transportation equipment manufacturing industry in Ontario and Quebec. New entrants will average 170 per year over the same period and net in-migration will average 50 per year. International in-migration requirements for aerospace engineers are minimal.

Computer Engineers

The Canadian economy will produce almost 800 job openings annually for computer engineers over the next five years. Most of these positions will be located in Ontario and Quebec. Canadian universities grant about 680 computer engineering degrees per year and it is expected that the flow of new entrants into the occupation will average 650 annually. The remaining supply requirement will be met through net in-migration which is expected to average 125 per year about 110 of these workers will come from international in-migration.

Other Engineers

The Canadian economy is expected to produce about 285 job openings for other engineers annually over the next five years. New entrants to the occupation will average about 135 annually over that period. Net in-migration will have to average about 112 annually to meet supply requirements over that period. It is expected that international in-migration for other engineers will meet most of the supply requirement and average about 90 per year.

Engineering Managers

There will be about 1080 job openings for engineering managers annually over the next five years. Over 70 per cent of these openings will be related to replacement demand. Net other mobility in the occupation is the primary source of supply as experienced engineers are promoted to the level of engineering manager. Net other mobility contributes 950 engineering managers annually. New entrants will be zero given the experience requirements of the occupation. International in-migration is expected to average about 100 annually while inter-provincial migration is limited due to licensing requirements.

Software Engineers

The forecast is for the Canadian economy to produce about 1250 job openings for software engineers annually over the next five years – half of those openings will be in Ontario. Job openings are expected to hold steady during the latter 5 year period despite reduced expansion demand from industry. Canadian universities are granting nearly 800 software engineering degrees and our projection is for new entrants to supply about 1000 workers annually to the occupation over the next 5 years. The projections suggest that no excess demand should be expected over the forecast.

1 INTRODUCTION AND APPROACH

Introduction

The Engineers Canada Labour Market Study report presents projections of future demand and supply requirements for 14 engineering occupations in Canada and the provinces to 2025. The occupation projections represent a "requirements" approach that focuses first on estimating the number and sources of workers required in light of the expected future economic and demographic performance of the economy. It focuses on the possible sources of these requirements and the number of workers that can or need to be obtained from them to meet the requirements.

For any occupation the total supply of workers includes new entrants to the occupation plus some inter-occupation mobility as well as interprovincial and international mobility. Canadian universities grant engineering degrees and provide a steady flow of new entrants to the occupation. New entrants to engineering occupations include an increasing number of females as well as international students. Migration requirements become relatively more important to meet supply requirements for engineering occupations. These occupations are regulated by the provincial regulators and this further contributes to the importance of international mobility.
The federal government's Canada Express Entry system is an example of the type of program that can be implemented to ensure that immigration needs are met in the future. As well, it is important that Canadian engineering programs continue to deliver quality education, and that engineering regulators work to promote inter-provincial mobility to ensure a sufficient supply of engineers across Canada.

Engineering Occupations

The report focuses on the outlook for fourteen engineering occupations. These occupations are:

Occupation Title	NOC Code
Civil Engineers	2131
Mechanical Engineers	2132
Electrical/Electronics Engineers	2133
Chemical Engineers	2134
Industrial/Manufacturing Engineers	2141
Metallurgical Engineers	2142
Mining Engineers	2143
Geological Engineers	2144
Petroleum Engineers	2145
Aerospace Engineers	2146
Computer Engineers	2147
Engineering Managers	0211
Software Engineers	2173
Other Professional Engineers	2148

Each chapter of the report contains a detailed analysis and explanation of the components of demand and supply for each of the 14 categories of engineers. The projections are over the period 2015 to 2025. Each chapter also contains information about the number of university degrees granted by province, provincial details about the average age of engineers, median annual wages paid to engineers by province. Detailed estimates for expansion and replacement demand as well as supply requirements (including international migration) are provided for all 10 provinces. Finally, in each chapter, a weighted ranking system of labour market tightness is provided for each occupation by province.

The Occupation Workforce Analysis Approach

The occupation projections presented below represent a "requirements" approach to workforce analysis. This approach focuses first on estimating the number and sources of workers required in light of the expected future economic and demographic performance of the economy. It then focuses on the possible sources of these requirements and the number of workers that can or need to be obtained from them to meet the requirements. Finally, it presents an assessment of the possible difficulty in meeting the requirements.

The approach does not attempt to forecast the "actual" supply that will exist for an occupation in the future. It provides an estimate of what supply would be "required" given the estimated demand requirements. This type of information is useful for workforce planning where organizations or policy makers can act to ensure that sufficient supply will be available in the future to meet demand. The estimated new entrant requirements, for example, provide information to organizations concerned with providing education and training regarding the types of occupations and number of persons they will need to educate or train. The estimated migration requirements, in particular on an international basis, provide information regarding the number of persons and types of occupations that will need to be sourced through immigration.

The approach starts with the use of macroeconomic models of the provincial economies to create the economic and demographic outlooks for the provincial economies and the Canadian economy as a whole. In these models workforce demand and supply for the "number of workers" at the aggregate level adjust over time to meet labour requirements. An important part of this adjustment is an "optimal" immigration approach where the federal government, through immigration policy, adjusts immigration to increase or decrease workforce supply needed to meet demand requirements. The Express Entry system is an example of the type of programs that are assumed to be implemented to ensure that immigration, and thereby supply, needs are met in the future. Under this approach there are no permanent shortages or surpluses in the "number" of workers as supply requirements adjust through immigration to meet demand requirements.

The requirement's approach does not show shortages because the model adjusts to meet forecasted demand. This is not assuming that the actual economy will adjust to meet this demand. For this reason, the model is able to show what must happen in order to meet forecasted demand. It shows what requirements need to be met in order for the economy to function at the level of demand that is forecasted. In terms of immigration, it is not assumed that the immigration projected for each province or occupation is what each of them will receive in actuality, it is only showing what each province or occupation will need in order to meet their projected demand.

The expected change in workforce demand, which is called job openings, is separated into two components. The first, which is called expansion demand, is determined by changes in economic performance that lead to changes in employment and the amount of excess workers that are required to meet normal turnover in the workforce. The second, which is call replacement demand, refers to job openings created by people retiring from the labour force[3] or dying that need to be replaced. The latter two sources are influenced by the aging of the population. As the population ages more and more people retire from the workforce or die before leaving the workforce.

3 See Appendix A for definition.

The sources of supply to meet the demand requirements are: young people entering the workforce after finishing school (new entrants); both international and interprovincial net in-migrants; and other sources, such as people changing occupations or deciding to enter the labour force because of more job opportunities and higher wages. There are a growing number of women and other traditionally underrepresented groups participating in various engineering occupations. If this trend continues we can expect to pull more supply from this demographic in the future.

The new entrants are people joining the workforce after leaving school when they finish their education. They are generally between the ages of 15 and 30. The number of new entrants is determined largely by the size and age distribution of this age group as well as the age between 15 and 30 when they become more attached to the labour force. The total number of new entrants for an economy is calculated from information created in the macroeconomic models. In the occupation modelling system, the proportion of new entrants allocated to an occupation is assumed to be determined by the occupation's recent share of the overall workforce. This share will change over time as the demand for the occupation changes relative to that for the other occupations.

In this report, historical information is presented on the number of engineering graduates across the country. This information represents the possible "supply" of new entrants into the engineering occupations. It differs from the concept of new entrants used in the report in that new entrants represent requirements, not actual supply. The number of engineering graduates in a province will not necessarily match new entrants requirements as the graduates may be foreign students who will return to their home country, may go on to graduate school, may move to take jobs in other provinces, or be unemployed. The graduates that move to another province would be considered as migrants in the approach used in this report.

The amount of migration allocated to an occupation as a source of supply is determined by first subtracting the number of new entrants from each occupation's supply requirements and summing these amounts to create a total value for all occupations. This measure is supply requirements left over to be filled once new entrants are taken into account. The migration requirements for each occupation are then computed as an occupation's share of the total value of this measure for all occupations multiplied by the total number of migrants. The latter total is constrained to be the same as that found in the macroeconomic model results.

While there are no shortages or persistent surpluses for the occupations, a labour market tightness ranking approach is available that attempts to provide an indication of the relative risk across occupations of obtaining their estimated supply requirements. This approach attempts to identify occupations that may be relatively difficult for organizations to find in the future.

Occupations with relatively strong demand growth, for example, may be more difficult to find than those where demand growth is weaker. Moreover, occupations where supply requirements are largely met through migration may be at risk if these requirements are not accommodated through additional immigration or Canadian workers do not wish or are not available to move to the particular locations in question. In cases where there is excess demand it would be beneficial to be able to pull more supply from workers of diverse backgrounds which are currently underutilized or are unable to access the profession. There may also be some tightness issues over economic cycles and for specific occupations. The latter is often measured as the gap between the

normal[4] and actual unemployment rates. The normal unemployment rate is a measure of the average unemployment rate that is impacted by normal turnover in the labour force, seasonal unemployment, and structural unemployment (the people available do not possess the required skills). This tightness is incorporated in the ranking approach.

The tightness ranks are qualitative measures of the possible tightness of the labour market and the associated risk of obtaining workers. There are three ranks measured from 1 to 3.

- **Rank of 1:** a situation of excess supply, where there are more than sufficient workers available to meet demand. Demand growth is slower than normal and there is less reliance than normal on migrants to fill jobs. It should be relatively easy to find workers;
- **Rank of 2:** represents a normal market situation where organizations can rely on their traditional methods for obtaining workers. Demand growth is normal and while organizations may have to rely on migrants to meet supply, this situation not different from what they have faced in the past; and
- **Rank of 3:** a situation of excess demand, a type of market situation where demand growth is quite strong and more emphasis than normal must be placed on organizations to access migrants to meet their worker requirements. It will be relatively more difficult to find workers.

4 See Appendix A for definition.

Occupation Data Sources

The occupation data are sourced from the National Household Survey (NHS) and the Labour Force Survey (LFS). They are measured on an LFS basis for the occupations as a whole. That is, the total labour force and total employment are equal to the LFS values each year. Nevertheless, the occupation data do not match the LFS occupation data published by Statistics Canada. The latter data have too small a sample size to provide reliable estimates of the occupations, particularly on a provincial basis.

Report Contents

The next section of this report provides a brief description of the macroeconomic and demographic performance of Canada's provincial economies. This performance drives the outlook for the demand and supply of engineering occupations. Economic growth determines the amount of employment growth and associated demand for engineering occupations. Changes in population through migration drive the change in the labour force, which represents the possible future supply of engineering occupations.

Chapters 3 through 14 describe the outlook for each of the engineering occupations across the provinces and the country as a whole. For each occupation information is provided on recent graduates (if available) including data on female graduates and visa graduates, the average age of the occupations, the median annual wages and salaries, the sources of their demand and supply, and the relative difficulty of meeting their supply requirements. Appendix A, Occupation Workforce Concepts, will be a useful tool to help the reader clarify definitions and concepts contained in this report.

For some occupations, sample sizes were such that either information was not available or were not useful because of Statistics Canada's random rounding procedure for data. Data for occupations which are either not available because the sample size is too small or not reliable, will be removed from charts and represented in tables by a dash "-".

2 ECONOMIC AND DEMOGRAPHIC OUTLOOK

This section describes the outlook for the economic and demographic drivers behind the occupation outlook.

Commodity Prices and Trading Partner Growth

The major factors influencing the economic drivers are commodity prices and the economic performance of Canada's major trading partners.

The assumptions regarding commodity prices show prices for agriculture, metals, and minerals products rising slower than inflation over the outlook period after having declined in the past 3 years. These assumptions are based on those found the latest World Bank commodity price outlook. Figure 2.1 shows the prices for Henry Hub natural gas and WTI oil measured in US dollars. After falling sharply in 2015, oil prices are expected to recover over the outlook period, but not reaching their previous high of $100 until 2023. Natural gas prices have been relatively low recently and are expected to trend upward in the future. These assumptions are based in part on those of the U.S. Energy Information Agency and other sources. The implication of these assumptions is that moderate growth in the resource sector would be expected in the outlook period.

Figure 2.1 Oil and Natural Gas Prices

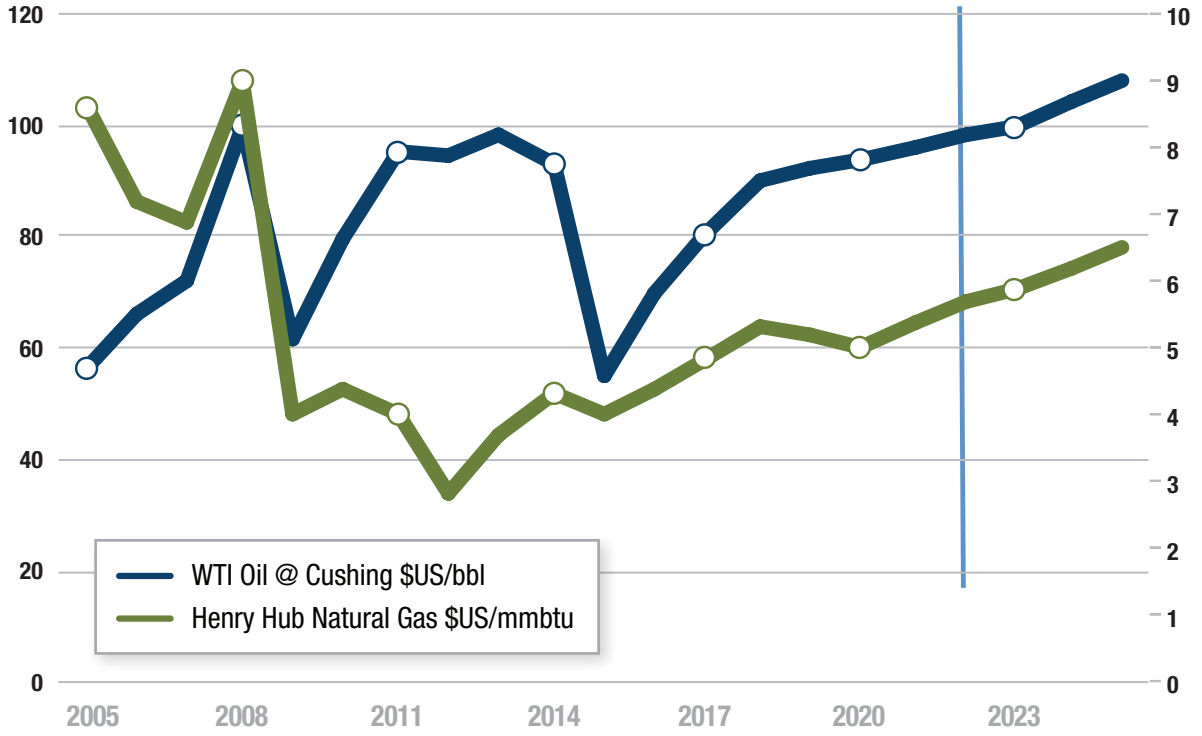
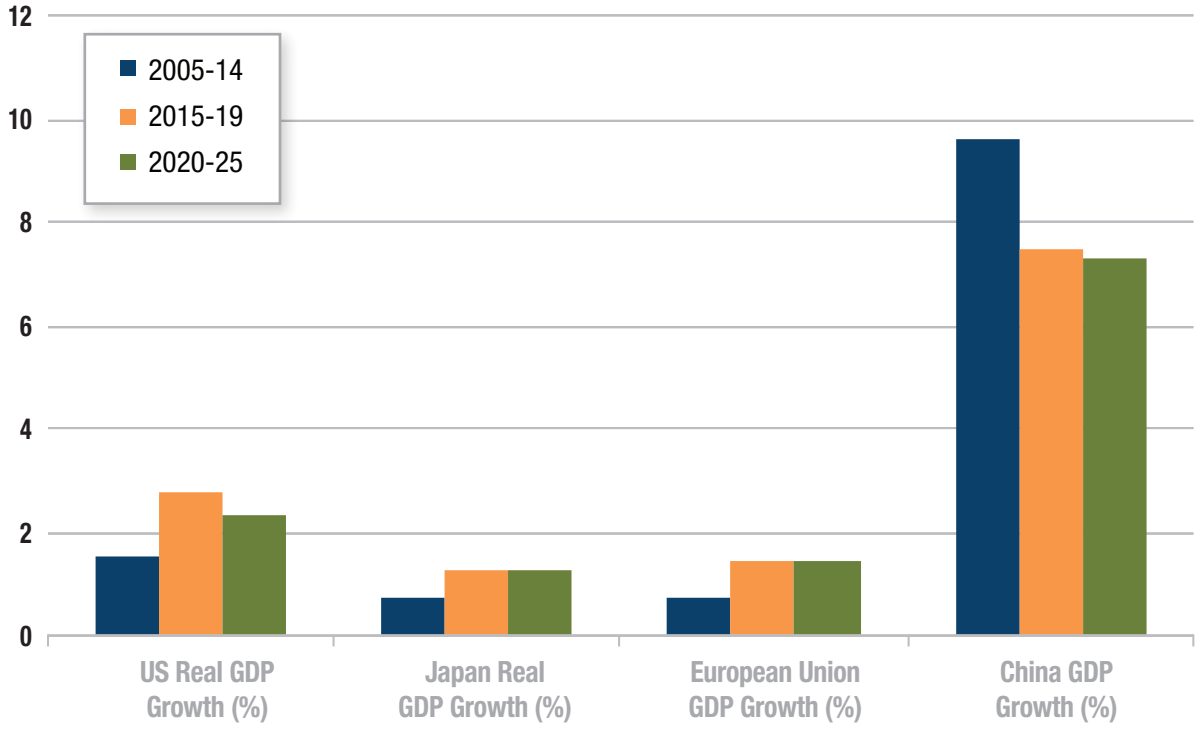


Figure 2.2 shows the assumptions for economic growth for Canada's major trading partners – United States, European Union, and Japan – in terms of average annual growth in the past 10 years and in the medium and long-term outlook periods. These assumptions are based on those from the World Bank, the IMF, and the OECD forecasts. Economic growth for the partners rises in the medium-term and for the United States and Japan slows in the long-term. Growth in the European Union continues to rise in the long-term as it is currently performing below potential growth. While China is not a major trading partner, its performance is important for the determination of commodity prices. As can be seen in Figure 2.2, growth remains high, but slows over the outlook period. The slower growth is in part responsible for the performance of commodity prices described above.

Figure 2.2 Trading Partner Economic Growth

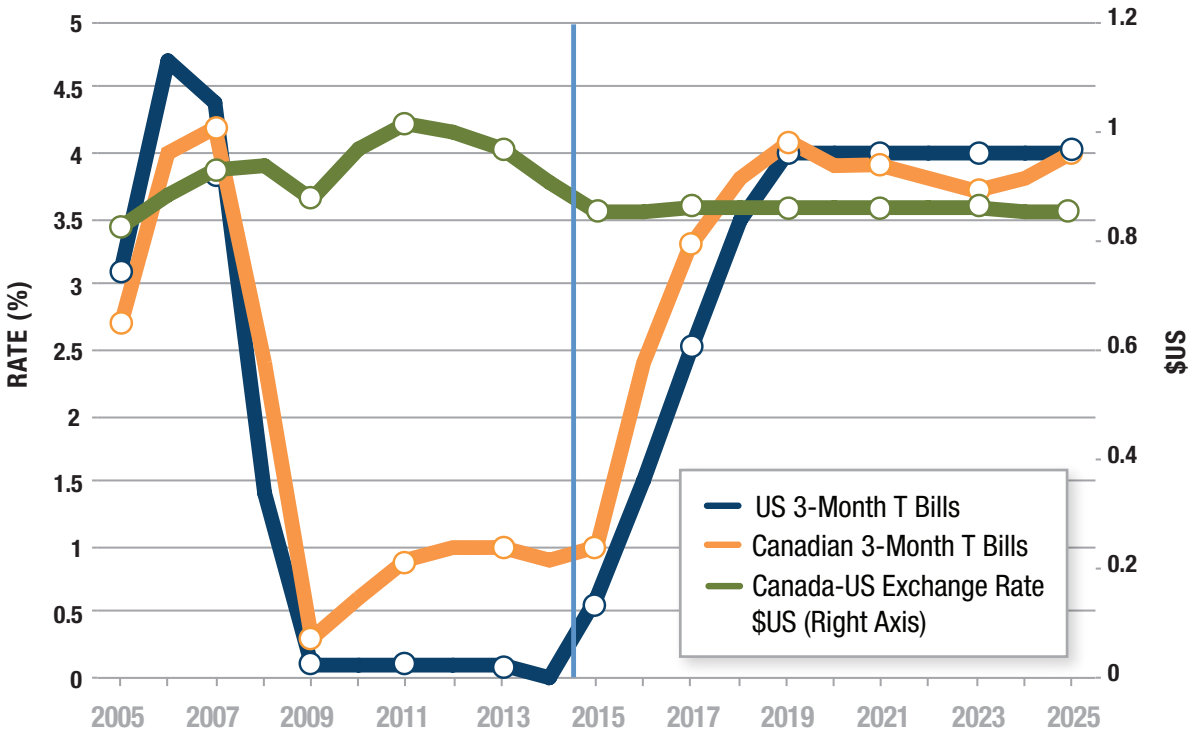


Interest Rates and Canada-U.S. Exchange Rate

The course of monetary policy in the United States has an important impact on Canada's interest and exchange rates. Figure 2.3 shows the three month Treasury Bill rates for Canada and the United States along with the Canada-U.S. exchange rate. There is considerable uncertainty regarding the direction of interest rates in both Canada and the United States over the next few years as there is also uncertainty about the strength of economic growth in the two countries. The outlook for interest rates in the context of the outlook for economic growth described below suggests short-term interest rates will begin to rise in 2015 and return to more normal levels in relation to inflation by 2020. The direction of these rates is required to keep inflation near its target values in both countries.

The Canada-U.S. exchange rate is assumed to average just over $US 0.85 over the period supported by rising oil prices and moderate inflation rates. The Consumer Price Index for Canada averages near 2.0 per cent over the outlook period.

Figure 2.3 Interest and Exchange Rates



Economic Growth

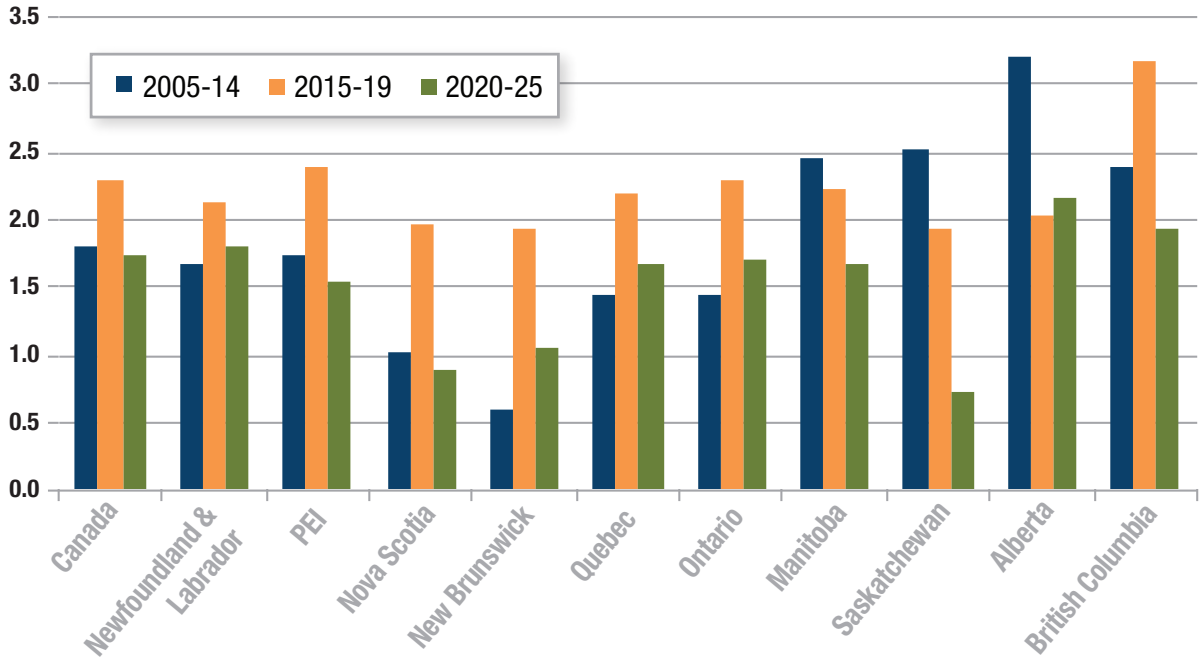
The outlook for Canada as a whole shows slower economic growth – growth in Gross Domestic Product adjusted for inflation, GDP – in the short-term driven by weak commodity prices including, in particular, oil prices, and overall slower world economic growth – see Figure 2.4. Over the remainder of the medium-term stronger world growth, particularly in the United States, rising oil prices, and a lower exchange rate, result in stronger economic growth through increased exports and investment. In the long-term, economic growth slows in line with reduced potential economic growth and slower growth in Canada's major trading partners. The reduced potential growth is caused by weaker labour force growth originating from an aging population and reduced growth in the natural resources sector.

In the West, the recent decline in oil prices has a negative impact on economic growth in Alberta and Saskatchewan over the medium-term, as oil investment expenditures decline and oil production subsequently weakens. In the long-term, increased investment in the oil and gas industry with rising oil prices, particularly in the oil sands, causes economic growth to strengthen in Alberta. Weak growth in the mining – in particular, potash – and the oil and gas industries leads to slower economic growth in Saskatchewan in the long run.

The other Western provinces show relatively strong growth in the medium-term as improved growth in the U.S. economy, lower oil prices, and a weaker exchange rate boost export growth. British Columbia shows strong growth driven by increased exports and continued growth in mining

and natural gas, including Liquefied Natural Gas (LNG), investment and production. Manitoba registers increased growth driven by utility investment, lower oil prices, and stronger export growth. Reduced trading partner growth and an aging population lead to slower growth in the long-term

Figure 2.4 GDP Growth (Annual Average, %)

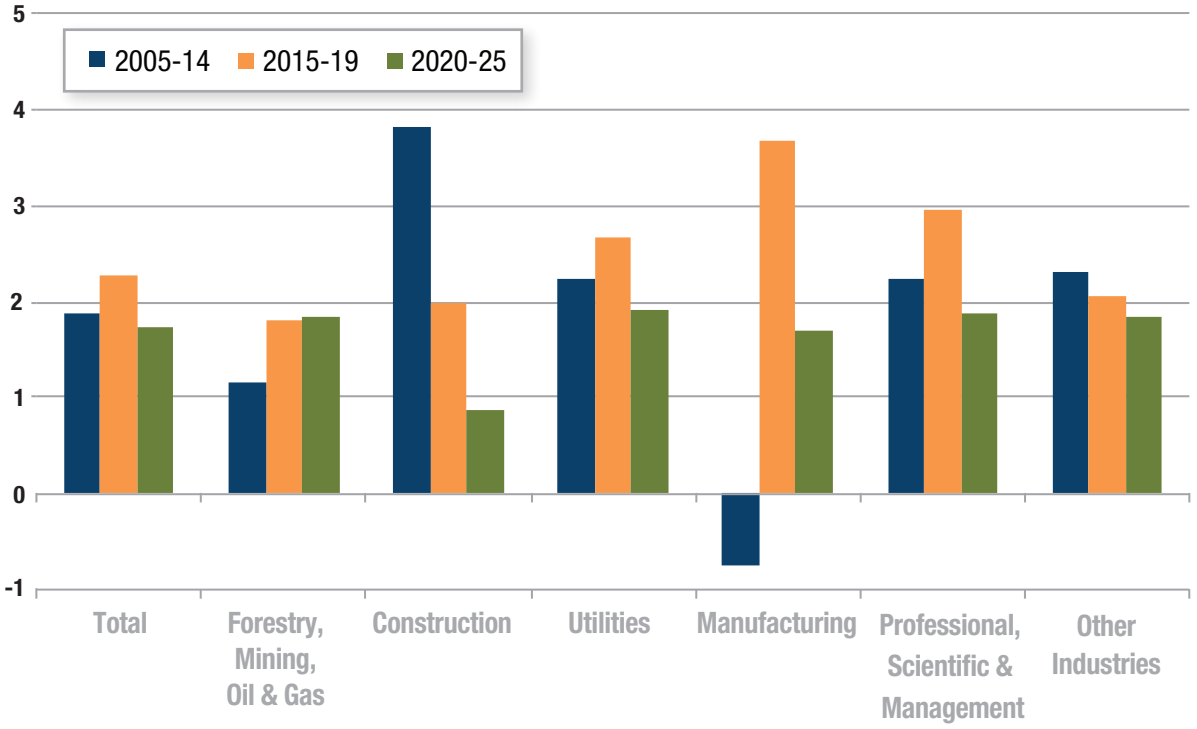


The recent decline in oil prices and the exchange rate, stronger U.S. growth, and increased investment cause economic growth in Ontario and Quebec to strengthen over the medium-term. The major drivers of growth in investment in Ontario are significant investments in electric power capacity across the province and mining investment in the North. Increases in manufacturing exports drive the growth in Ontario's exports and manufacturing investment as additional capacity is required to produce the exports. Quebec also shows stronger growth in manufacturing exports and investment, particularly for mining, manufacturing, and utilities.

Despite lower oil prices, the completion of a number of major oil and mining projects in the medium-term leads to an increase in economic growth in Newfoundland and Labrador. In the long-term, growth weakens with slower growth in oil production and weaker labour force growth associated with an aging population. Lower oil prices, a weaker exchange rate, and stronger U.S. economic growth boost the performance of the other Atlantic Provinces. The major driver behind growth in PEI and Nova Scotia in the medium-term is an increase in exports. In New Brunswick, increased mining investment expenditures along with stronger manufacturing exports drive growth. Over the long-term, weaker trading partner growth and population aging will slow growth. In Nova Scotia, a reduction in natural gas production is an additional factor reducing long-term growth.

The rate of economic growth across the industries in which the largest number of engineers is found is shown in Figure 2.5 below. The other industries category includes GDP growth in all other industries. These growth rates represent average annual rates for the periods shown.

Figure 2.5 Industry GDP Growth Rates, Canada (Annual Average, %)

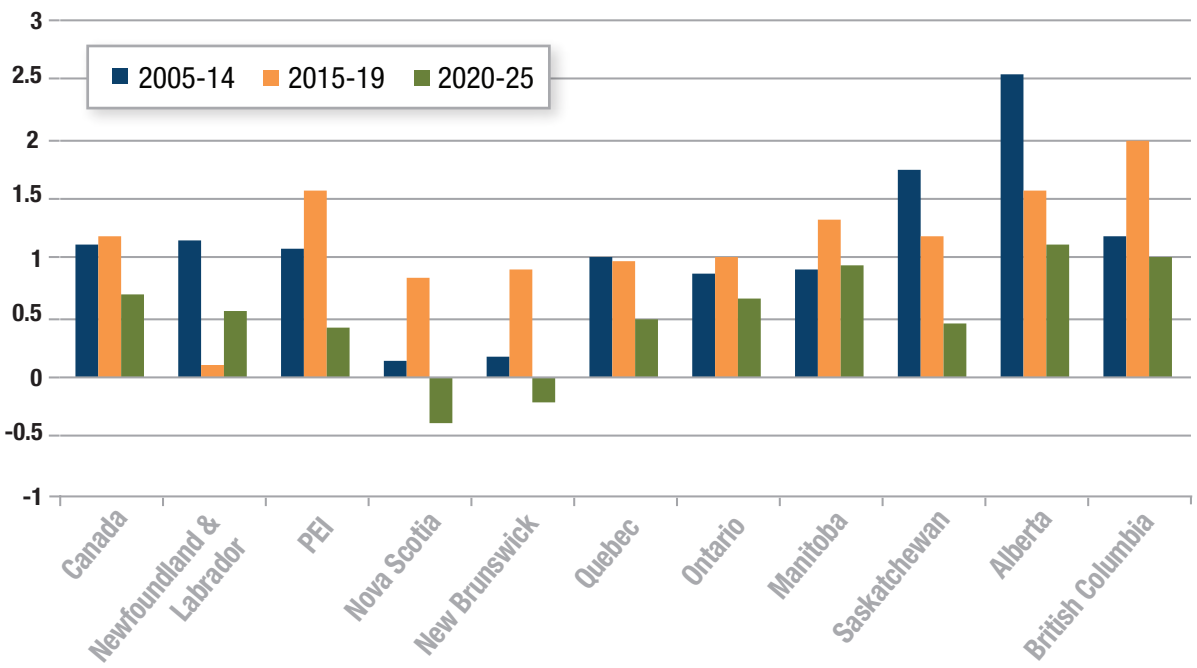


As can be seen from the figure, the utilities, manufacturing, and professional scientific, and management industries show the strongest growth in the medium-term with slower growth expected in the long-term for the reasons described above. Growth in forestry, mining, and oil and gas increases from the past 10 years driven by the completion of a number mining projects and additional oil and gas production. Growth slows in the construction sector from the past few years. While investment remains high over the outlook period, its growth rates are much smaller than those observed over the past 10 years. The other industries are dominated by private and public services where growth is pulled down by reductions in the growth of government expenditures in the medium-term.

Employment Growth

Employment growth moves in line with GDP growth and changes in labour productivity. Figure 2.6 shows average annual growth rates in employment across the provinces. As can be seen from the figure, employment growth strengthens in the medium-term from its past 10 year average. It is the strongest in the West in the medium-term, although in the case of Alberta and Saskatchewan it is slower than in the past 10 years, reflecting in part the impact of low oil prices. It strengthens slightly in Ontario and remains approximately the same in Quebec. With the exception of Newfoundland and Labrador, employment growth strengthens in the medium-term in the Atlantic Provinces.

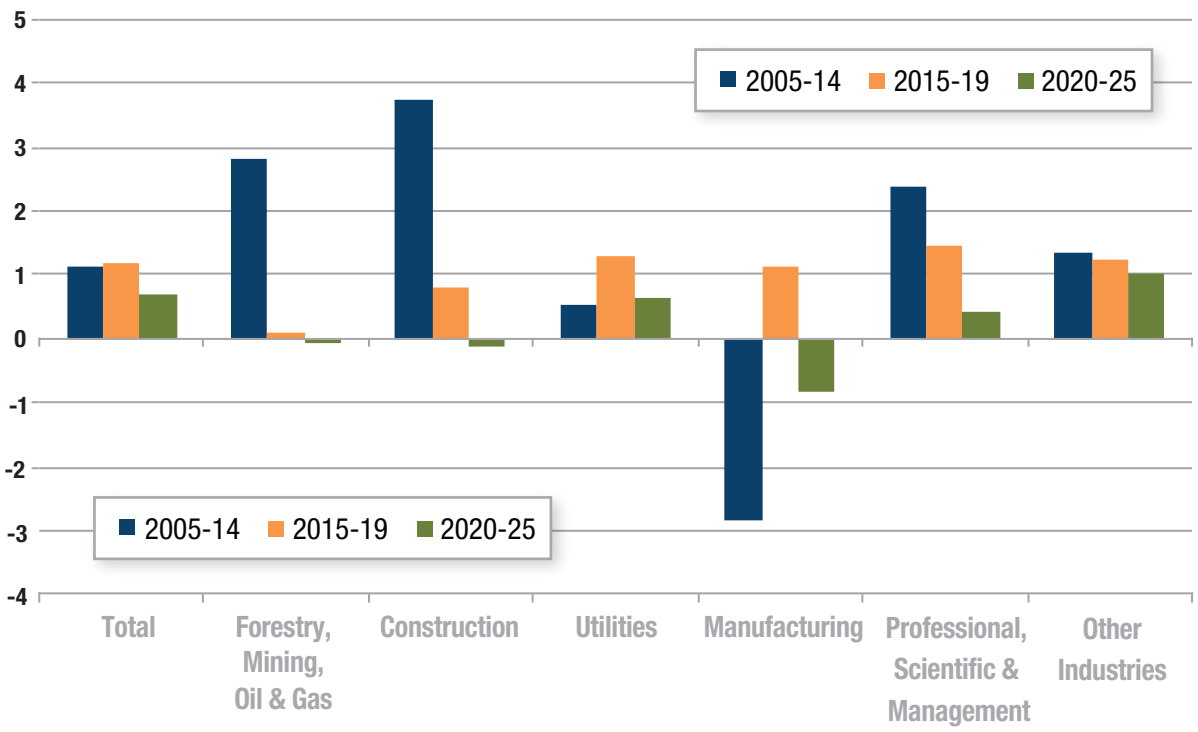
Figure 2.6 Employment Growth (Annual Average, %)



Employment growth weakens in all provinces in the long-term, in line with slower economic growth and stronger growth in labour productivity. This increased productivity growth is a result of upward pressure on wages caused by tighter labour markets – falling unemployment rates. The higher wages cause firms to economize on workers through increased investment in technology, which reduces the need for workers. The tighter labour markets are caused by reductions in labour force growth that are, in turn, driven by reductions in the percentage of the population in labour force. The latter are a result of increased retirements associated with an aging population.

Employment growth in those industries where the largest number of engineers is found is shown in Figure 2.7. In the medium-term, with exception of forestry, mining, and oil and gas, employment growth generally is above 1 per cent per year across the industries. The positive growth in manufacturing employment represents a significant turnaround from the large declines observed in the past 10 years. The weak growth in mining and oil and gas in the medium-term reflects the lower oil prices as well as productivity growth. In the long-term employment growth is reduced by weaker GDP growth and rising productivity growth, as described above.

Figure 2.7 Industry Employment Growth, Canada (Annual Average, %)



Labour Force Growth

Population growth is a major driver of labour force growth along with the percentage of the population that is in the labour force – labour force participation rates – and the age distribution of the population.

Figure 2.8 shows average annual population growth across the provinces. As can be seen from the figure population growth tends to follow employment growth. Population growth has generally been the strongest in the West over the past few years and weakest in the Atlantic Provinces. Over the medium and long-term, the West continues to show strong population growth in line with employment growth. Saskatchewan's population growth slows in the long-term in line with reduced economic and employment growth. Ontario registers growth similar to the last 10 years over the outlook period, while growth increases somewhat in Quebec. PEI is an exception in the Atlantic Provinces as it has a relatively younger province in contrast to the other provinces that are characterized by relatively old populations and need to import people to keep their populations from declining.

The relative need for provinces to rely on migration for population growth can be seen from Figure 2.8. It shows the contribution to population growth, shown in Figure 2.7, of births minus deaths, defined as natural population growth. The natural rate of population growth is negative in the Atlantic Provinces, except for PEI. It is also quite low in British Columbia. These provinces have relatively old populations due in part to their lower fertility rates. These provinces are likely to have

higher retirement rates from the labour force than the other provinces. Saskatchewan and Alberta have fertility rates – just over two children per woman in their child-bearing age group – and accordingly lower retirement rates from the labour force.

Figure 2.8 Population Growth (Annual Average, %)

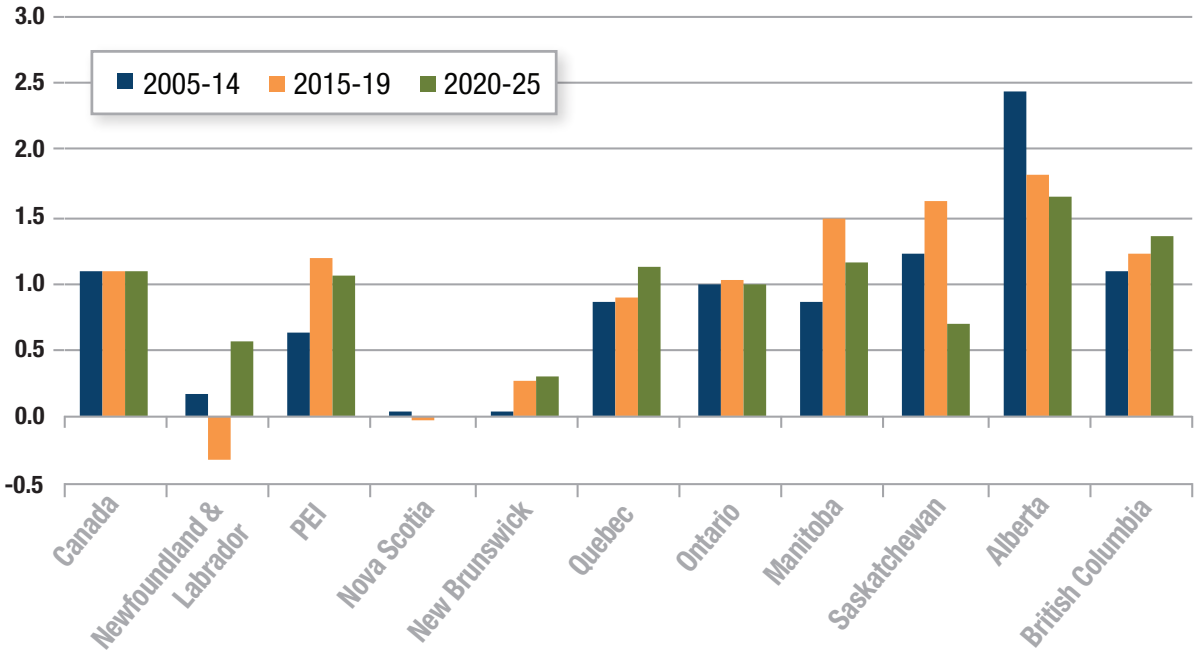


Figure 2.9 Natural Population Growth (Annual Averge, %)

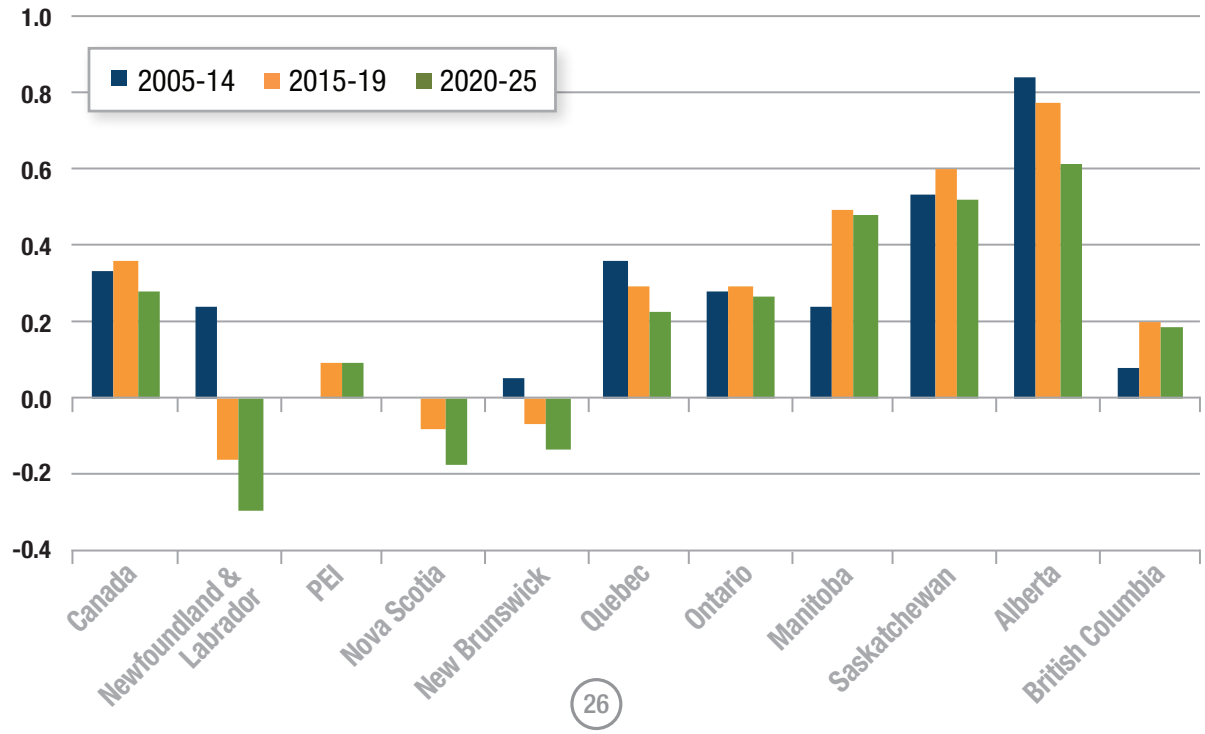


Table 2.1 shows the average annual number of net in-migrants to the provinces for total migrants, international migrants and net interprovincial migrants associated with the population outlook. The number of net international in-migrants rises from an average of about 250 thousand over the past 10 years to over 300 thousand in the long-term.

Table 2.1 Net In-Migration (000s)

	Total Net In-Migration			International			Interprovincial		
	2005-14	2015-19	2020-25	2005-14	2015-19	2020-25	2005-14	2015-19	2020-25
Canada	247.6	271.6	312.3	247.2	271.3	311.9			
Newfoundland & Labrador	-0.3	-0.8	4.6	0.8	0.9	1.1	-1.0	-1.8	3.5
PEI	0.9	1.6	1.6	1.4	1.6	1.9	-0.5	0.0	-0.3
Nova Scotia	0.3	0.6	1.5	2.4	2.3	2.7	-2.1	-1.7	-1.2
New Brunswick	0.0	2.5	3.4	1.8	2.7	3.3	-1.8	-0.2	0.1
Quebec	39.2	51.7	77.9	47.7	59.8	83.6	-8.5	-8.0	-5.7
Ontario	91.3	99.6	104.0	103.9	113.0	123.9	-12.6	-13.5	-19.9
Manitoba	7.6	13.1	9.4	12.3	17.0	17.8	-4.7	-3.9	-8.4
Saskatchewan	7.3	12.3	2.6	7.5	11.0	7.2	-0.2	1.3	-4.6
Alberta	57.4	43.9	48.0	32.1	27.9	21.9	25.3	16.0	26.1
British Columbia	44.0	46.9	59.4	37.4	34.9	48.7	6.6	12.1	10.7

Ontario and Quebec continue to receive the largest number of international migrants, but also continue to lose population through interprovincial migration to other provinces. Alberta and British Columbia also receive large numbers of international migrants and also get additional migrants from other provinces.

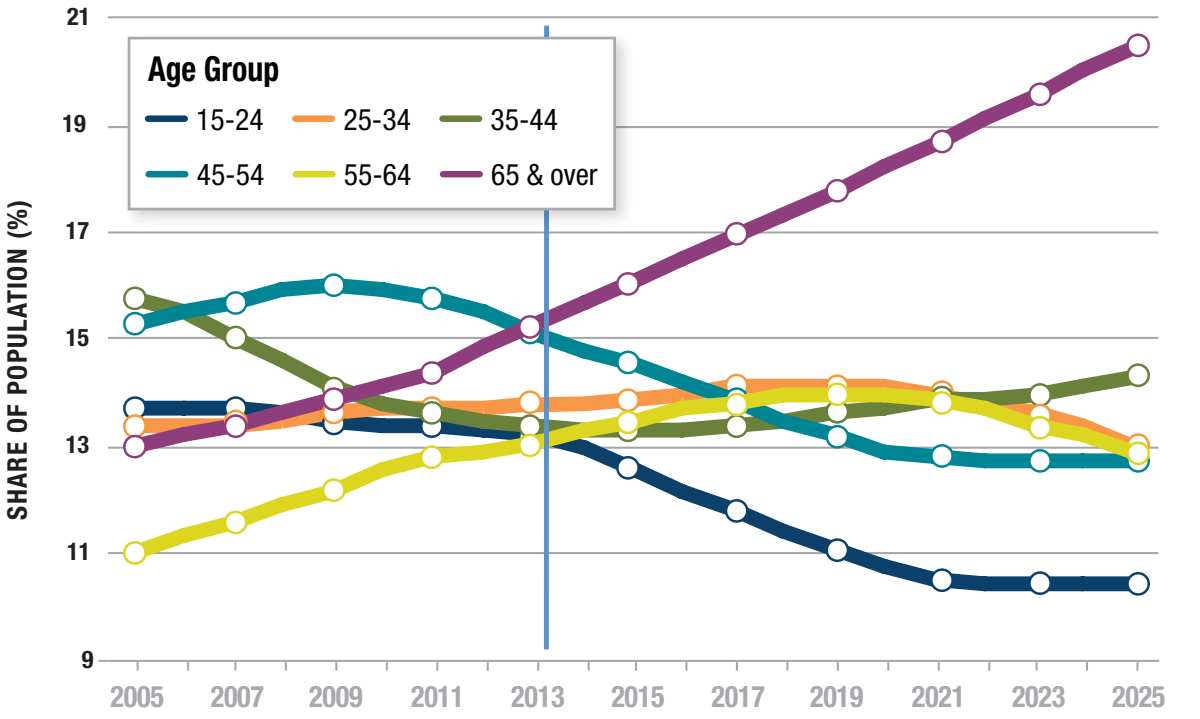
The Atlantic Provinces generally receive a larger number of migrants over the period to meet their employment requirements. They still lose some people to other provinces, but this amount falls as additional workers are required at home with rising retirements from their labour force.

The other driver of labour force is the labour force participation rate. As this rate falls, additional population will be needed to obtain the same amount labour force with the same population. In the current outlook, this rate falls as the percentage of the population in the labour force is much lower for persons over 55 years of age than it is for persons in the 25 to 54 year age group.

The age distribution of the population for Canada as a whole is shown in Figure 2.10 for different age groups starting the 15 to 24 year age group and ending with the 65 and over age group. As can be seen, the percentage of the population 65 years of age and over is growing rapidly over the outlook period. In contrast, the 15 to 24 year age group is heading in the opposite direction. This figure reflects the impact of the baby boomers on the population age distribution and the fact that fertility rates for women are in many provinces below that needed to replace the population.

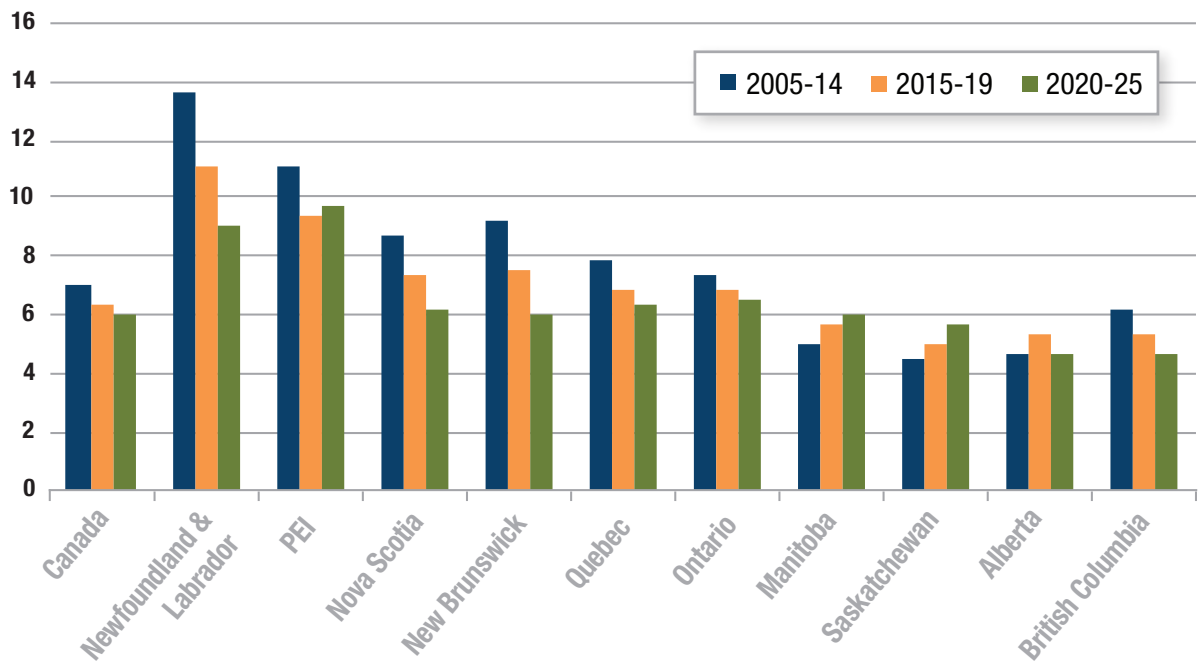
As more and more people move into the 55 and over age groups, retirements from the labour force will increase and the percentage of the population in the labour force will fall. Fewer persons entering the labour force under the age of 30 reduces the number of new entrants to the labour force to offset the increasing number retiring. Those provinces, such as the Atlantic Provinces, with an aging population will see rising retirements and few new entrants into the labour force.

Figure 2.10 Population Age Group Shares, Canada



The implication of the aging of the population on unemployment rates is shown in Figure 2.11. This figure shows declining unemployment rates in the Atlantic Provinces, Quebec, Ontario, and British Columbia. In Manitoba, Saskatchewan, and Alberta rates rise somewhat with slower economic growth. The reductions in the unemployment indicate a general tightening in labour markets over the outlook period. The decline in these rates has been offset by adding additional migrants to the population over the outlook period. Without additional migration even tighter labour markets would exist.

Figure 2.11 Unemployment Rates (Annual Average, %)



Risks to the Outlook

There are a number of uncertainties regarding the future performance of the Canadian economy. Almost all of these uncertainties are associated with the future performance of the World economy. The risks to the outlook seem to be mostly associated with a weaker than expected economic performance of the Canadian economy.

The recent sharp drop in oil prices, for example, was not anticipated and has had a negative impact on Canada's economic performance. It is uncertain as to when the oil price will begin to rise or what will be its future trajectory. Oil prices have the largest impact on the major oil producing provinces of Alberta, Saskatchewan, and Newfoundland and Labrador. If prices stay near current levels for a number of years the economies of these provinces will show relatively slow growth and likely further declines in employment related to reductions in exploration, development, and production of oil as well as reductions in growth in industries that supply the oil industry.

The impacts on the non-oil producing provinces from low oil prices and a weaker exchange rate will be less and in many cases lead to improved performance of their economies. The lower exchange rate makes Canadian goods and services more competitive in relation to those in the United States, which will improve exports and reduce imports. This impact will lead to increases in economic growth and employment. Such a situation would lead to a movement of people from the oil producing provinces to the other provinces to take advantage of the stronger economic activity.

The uncertainty regarding the future direction of oil prices is in part a result of the unexpected weak performance of the world economy and uncertainty as to what will happen to world growth. The European economy, for example, has not performed well over the past few years and many countries, such as Greece, have financial difficulties. China is experiencing slower growth as

its trading partners are also experiencing slower growth. While the United States is showing stronger growth, there appears to be some uncertainty as to the sustainability of such growth that is reflected in the caution on the part of the Federal Reserve Board in announcing the timing of increases in interest rates. Weaker world growth would not only keep downward pressure on oil and other commodity prices, but also lead to slower growth in all provinces than is shown in the current economic outlook.

If world growth improves faster than expected, then oil and other commodity prices will strengthen, leading to stronger growth across the country. The outlook would be characterized by higher interest rates and the exchange rate and tighter labour markets. The latter condition would make it more difficult for organizations to find the workers they require as significant immigration would be required to offset the effects of weaker labour force growth caused by population aging.

3 CIVIL ENGINEERS

A normal market situation is expected for civil engineers across most provinces. British Columbia and Manitoba are the exception. The average age of civil engineers rises notably in British Columbia and Manitoba, which will lead to excess demand in these provinces in the short to medium term as many approach retirement age and leave the field. Given the current graduate levels, the forecasted new entrants levels and international in-migration of civil engineers to the provinces, there should be no difficulties in obtaining the required workforce for civil engineers in these provinces. Mobility of new entrants across the country may be the greatest difficulty, particularly for British Columbia where there is a relatively high requirement for mobility.

Occupation Characteristics

Graduates

Graduates in civil engineering across the country from 2000 to 2013 are presented in Table 3.1. The first two columns of the table show a five year average, while the last four columns represent annual data. The annual number of graduates in Ontario and Quebec from civil engineering has been growing relatively quickly since 2004. Graduates in 2013 for Quebec and Ontario were approximately 900 and 1,000, respectively. Female graduates have been rising steadily over the last decade and in 2013 accounted for nearly 25 per cent of total civil engineering graduates. Over the ten year period from 2003 to 2013, visa graduates[5] as a per cent of total graduates rose from 4.3 to 7.1 per cent.

5 Source: Engineers Canada. Visa data in this report refers to undergraduates only.

The recent level of graduates for Quebec and Ontario exceeds the average number of job openings for these provinces, which will be shown in the subsequent section on Sources of Demand. This supply of graduates may be helpful for provinces such as Alberta, British Columbia and Manitoba, where the level of graduates falls short of the level of average annual job openings expected. Though, as was noted in the introduction, many of these graduates may go on to graduate school or may not remain in the province or in Canada, and will therefore not be available for work in the province in which they graduate.

Table 3.1 Degrees Granted: Civil Engineering (2000-2013)

	Average 2000-04	Average 2005-09	2010	2011	2012	2013
British Columbia	101	116	184	239	237	254
Alberta	156	195	234	229	257	269
Saskatchewan	26	61	85	83	100	125
Manitoba	33	41	53	58	56	58
Ontario	524	705	799	956	1017	1159
Quebec	226	390	592	690	735	923
New Brunswick	52	73	76	86	81	88
Nova Scotia	28	63	88	90	81	111
Prince Edward Island	0	0	0	0	0	0
Newfoundland & Labrador	25	39	32	33	19	64

Source: Engineers Canada's 2014 Enrolment and Degrees Awarded Report

Industry Employment

A ranking of employment by industry and by province for civil engineers is presented in Table 3.2. Most civil engineers work in the Architectural, Engineering and Related Services industry. The majority of these are in Ontario but there are significant numbers in Alberta, Quebec and British Columbia. A large number of civil engineers also work in Public Administration, at all levels of government. Ontario has the highest concentration of civil engineers across the country.

Table 3.2 Top 25 Employment Estimates, Civil Engineers by Industry and Province (2015-2025)

Province	Industry	Average 2015-19	Average 2020-25
ONTARIO	Architectural, Engineering and Related Services	12279	12746
ALBERTA	Architectural, Engineering and Related Services	6890	7370
QUEBEC	Architectural, Engineering and Related Services	6146	6221
BRITISH COLUMBIA	Architectural, Engineering and Related Services	5445	5722
ONTARIO	Local municipal and regional public administration	1394	1480
ONTARIO	Heavy and Civil Engineering Construction	1039	1029
ONTARIO	Management, Scientific and Technical Consulting Services	866	900
MANITOBA	Architectural Engineering and Related Services	817	861
NOVA SCOTIA	Architectural Engineering and Related Services	771	765
SASKATCHEWAN	Architectural Engineering and Related Services	737	752
NEW BRUNSWICK	Architectural Engineering and Related Services	663	649
QUEBEC	Provincial and Territorial Public Administration	648	683
ONTARIO	Residential Building Construction	579	570
QUEBEC	Non-residential Building Construction	564	604
NEWFOUNDLAND AND LABRADOR	Architectural, Engineering and Related Services	560	566
ONTARIO	Provincial and Territorial Public Administration	551	575
ALBERTA	Local Municipal and regional public administration	539	588
ALBERTA	Heavy and Civil Engineering Construction	511	543
BRITISH COLUMBIA	Heavy and Civil Engineering Construction	497	459
ONTARIO	Federal government public administration	485	508
QUEBEC	Local Municipal and regional public administration	480	510
ONTARIO	Trade contracting	460	461
ALBERTA	Oil and gas extraction	446	380
ONTARIO	Utilities	438	446
ALBERTA	Non-residential Building Construction	434	508

Age Structure

The age distribution of a population has an important influence on workforce supply. An aging population reduces the growth in the supply through increased retirements and deaths. Engineers in Canada are generally in the 30 to 55 year old age range. Average age for each year of the forecast period for civil engineers, by province is presented in Table 3.3. Civil engineers in British Columbia have the highest average age in 2015 at 50 years, followed by Manitoba at 48 years of age.

The projections show a noticeable decline in the average age for civil engineers in British Columbia and Manitoba over the period. As civil engineers in these provinces retire and new entrants or migrants of a younger age are brought into the workforce the average age will begin to decline. There is the ongoing issue of the skills gap between retirees and new entrants, in that new entrants do not have the skills set that retirees have acquired during their work experience. Provinces may attempt to bring in experienced workers through inter-provincial or international migration.

Table 3.3 Average Age for Civil Engineers (2015-2025)

	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
British Columbia	50	49	48	47	46	46	45	45	44	44	44
Alberta	42	42	42	42	42	42	42	42	42	42	42
Saskatchewan	43	43	42	42	42	43	43	43	43	43	43
Manitoba	48	47	46	46	45	45	44	44	44	43	43
Ontario	42	42	42	42	42	42	42	42	42	42	43
Quebec	43	43	43	43	43	43	43	43	43	43	43
New Brunswick	44	44	43	43	43	42	42	42	42	42	42
Nova Scotia	43	43	43	43	43	43	43	42	43	43	43
Prince Edward Island	42	42	42	43	43	43	43	44	44	44	44
Newfoundland & Labrador	42	42	43	43	43	43	42	42	42	42	42

Median annual wage data for civil engineers across the provinces is shown in Table 3.4 below. The data in the table represents thousands of dollars. Alberta shows the highest wage paid for civil engineers in Canada, followed closely by Newfoundland and Labrador. The lowest wage for these engineers is in Prince Edward Island where there is very little demand for the occupation.

Table 3.4 Median Annual Wage ($ 000s) 2015-2025

	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
British Columbia	82.6	85.2	88.5	92.4	96.5	100.6	104.5	108.2	111.7	115.2	118.6
Alberta	104.1	106.1	108.5	111.8	115.8	120.1	124.6	128.8	132.7	136.4	140.0
Saskatchewan	95.1	98.4	101.4	104.1	106.3	108.2	109.6	111.0	112.5	114.7	117.7
Manitoba	79.0	81.4	83.7	85.9	87.7	89.4	91.0	92.7	94.6	96.6	98.9
Ontario	84.6	87.1	89.7	92.5	95.1	97.5	99.9	102.3	104.9	107.8	111.0
Quebec	80.0	82.5	85.3	88.5	91.5	94.4	97.1	99.7	102.2	104.8	107.6
New Brunswick	78.6	80.2	82.6	85.6	88.8	92.2	95.5	98.7	102.0	105.3	108.7
Nova Scotia	87.1	89.9	93.2	96.8	100.3	103.9	107.4	111.0	114.7	118.7	122.9
Prince Edward Island	67.3	68.0	68.8	69.9	71.0	71.9	72.7	73.4	74.1	74.8	75.5
Newfoundland & Labrador	102.1	104.6	106.9	110.0	113.4	117.3	121.5	125.8	129.8	133.3	136.6

Sources of Demand

Expansion Demand and Replacement Demand

Total demand (total job openings) is composed of expansion demand and replacement demand (retirements and deaths). The importance of replacement to total demand change in all provinces across the forecast period is shown in Figure 3.1 below. In the Atlantic Provinces total demand change is comprised almost entirely of replacement demand. The importance of replacement demand to total demand change, with a breakdown of the components into the short to medium and long-term, is further shown in Table 3.5 below.[6]

6 Due to random rounding, expansion demand plus replacement demand may not equal total job openings

Figure 3.1 Sources of Demand for Civil Engineers, Annual Average (2015-2025)

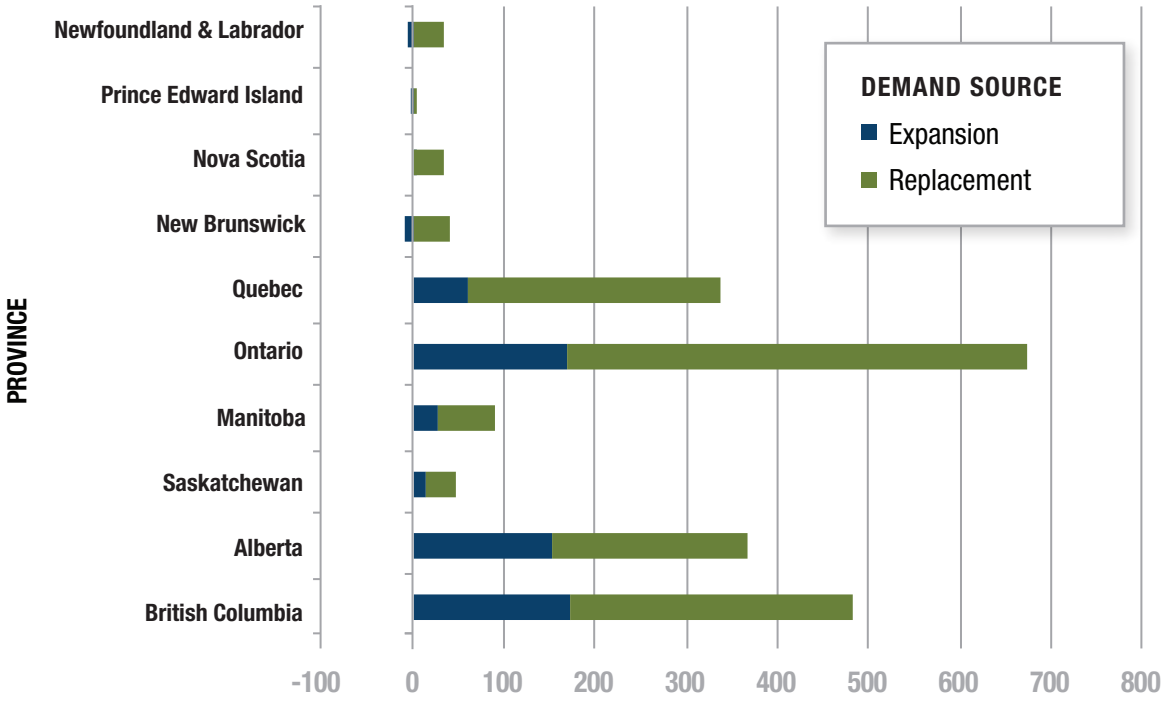


Table 3.5 Sources of Demand for Civil Engineers (Annual Average 2015-19 and 2020-25)

	Average 2015-19			Average 2020-25		
	Expansion	Replacement	Job Openings	Expansion	Replacement	Job Openings
British Columbia	338	329	667	37	291	328
Alberta	230	198	427	92	225	317
Saskatchewan	23	34	57	6	34	41
Manitoba	45	65	110	16	58	74
Ontario	228	498	726	120	511	631
Quebec	136	276	413	-5	279	275
New Brunswick	-3	45	42	-11	38	27
Nova Scotia	14	37	51	-11	34	23
Prince Edward Island	0	4	3	-1	5	5
Newfoundland & Labrador	-12	36	23	0	33	33

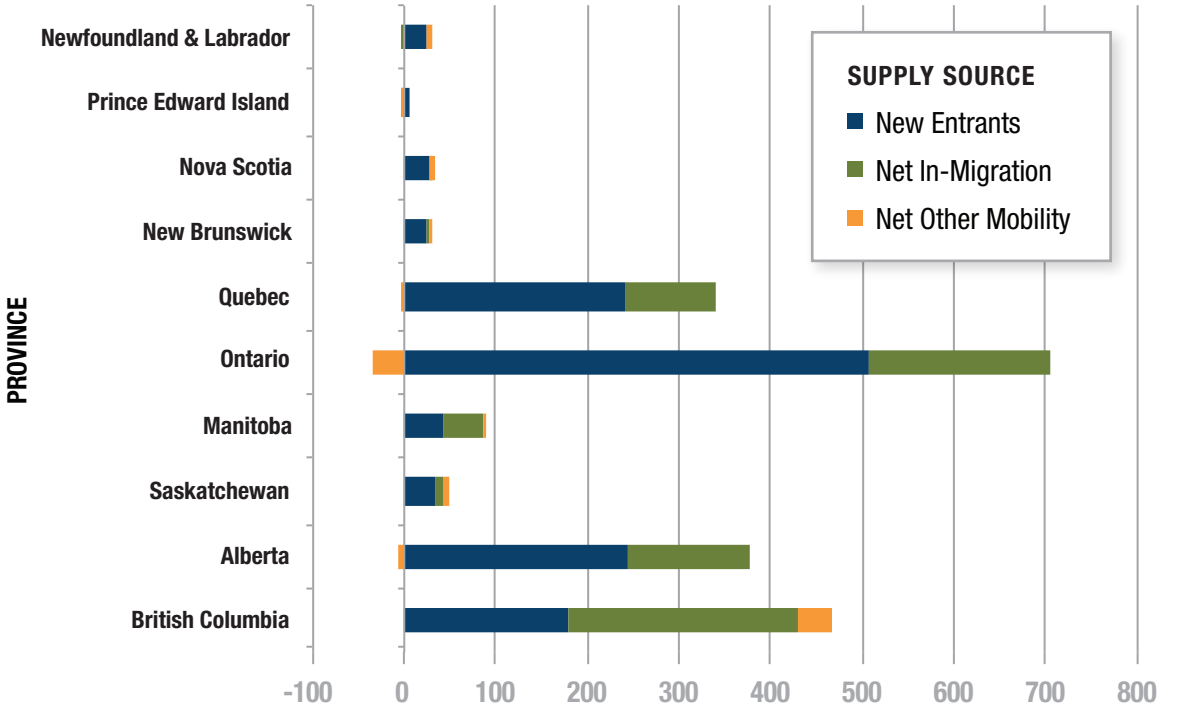
Sources of Supply

New Entrants, Migration and Other Mobility[7]

The sources of supply change shown in Figure 3.2 are new entrants, net in-migration and net other mobility, the latter two being the components of net in-mobility. Net other mobility includes workers moving from other occupations – inter-occupation mobility – and other factors that impact the participation rate of the population in the labour force such as the availability of higher wages and decisions to postpone retirement.

As was seen previously in Figure 3.1, there is strong demand for civil engineers in British Columbia, Alberta, Ontario and Quebec. The supply of civil engineers is shown in Figure 3.2, below. It can be seen from the level of new entrants in the forecast period that young people are being drawn into the occupation. There is also strong net in-migration required for civil engineers to the aforementioned provinces.

Figure 3.2 Sources of Supply for Civil Engineers, Annual Average (2015-2025)



The number of new entrants is the more stable source of supply and easier to target. Expected new entrants for civil engineers across the country are shown in Table 3.6, below. As one would expect, they are found in the larger provinces and with relatively large demands for civil engineers. Ontario, Quebec, British Columbia and Alberta stand out as locations from which new entrants could be obtained.

7 See Appendix A for definition.

The model assumes that an occupation will get its share of total new entrants to the provincial economy based on its share of employment in the provincial economy as a whole. This is only an assumption and it is important for organizations requiring civil engineers to try their best to attract young people into the occupation. Total new entrants across the country amount to about half of the job openings forecasted across the country. This says that there are not enough young people coming into the labour force as a whole to meet expansion and replacement demand.

Table 3.6

Sources of Supply for Civil Engineers (Annual Average 2015-19 and 2020-25)

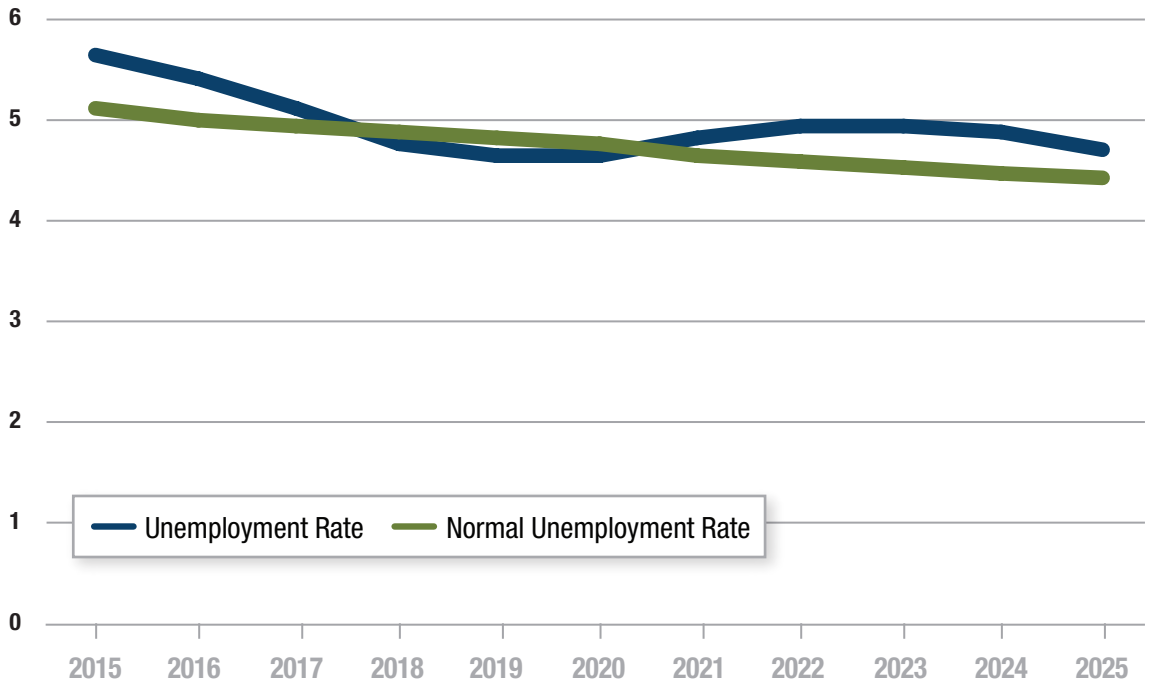
	Average 2015-19				Average 2020-25			
	New Entrants	Net In-Migration	Net Other Mobility	Total Supply	New Entrants	Net In-Migration	Net Other Mobility	Total Supply
British Columbia	178	314	111	604	178	197	-23	352
Alberta	233	179	7	418	252	96	-15	333
Saskatchewan	34	24	2	60	36	-4	8	40
Manitoba	43	57	7	107	45	29	0	73
Ontario	512	214	2	728	503	184	-64	623
Quebec	236	126	27	389	244	78	-29	293
New Brunswick	26	3	6	36	25	3	0	28
Nova Scotia	28	1	15	43	26	2	-4	24
Prince Edward Island	5	-1	0	4	5	0	0	5
Newfoundland & Labrador	26	-16	12	21	25	8	2	35

Labour Market Tightness

Actual vs. Normal Unemployment Rates and Gap

The actual and the normal unemployment rate for civil engineers in Canada are shown in Figure 3.3, below. Unemployment rates near the normal unemployment rate suggests a normal labour market, while unemployment rates noticeably above or below the normal rate suggests either a loose or tight market, respectively. The chart suggests a normal market situation. The actual unemployment rate drops below the normal rate over the medium-term of the forecast, but not by a significant amount.

Figure 3.3 Unemployment Rate for Civil Engineers (%)



Although the labour market for civil engineers in Canada as a whole seems to suggest a normal market situation, the outlook by province could vary significantly. The labour market tightness rankings for civil engineers across the provinces are shown in Table 3.7, below. Rankings of 3 are colour coded in red and represent excess demand, a rank of 2 is a normal situation for the labour market, and a 1 (not seen in this occupation) is a situation of excess supply.

Most provinces will experience normal labour market tightness for civil engineers in the future, as can be seen from Table 3.7, below. The excess demand rankings in British Columbia and Manitoba likely reflect upcoming major projects in these provinces, placing pressure on the demand for these workers.

The labour market tightness rank of 3 over the medium-term of the forecast in British Columbia and Manitoba suggests a slightly higher than normal rate of difficulty in finding civil engineers in these provinces during this period. Given that it appears that the labour market for civil engineers in these two provinces will be only slightly tight in a few years, through the medium-term, it may not be necessary to go outside the provinces to find them. If they were to look outside the province however, the degree of difficulty in this effort will depend on the demand-supply situation in other provinces.

Table 3.7 Weighted Labour Market Tightness Rank (1-3) for Civil Engineers (2015-2025)

	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
British Columbia	3	3	3	3	3	2	2	2	2	2	2
Alberta	2	2	2	2	2	2	2	2	2	2	2
Saskatchewan	2	2	2	2	2	2	2	2	2	2	2
Manitoba	3	3	3	2	2	2	2	2	2	2	2
Ontario	2	2	2	2	2	2	2	2	2	2	2
Quebec	2	2	2	2	2	2	2	2	2	2	2
New Brunswick	2	2	2	2	2	2	2	2	2	2	2
Nova Scotia	2	2	2	2	2	2	2	2	2	2	2
Prince Edward Island	2	2	2	2	2	2	2	2	2	2	2
Newfoundland & Labrador	2	2	2	2	2	2	2	2	2	2	2

The breakdown of in-migration into international and inter-provincial in-migration is shown in Table 3.8, below. As you can see in the table, international in-migration is the largest source of in-migration across the country. As the average age of civil engineers rises in British Columbia and Manitoba, there will be excess demand in the short to medium-term. Given the current graduate levels, the forecasted new entrants levels and international in-migration of civil engineers to the provinces, there should be no difficulties in obtaining the required workforce. Mobility of new entrants across the country may be the greatest difficulty.

Table 3.8 International and Inter-Provincial In-Migration of Civil Engineers (2015-2025)

	Average 2015-19		Average 2020-25	
	International	Inter-Provincial	International	Inter-Provincial
British Columbia	234	80	161	37
Alberta	115	63	41	54
Saskatchewan	21	3	-3	-1
Manitoba	73	-16	54	-26
Ontario	246	-32	218	-34
Quebec	148	-22	84	-6
New Brunswick	0	3	3	0
Nova Scotia	2	-2	4	-2
Prince Edward Island	-1	0	1	0
Newfoundland & Labrador	7	-24	1	8

4 MECHANICAL ENGINEERS

The forecast is for the Canadian economy to produce about 2,100 job openings for mechanical engineers annually over the next five years – about 60 per cent of these openings will be driven by replacement demand. The number of job openings will fall to 1,400 annually during the latter five years of the forecast primarily due to diminished expansion demand from industry.

The expectation is that new entrants to the occupation will average about 1,200 annually over the next five years. Net other mobility (inter-occupation) is limited for engineers; the result is that net in-migration will have to average about 680 annually to meet supply requirements over that period. International in-migration requirements for mechanical engineers will be high – averaging about 620 per year. During the latter 5 year period the pressures on international in-migration will be reduced to 175 annually.

Occupation Characteristics

Graduates

Mechanical engineering degrees granted by province are presented in Table 4.1, below. Ontario universities granted by far the largest number of mechanical engineering degrees in 2013 – just over 1,400. The increase in mechanical engineering degrees granted in Ontario since 2000 has also been remarkable. British Columbia universities granted far fewer mechanical engineering degrees, but the increase was just as significant, and the same has been the case in Newfoundland and Labrador. The number of degrees granted was relatively stagnant over the period in Saskatchewan and Nova Scotia. Quebec universities granted nearly 800 degrees in 2013, but the increase since 2000 has been rather limited. The number of mechanical engineering degrees granted to women has increased from 263 in 2000 to 342 in 2013[8]. They accounted for 10 per cent of the total mechanical engineering degrees in 2013. The number of these degrees granted to visa students increased steadily to 297 in 2013[9].

8 Source: Engineers Canada

9 Source: Engineers Canada. Visa data in this report refers to undergraduates only.

Table 4.1 Degrees Granted, Mechanical Engineering (2000-2013)

	Average 2000-04	Average 2005-09	2010	2011	2012	2013
British Columbia	150	172	241	264	276	330
Alberta	218	263	287	339	322	314
Saskatchewan	59	66	60	73	88	60
Manitoba	59	61	70	79	75	77
Ontario	798	1091	1344	1229	1370	1416
Quebec	666	805	768	795	816	792
New Brunswick	50	84	76	65	64	94
Nova Scotia	58	58	70	53	56	77
Prince Edward Island	0	0	0	0	0	0
Newfoundland & Labrador	53	56	68	69	86	95

Source: Engineers Canada's 2014 Enrolment and Degrees Awarded Report

Industry Employment

Table 4.2, below, shows a ranking of employment by industry and province for mechanical engineers over the forecast period. A large number of mechanical engineers work in the Architectural, Engineering and Related Services industry. The majority of these are in Ontario but there are also significant numbers in Alberta, Quebec and British Columbia. A large number of mechanical engineers also work in the Transportation Equipment Manufacturing industry in Ontario and Quebec as well as in Machinery Manufacturing in Ontario, Alberta and Quebec. Oil and Gas Extraction in Alberta also employs many mechanical engineers.

Table 4.2 Top 25 Employment Estimates, Mechanical Engineers by Industry and Province (2015-2025)

Province	Industry	Average 2015-19	Average 2020-25
ONTARIO	Architectural, Engineering and Related Services	7191	7464
ALBERTA	Architectural, Engineering and Related Services	4936	5280
ONTARIO	Transportation equipment manufacturing	4460	4294
QUEBEC	Architectural, Engineering and Related Services	3056	3093
QUEBEC	Transportation equipment manufacturing	2606	2449
BRITISH COLUMBIA	Architectural, Engineering and Related Services	2174	2285
ONTARIO	Machinery manufacturing	1828	1903
ONTARIO	Utilities	1366	1396
ONTARIO	Wholesale Trade	1023	1067
ALBERTA	Conventional Oil	838	687
ALBERTA	Machinery manufacturing	833	843
QUEBEC	Machinery manufacturing	786	740
ONTARIO	Fabricated metal product manufacturing	743	746
ONTARIO	Computer and electronic product manufacturing	728	766
ONTARIO	Other Professional, Scientific and Technical Services	709	737
ONTARIO	Federal government public administration	596	622
ONTARIO	Trade contracting	490	491
BRITISH COLUMBIA	Machinery manufacturing	463	449
NOVA SCOTIA	Architectural, Engineering and Related Services	462	459
ALBERTA	Support activities for mining and oil and gas extraction	458	463
QUEBEC	Wholesale Trade	455	451
ONTARIO	Management, Scientific and Technical Consulting Services	445	462
SASKATCHEWAN	Architectural, Engineering and Related Services	436	444
ONTARIO	Electrical equipment appliance and component manufacturing	418	415
QUEBEC	Utilities	414	432

Age Structure

The average age of engineers in Canada is between 30 and 55 years old. British Columbia has the highest average age for mechanical engineers at 46. It is also quite high in Manitoba and New Brunswick – 44 in both provinces. The average age of mechanical engineers is lower in Saskatchewan, Quebec and Newfoundland and Labrador.

The projections show a decline in the average age for mechanical engineers in British Columbia over the forecast. As mechanical engineers in British Columbia retire and new entrants or younger

migrants are brought into the workforce, the average age will to decline. The average age of mechanical engineers will increase in Quebec and Newfoundland and Labrador over the forecast period while they will remain stable in the other provinces.

The skills gap between retirees and new entrants is an important issue for mechanical engineers. New entrants into the labour force do not have the skill set that retirees have acquired during their work experience. Provinces may attempt to bring in experienced workers through inter-provincial or international migration.

Table 4.3 Average Age of Mechanical Engineers (2015-2025)

	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
British Columbia	46	45	45	44	44	44	44	44	44	43	43
Alberta	42	42	42	42	42	42	43	43	43	43	43
Saskatchewan	41	41	41	41	42	42	42	42	42	42	42
Manitoba	44	44	44	43	43	43	43	43	43	43	43
Ontario	43	43	43	43	43	43	43	43	43	43	43
Quebec	41	41	42	42	42	42	43	43	43	43	43
New Brunswick	44	44	44	44	44	44	44	44	44	44	44
Nova Scotia	42	42	42	42	42	42	42	42	43	43	43
Prince Edward Island	42	43	43	44	44	44	45	45	45	45	45
Newfoundland & Labrador	37	37	37	37	38	38	38	39	39	40	40

Median wage data for mechanical engineers by province is shown in Table 4.4 below. The data in the table represents thousands of dollars per year. Mechanical engineers in Alberta have median wages that are considerably higher than other provinces. They are expected to be pushed higher by strong demand over the forecast. Median annual wages for mechanical engineers are relatively low in Manitoba and New Brunswick. The median annual wage for mechanical engineers in Prince Edward Island is very low, although the employment of these engineers in Prince Edward Island is nearly zero and therefore the sample size for wage data in the province is not reliable.

Table 4.4 Median Annual Wage ($ 000s) 2015-2025

	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
British Columbia	78.6	81.0	84.0	87.5	91.3	95.1	98.8	102.2	105.5	108.7	111.9
Alberta	107.3	109.5	111.9	115.4	119.4	123.7	128.1	132.3	136.2	140.0	143.6
Saskatchewan	88.7	91.8	94.6	97.0	99.0	100.8	102.1	103.4	104.9	106.9	109.7
Manitoba	67.1	69.0	70.9	72.8	74.5	76.1	77.5	78.9	80.4	82.1	84.0
Ontario	83.8	86.3	88.9	91.7	94.2	96.6	98.9	101.2	103.7	106.5	109.7
Quebec	75.0	77.4	80.0	82.9	85.7	88.3	90.7	93.0	95.2	97.5	100.0
New Brunswick	68.8	70.3	72.4	75.0	77.7	80.7	83.6	86.5	89.3	92.2	95.2
Nova Scotia	77.0	79.5	82.4	85.7	88.8	92.0	95.2	98.4	101.6	105.1	108.9
Prince Edward Island	40.7	41.1	41.6	42.3	42.9	43.5	44.0	44.4	44.8	45.2	45.7
Newfoundland & Labrador	86.6	88.8	91.1	94.2	97.4	100.9	104.5	108.1	111.4	114.1	117.1

Sources of Demand

Expansion Demand and Replacement Demand

Total demand (total job openings) is composed of expansion demand and replacement demand (retirements and deaths). Figure 4.1 shows the importance of replacement to total demand change for mechanical engineers by province over the forecast period. In the Atlantic Provinces, total demand change is comprised almost entirely of replacement demand. Expansion demand for mechanical engineers in Ontario, Alberta and British Columbia is significant over the forecast, but replacement is considerably higher.

Table 4.5 below shows that average annual job openings for mechanical engineers in Ontario over the next five years is by far the highest of any province at 876[10]. Replacement demand is expected to contribute nearly 70 per cent of total job openings over that period. The importance of replacement demand will increase to nearly 90 per cent of total job openings during the last five years. Job openings for mechanical engineers will also be significant in Alberta, Quebec and British Columbia over the next five years but will taper off sharply as expansion demand collapses.

10 Due to random rounding, expansion demand plus replacement demand may not always equal total job openings

Figure 4.1 Sources of Demand for Mechanical Engineers (Annual Average 2015-2025)

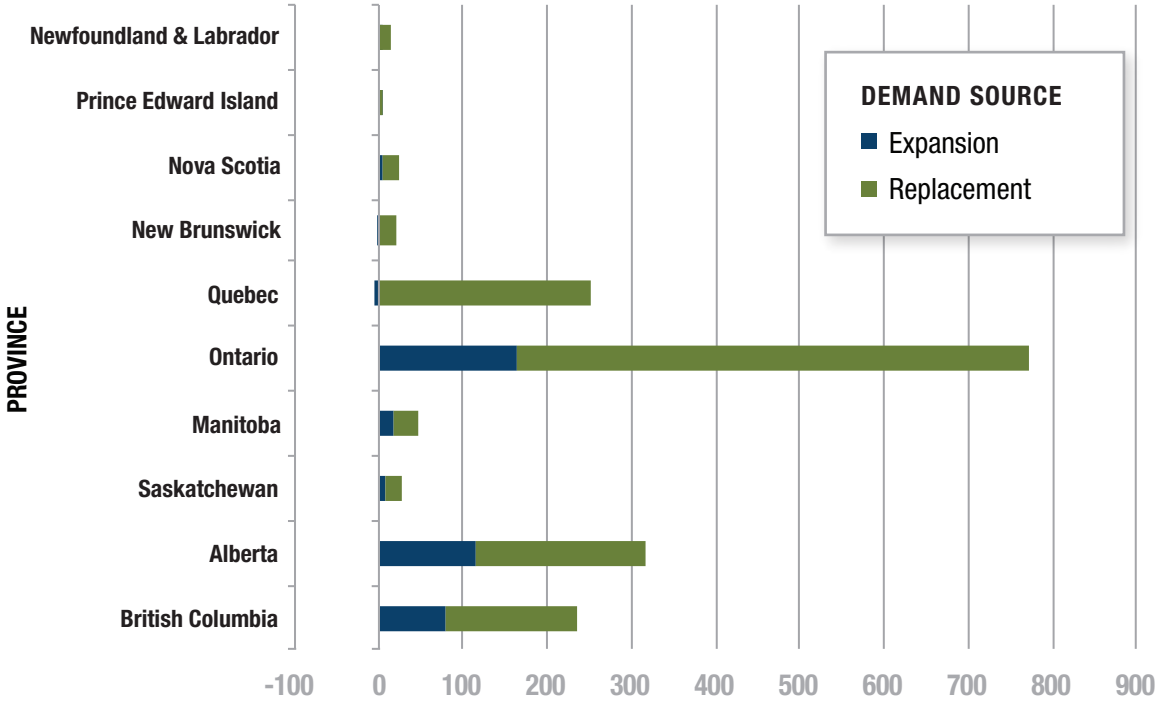


Table 4.5 Sources of Demand for Mechanical Engineers (Annual Average 2015-19 and 2020-25)

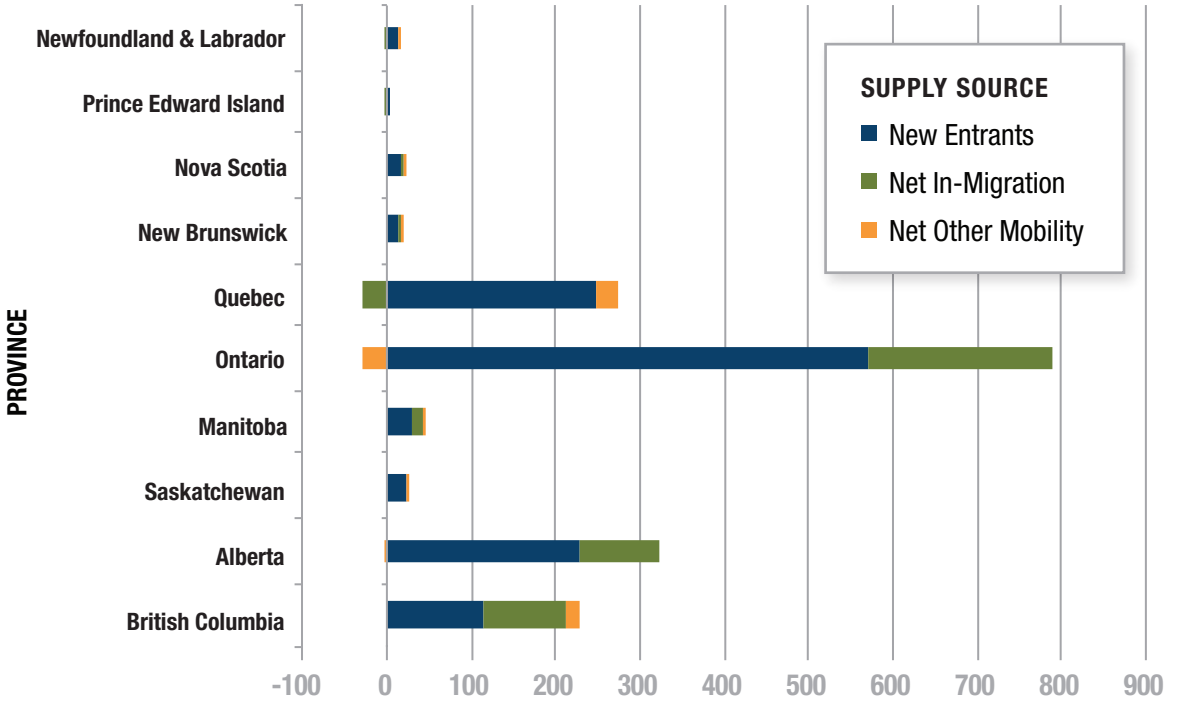
	Average 2015-19			Average 2020-25		
	Expansion	Replacement	Job Openings	Expansion	Replacement	Job Openings
British Columbia	167	161	328	4	153	157
Alberta	211	186	397	34	217	250
Saskatchewan	12	17	29	5	21	25
Manitoba	28	28	56	7	29	36
Ontario	276	600	876	72	615	687
Quebec	107	230	337	-98	269	171
New Brunswick	1	22	22	-7	21	14
Nova Scotia	16	19	35	-8	22	14
Prince Edward Island	0	1	1	0	2	1
Newfoundland & Labrador	5	10	15	-1	12	11

Sources of Supply

New Entrants, Migration and Other Mobility

Figure 4.2, below, shows the sources of supply for mechanical engineers. The number of new entrants to the occupation over the forecast period in Ontario is very large. This is followed by Quebec, Alberta and British Columbia. The number of new entrants is nearly insignificant in the Atlantic Provinces, Manitoba and Saskatchewan. Ontario, Alberta and British Columbia are receiving the majority of net in-migration.

Figure 4.2 **Sources of Supply for Mechanical Engineers (Annual Average 2015-2025)**



Total supply requirements and the components of supply for mechanical engineers are provided in Table 4.6 below. Over the next five years Ontario's supply requirements for mechanical engineers averages 864 per year followed by Alberta with 390 and Quebec with 317. The new entrants' share of total supply requirements is highest in Ontario and Quebec. Net in-migration is very low in Quebec while net in-migration exceeds new entrants in British Columbia. Supply requirements drop sharply during the last five years of the forecast.

It is important to notice that total new entrants amount to about half of the forecasted job openings. This says that there are not enough young people coming into the labour force as a whole to meet expansion and replacement demand.

Table 4.6 Sources of Supply for Mechanical Engineers (Annual Average 2015-19 and 2020-25)

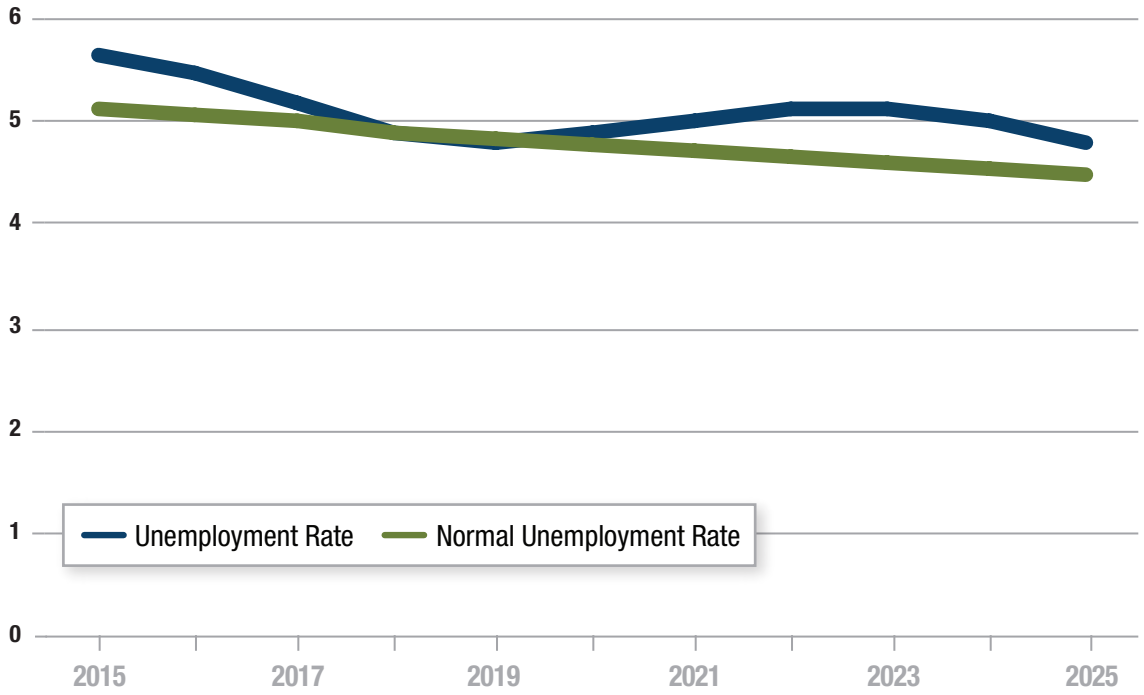
	Average 2015-19				Average 2020-25			
	New Entrants	Net In-Migration	Net Other Mobility	Total Supply	New Entrants	Net In-Migration	Net Other Mobility	Total Supply
British Columbia	117	133	49	299	114	65	-7	172
Alberta	221	165	5	390	233	37	-5	265
Saskatchewan	22	8	2	31	23	-6	9	25
Manitoba	27	26	3	56	29	8	0	37
Ontario	580	273	11	864	562	175	-61	677
Quebec	248	55	14	317	247	-97	40	190
New Brunswick	15	2	2	19	14	0	1	15
Nova Scotia	19	1	9	30	18	1	-4	14
Prince Edward Island	1	-1	0	1	2	0	0	2
Newfoundland & Labrador	15	3	-4	14	15	-6	4	13

Labour Market Tightness

Actual vs. Normal Unemployment Rates and Gap

The actual and the normal unemployment rate for mechanical engineers in Canada are shown in Figure 4.3 below. Unemployment rates near the normal unemployment rate suggests a normal labour market, while unemployment rates noticeably above or below the normal rate suggests either a loose or tight market, respectively. The chart suggests a normal market situation.
The actual unemployment rate drops below the normal rate over the medium-term of the forecast, but not by a significant amount.

Figure 4.3 Unemployment Rate for Mechanical Engineers (%), Canada (2015-2025)



Although the labour market for mechanical engineers in Canada as a whole seems to suggest a normal market situation, the outlook by province could vary significantly. The labour market tightness rankings for mechanical engineers by province are shown in Table 4.7, below. Rankings of 3 are colour coded in red and represent excess demand, a rank of 2 is a normal situation for the labour market, and a 1 (not seen in this occupation) is a situation of excess supply.

Most provinces will experience normal labour market tightness for mechanical engineers in the future, as can be seen from Table 4.7 below. The labour market tightness rank of 2 suggests a balanced market for mechanical engineers over the forecast period. A tightness ranking of 3 in Manitoba in 2018 suggests a slightly higher than normal rate of difficulty in finding mechanical engineers during this period, and is likely the result of an upcoming project in the province.

Table 4.7 Weighted Labour Market Tightness Rank (1-3) for Mechanical Engineers (2015-2025)

	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
British Columbia	2	2	2	2	2	2	2	2	2	2	2
Alberta	2	2	2	2	2	2	2	2	2	2	2
Saskatchewan	2	2	2	2	2	2	2	2	2	2	2
Manitoba	2	2	2	3	2	2	2	2	2	2	2
Ontario	2	2	2	2	2	2	2	2	2	2	2
Quebec	2	2	2	2	2	2	2	2	2	2	2
New Brunswick	2	2	2	2	2	2	2	2	2	2	2
Nova Scotia	2	2	2	2	2	2	2	2	2	2	2
Prince Edward Island	2	2	2	2	2	2	2	2	2	2	2
Newfoundland & Labrador	2	2	2	2	2	2	2	2	2	2	2

Table 4.8, below, shows a breakdown of international and inter-provincial in-migration for mechanical engineers. In general international in-migration is the largest source of in-migration. Strong international and inter-provincial in-migration is required in British Columbia and Alberta to meet the demand for mechanical engineers. In Ontario and Quebec, the weak demand for mechanical engineers results in negative inter-provincial in-migration or mechanical engineers leaving the province for jobs elsewhere – most likely in British Columbia and Alberta.

Table 4.8 International and Inter-Provincial In-Migration of Mechanical Engineers (2015-2025)

	Average 2015-19		Average 2020-25	
	International	Inter-Provincial	International	Inter-Provincial
British Columbia	100	34	53	12
Alberta	109	55	16	21
Saskatchewan	7	1	-8	1
Manitoba	34	-9	15	-7
Ontario	309	-36	203	-28
Quebec	65	-10	-104	7
New Brunswick	1	1	0	0
Nova Scotia	1	0	2	-1
Prince Edward Island	-1	0	0	0
Newfoundland & Labrador	-5	8	-1	-5

5 ELECTRICAL AND ELECTRONICS ENGINEERS

The forecast is for the Canadian economy to produce about 1,800 job openings for electrical and electronic engineers annually over the next five years. Sixty-five per cent of these openings will be driven by replacement demand. It is expected that total job openings will taper off to about 1,350 per year during the latter 5 year period as expansion demand from industry falls off.

Canadian universities grant over 2,000 degrees to electrical and electronic engineers annually and will have little problems supplying the needed workers in the occupation. The expectation is that new entrants to the occupation will average about 1,100 annually over the next five years. Net in-migration will have to average about 640 annually to meet demand requirements over that period. It is expected that international in-migration for electrical and electronic engineers will provide the majority of these workers - about 590 per year. During the latter 5 year period the pressures on international in-migration will be reduced to about 420 annually.

Occupation Characteristics

Graduates

Electrical and electronics engineering degrees granted by province are presented in Table 5.1, below. Universities in Ontario and Quebec have granted by far the largest number of these degrees. However, the number has remained constant since 2000. British Columbia universities have granted far fewer of these degrees; however the number has increased markedly since 2000. In 2000, Alberta universities were granting many more than in neighbouring British Columbia. Alberta's electrical and electronics degrees granted has remained almost stagnant more recently. Visa students were granted 297 of these degrees in 2013[11]. The proportion of these degrees granted to visa students peaked in 2009 at 15 per cent and has remained essentially constant since then. Female students were granted 283 of these degrees in 2013.

11 Source: Engineers Canada. Visa data in this report refers to undergraduates only.

Table 5.1 Degrees Granted, Electrical and Electronics Engineering (2000-2013)

	Average 2000-04	Average 2005-09	2010	2011	2012	2013
British Columbia	100	172	206	203	210	232
Alberta	174	193	196	206	201	208
Saskatchewan	52	44	29	19	23	39
Manitoba	38	31	39	33	18	21
Ontario	1007	1040	969	936	973	973
Quebec	580	686	564	551	529	570
New Brunswick	46	52	32	36	44	43
Nova Scotia	43	45	30	33	35	29
Prince Edward Island	0	0	0	0	0	0
Newfoundland & Labrador	36	24	38	24	22	22

Source: Engineers Canada's 2014 Enrolment and Degrees Awarded Report

Industry Employment

Table 5.2, below, shows a ranking of employment by industry and province for electrical and electronics engineers over the forecast period. A large number of electrical and electronics engineers work in the Architectural, Engineering and Related Services industry. The majority of these are in Ontario but there are significant numbers in Alberta, Quebec and British Columbia. A large number of electrical and electronics engineers also work in Computer and Electronic Product Manufacturing and Computer Systems Design in Ontario. The Utilities industry in Ontario and Quebec also employ large numbers as well.

Table 5.2 Top 25 Employment Estimates, Electrical and Electronics Engineers by Industry and Province (2015-2025)

Province	Industry	Average 2015-19	Average 2020-25
ONTARIO	Architectural, Engineering and Related Services	6228	6464
ALBERTA	Architectural, Engineering and Related Services	3796	4060
ONTARIO	Computer and electronic product manufacturing	2510	2639
QUEBEC	Architectural, Engineering and Related Services	2292	2320
ONTARIO	Utilities	2010	2055
BRITISH COLUMBIA	Architectural, Engineering and Related Services	1763	1853
QUEBEC	Utilities	1309	1364
ONTARIO	Wholesale Trade	1167	1217
ONTARIO	Computer Systems Design and Related Services	1072	1110
ONTARIO	Transportation equipment manufacturing	1053	1014
ONTARIO	Other Professional, Scientific and Technical Services	1026	1067
QUEBEC	Computer and electronic product manufacturing	786	741
ONTARIO	Electrical equipment appliance and component manufacturing	766	760
BRITISH COLUMBIA	Utilities	711	758
ALBERTA	Utilities	690	737
ONTARIO	Machinery manufacturing	647	673
ONTARIO	Telecommunications	640	654
ONTARIO	Federal government public administration	555	579
QUEBEC	Computer Systems Design and Related Services	547	554
BRITISH COLUMBIA	Computer and electronic product manufacturing	546	531
QUEBEC	Transportation equipment manufacturing	544	511
ONTARIO	Trade contracting	539	539
QUEBEC	Other Professional, Scientific and Technical Services	481	486
ALBERTA	Oil and gas extraction	459	404
MANITOBA	Utilities	430	466

Age Structure

The average age of electrical and electronics engineers ranges from 41 in Saskatchewan to 47 in New Brunswick. Average ages are expected to remain relatively constant over the forecast period in all provinces.

Table 5.3 Average Age of Electrical and Electronics Engineers (2015-2025)

	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
British Columbia	44	44	44	44	44	43	43	43	43	43	43
Alberta	43	43	43	43	43	43	43	43	43	43	43
Saskatchewan	41	41	41	42	42	42	43	43	43	43	43
Manitoba	44	44	43	43	43	43	43	43	43	43	43
Ontario	44	44	43	43	43	43	43	43	43	43	43
Quebec	43	43	43	43	43	43	44	44	44	44	44
New Brunswick	47	47	47	46	46	45	45	45	44	44	44
Nova Scotia	44	44	44	43	43	43	43	43	43	43	43
Prince Edward Island	-	-	-	-	-	-	-	-	-	-	-
Newfoundland & Labrador	42	42	41	41	41	42	42	42	42	43	42

Median annual wage data for electrical and electronics engineers is shown in Table 5.4, below. The data in the table represents thousands of dollars. Median annual wage for electrical and electronics engineers are quite high in Alberta but surprisingly even higher in Newfoundland and Labrador. The forecast is for sizeable increases in annual wages in both these provinces. The lowest median wage for these engineers is in Nova Scotia and Manitoba where there is relatively low demand generated by industry.

Table 5.4 Median Annual Wage ($ 000s) 2015-2025

	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
British Columbia	87.8	90.3	93.6	97.5	101.7	106.0	110.1	114.0	117.7	121.4	125.0
Alberta	105.8	107.9	110.3	113.7	117.6	122.0	126.4	130.6	134.5	138.2	141.9
Saskatchewan	91.8	95.0	97.8	100.3	102.4	104.2	105.6	106.9	108.4	110.5	113.3
Manitoba	85.1	87.7	90.2	92.6	94.7	96.6	98.4	100.3	102.4	104.5	107.0
Ontario	87.9	90.5	93.2	96.1	98.8	101.3	103.8	106.3	108.9	111.9	115.3
Quebec	87.7	90.3	93.4	96.8	100.0	103.2	106.1	108.8	111.5	114.2	117.3
New Brunswick	91.6	93.5	96.3	99.7	103.4	107.3	111.2	115.0	118.8	122.6	126.7
Nova Scotia	84.4	87.2	90.4	93.9	97.3	100.8	104.3	107.8	111.3	115.2	119.3
Prince Edward Island	-	-	-	-	-	-	-	-	-	-	-
Newfoundland & Labrador	120.2	123.2	126.7	131.5	136.1	141.1	145.9	150.8	155.2	159.2	163.5

Sources of Demand

Expansion Demand and Replacement Demand

Total demand (total job openings) is composed of expansion demand and replacement demand (retirements and deaths). Figure 5.1 shows the importance of replacement to total demand change for electrical and electronic engineers by province over the forecast period. Total demand change is minimal in the Atlantic Provinces, Manitoba, and Saskatchewan and is comprised almost entirely of replacement demand. Expansion demand for electrical and electronics engineers in Ontario, Alberta and British Columbia is significant over the forecast, but replacement is considerably higher. There is very little expansion demand in Quebec, Manitoba and Saskatchewan related to the growth of industries employing electrical and electronics engineers.

Figure 5.1 Sources of Demand for Electrical and Electronics Engineers (Annual Average 2015-2025)

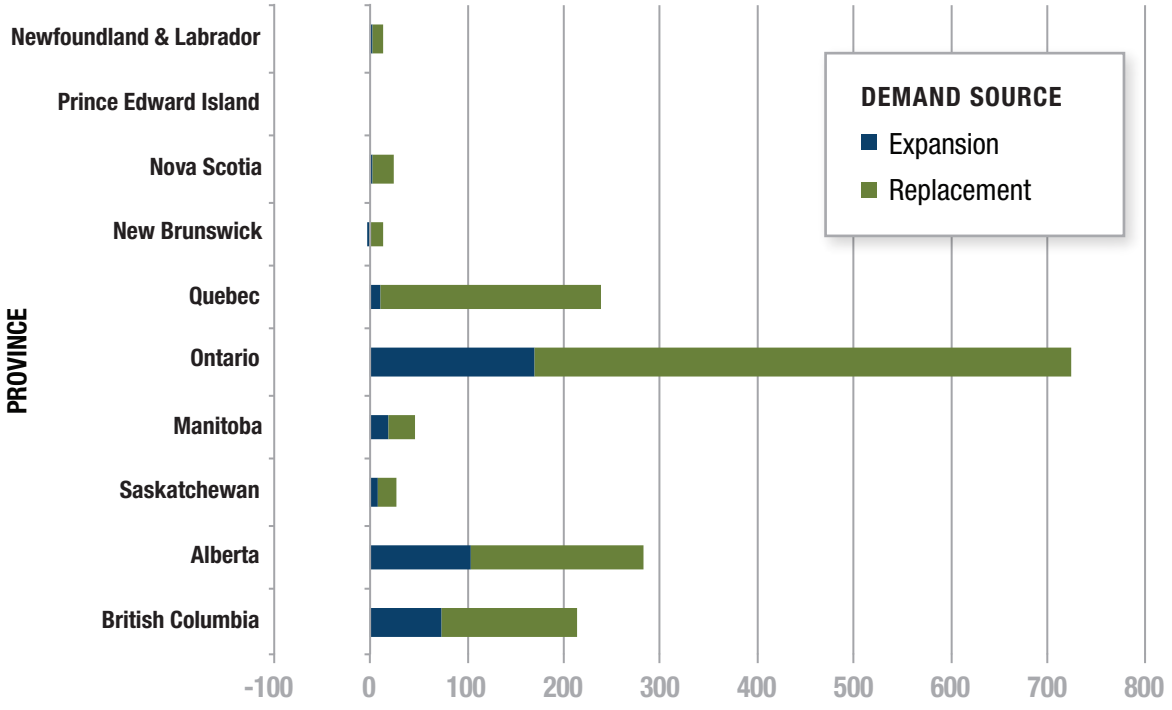


Table 5.5 shows that average job openings for electrical and electronics engineers in Ontario over the next five years is by far the highest of any province at 792 per year.[12] Replacement demand related to retirements is expected to contribute nearly 70 per cent of total job openings over that period. The importance of replacement demand will increase to over 80 per cent of total job openings during the last five years. Job openings for electrical and electronics engineers will also be significant in Alberta, Quebec and British Columbia over the next five years but will taper off sharply as expansion demand is sharply diminished during the latter five years.

Table 5.5 Sources of Demand for Electrical and Electronics Engineers (Annual Average 2015-19 and 2020-25)

	Average 2015-19			Average 2020-25		
	Expansion	Replacement	Job Openings	Expansion	Replacement	Job Openings
British Columbia	133	140	273	23	144	167
Alberta	174	164	338	47	187	233
Saskatchewan	11	18	29	4	22	26
Manitoba	30	27	56	11	29	40
Ontario	245	547	792	109	557	667
Quebec	69	217	286	-39	237	198
New Brunswick	0	15	16	-3	13	11
Nova Scotia	13	23	35	-7	22	15
Prince Edward Island	-	-	-	-	-	-
Newfoundland & Labrador	9	10	19	-1	12	11

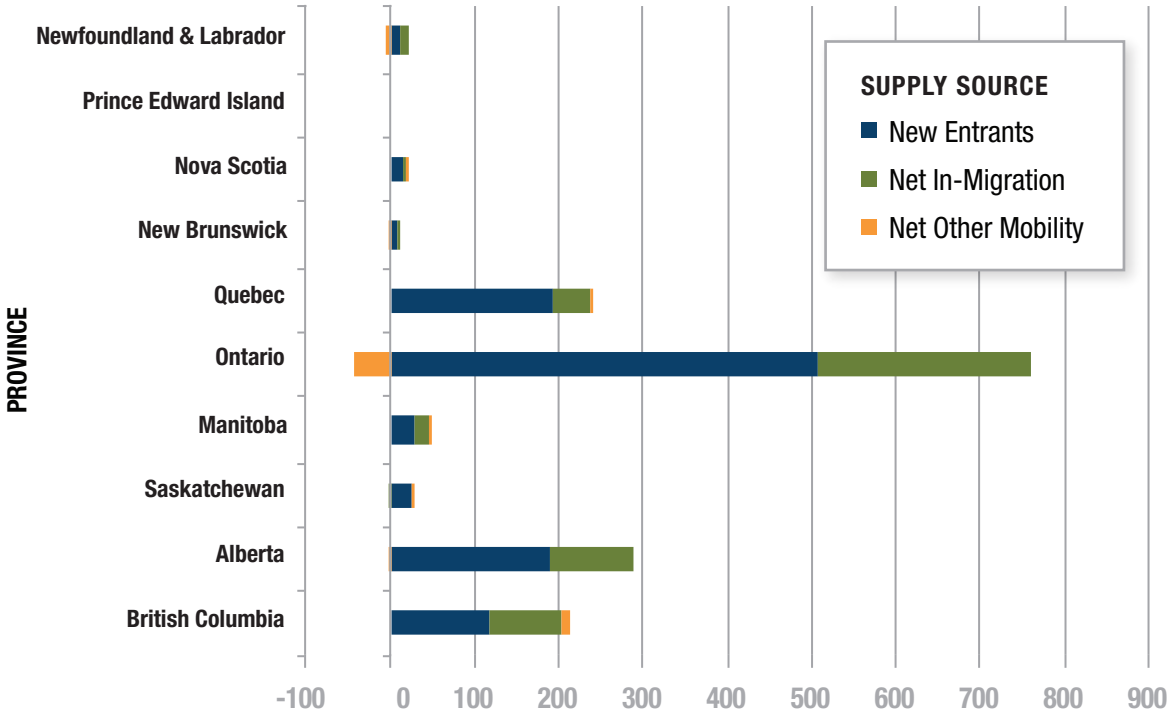
12 Due to random rounding, expansion demand plus replacement demand may not equal total job openings

Sources of Supply

New Entrants, Migration and Other Mobility

Sources of supply of electrical and electronics engineers are shown in Figure 5.2. The number of new entrants to the occupation over the forecast period in Ontario is very large – followed by Quebec, Alberta and British Columbia. The number of new entrants is insignificant in the Atlantic Provinces, Manitoba and Saskatchewan. Ontario, Quebec, Alberta and British Columbia are receiving the majority of net in-migration of electrical and electronics engineers in Canada.

Figure 5.2 Sources of Supply for Electrical and Electronics Engineers (Annual Average 2015-2025)



Total supply requirements and the components of supply of electrical and electronics engineers are provided in Table 5.6. Over the next five years Ontario's supply requirements for electrical and electronics engineers averages 789 per year followed by Alberta with 333 and Quebec with 274. The new entrants' share of the total supply requirement is highest in Ontario and Quebec. Net in-migration is very low relative to the total supply requirement in Quebec. Net in-migration nearly matches new entrants in British Columbia during the first five years. The supply requirements for electrical and electronics engineers are more moderate during the last five years of the forecast for all provinces.

Table 5.6

Sources of Supply for Electrical and Electronics Engineers (Annual Average 2015-19 and 2020-25)

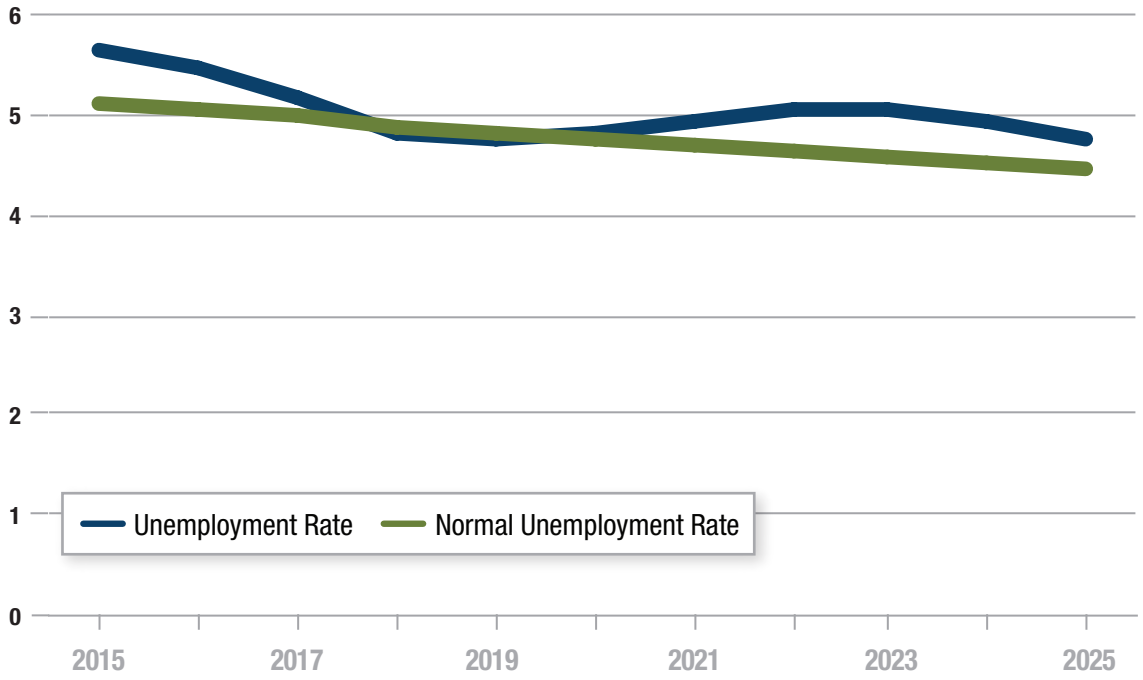
	Average 2015-19				Average 2020-25			
	New Entrants	Net In-Migration	Net Other Mobility	Total Supply	New Entrants	Net In-Migration	Net Other Mobility	Total Supply
British Columbia	118	100	34	252	116	74	-8	182
Alberta	182	146	5	333	194	61	-10	246
Saskatchewan	24	7	1	33	25	-8	8	25
Manitoba	27	26	3	56	28	11	0	39
Ontario	511	274	4	789	501	241	-84	659
Quebec	193	66	15	274	195	28	-10	213
New Brunswick	8	3	3	14	8	7	-3	11
Nova Scotia	17	1	14	31	16	2	-2	15
Prince Edward Island	-	-	-	-	-	-	-	-
Newfoundland & Labrador	11	19	-12	18	11	2	-1	12

Labour Market Tightness

Actual vs. Normal Unemployment Rates and Gap

Unemployment rates near the normal unemployment rate suggests a normal labour market, while unemployment rates noticeably above or below the normal rate suggests either a loose or tight market, respectively. The chart suggests a normal market situation. The actual unemployment rate rises slightly above the normal rate over the long-term of the forecast, but not by a significant amount.

Figure 5.3 Unemployment Rate for Electrical and Electronics Engineers (%), Canada (2015-2025)



The labour market for electrical and electronics engineers in the country as a whole seems to suggest a normal market situation; the outlook by province could vary significantly. The labour market tightness rankings for electrical and electronics engineers across the provinces are shown in Table 5.7. Rankings of 3 are colour coded in red and represent excess demand, a rank of 2 is a normal situation for the labour market, and a 1 (not seen in this occupation) is a situation of excess supply.

Most provinces will experience normal labour market tightness for electrical and electronic engineers in the future. The excess demand ranking in Newfoundland and Labrador likely reflects upcoming major projects which will put some pressure on the demand for these workers.

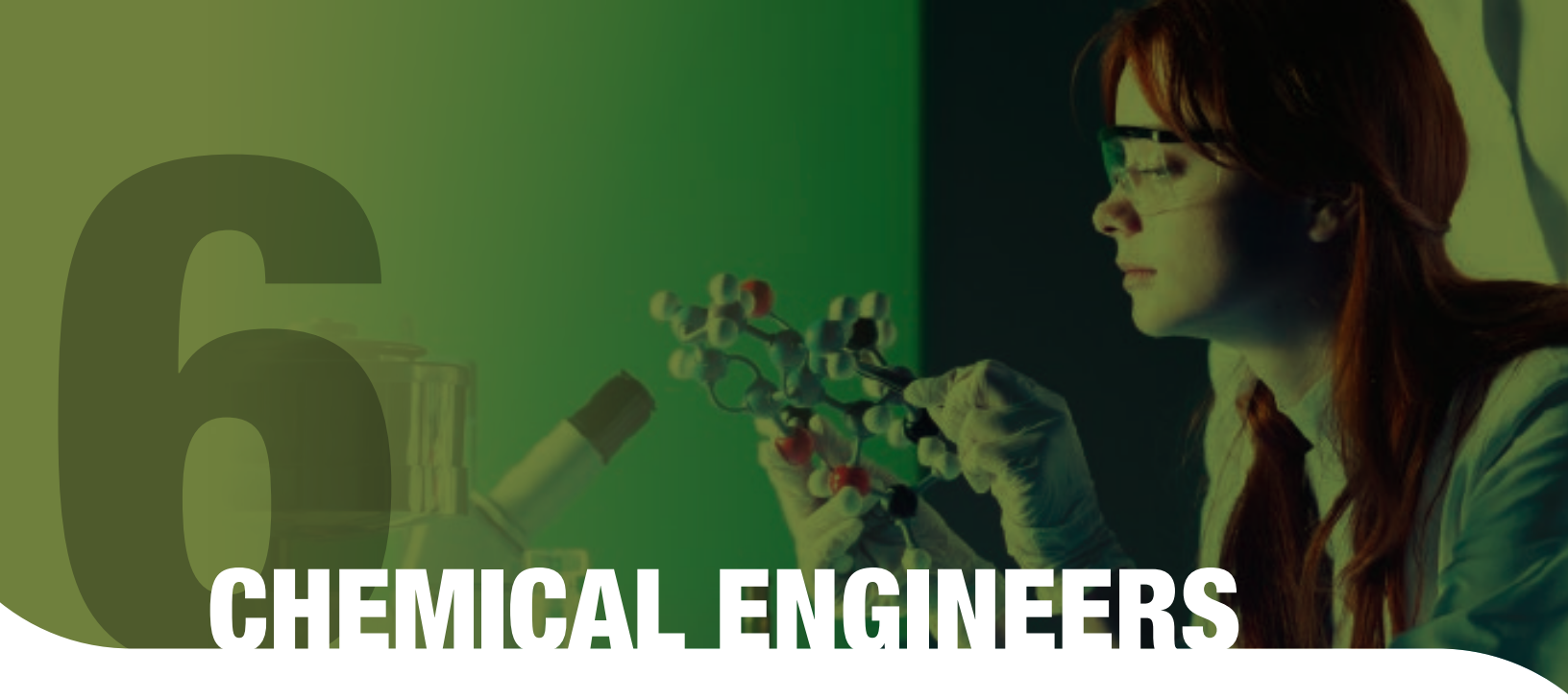
Table 5.7 Weighted Labour Market Tightness Rank (1-3) for Electrical and Electronics Engineers (2015-2025)

	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
British Columbia	2	2	2	2	2	2	2	2	2	2	2
Alberta	2	2	2	2	2	2	2	2	2	2	2
Saskatchewan	2	2	2	2	2	2	2	2	2	2	2
Manitoba	2	2	2	2	2	2	2	2	2	2	2
Ontario	2	2	2	2	2	2	2	2	2	2	2
Quebec	2	2	2	2	2	2	2	2	2	2	2
New Brunswick	2	2	2	2	2	2	2	2	2	2	2
Nova Scotia	2	2	2	2	2	2	2	2	2	2	2
Prince Edward Island	-	-	-	-	-	-	-	-	-	-	-
Newfoundland & Labrador	2	2	3	2	2	2	2	2	2	2	2

Table 5.8, below, provides a breakdown of international and inter-provincial in-migration for electrical and electronic engineers by province. International in-migration is the largest source of in-migration in every province. Given the current graduate levels, the forecasted new entrants levels and international in-migration of electrical and electronic engineers to the provinces, there should be no difficulties in obtaining the required workforce. Mobility of new entrants across the country may be the greatest difficulty.

Table 5.8 International and Inter-Provincial In-Migration of Electrical and Electronics Engineers (2015-2025)

	Average 2015-19		Average 2020-25	
	International	Inter-Provincial	International	Inter-Provincial
British Columbia	74	26	61	13
Alberta	96	50	26	35
Saskatchewan	6	1	-11	3
Manitoba	35	-8	22	-10
Ontario	312	-38	284	-43
Quebec	76	-10	30	-2
New Brunswick	3	0	6	0
Nova Scotia	3	-2	3	-1
Prince Edward Island	-	-	-	-
Newfoundland & Labrador	-16	35	0	2



6 CHEMICAL ENGINEERS

The forecast is for the Canadian economy to produce about 400 job openings for chemical engineers annually over the next five years. Seventy per cent of these openings will be driven by replacement demand. It is expected that total job openings will taper off to about 300 per year during the latter 5 year period as expansion demand from industry is diminished.

Canadian universities grant about 1,300 chemical engineering degrees annually and should not have any problems supplying the needed workers in the occupation. The expectation is that new entrants to the occupation will average about 300 annually over the next five years. Net in-migration will have to average about 95 annually to meet demand requirements over that period. It is expected that international in-migration for chemical engineers will average about 90 per year. During the latter 5 year period the pressures on international in-migration will be reduced to about 25 annually.

Occupation Characteristics

Graduates

Chemical engineering degrees granted by province are presented in Table 6.1, below. Universities in Ontario have granted by far the largest number of these degrees over the years and the number has essentially doubled since 2000. Alberta universities have granted fewer of these degrees however the number has increased markedly since 2000. Quebec universities granted the third largest number of chemical engineering degrees however the number has not increased much since 2000. Very few of these degrees are granted in the other provinces. The number of chemical engineering degrees granted to women increased from 294 in 2000 to 427 in 2013. They accounted for 33 per cent of the total chemical engineering degrees granted in 2013. The number of these degrees granted to visa students has increased steadily and was 156 in 2013[13].

13 Source: Engineers Canada. Visa data in this report refers to undergraduates only.

Table 6.1 Degrees Granted, Chemical Engineering (2000-2013)

	Average 2000-04	Average 2005-09	2010	2011	2012	2013
British Columbia	45	8	0	0	60	53
Alberta	141	159	208	212	205	220
Saskatchewan	27	37	44	39	55	56
Manitoba	0	0	0	0	0	0
Ontario	353	467	636	657	657	718
Quebec	162	169	185	189	217	185
New Brunswick	26	23	38	22	50	43
Nova Scotia	24	27	37	42	34	32
Prince Edward Island	0	0	0	0	0	0
Newfoundland & Labrador	0	0	0	0	0	0

Source: Engineers Canada's 2014 Enrolment and Degrees Awarded Report

Industry Employment

Table 6.2 shows a ranking of employment by industry and province for chemical engineers over the forecast period. A large number of chemical engineers work in the Architectural, Engineering and Related Services industry in Alberta, Ontario, Quebec and British Columbia. A large number of chemical engineers also work in Oil and Gas Extraction in Alberta and Chemical Manufacturing in Ontario and Alberta. The Conventional Oil industry in Alberta also employs large numbers, as well.

Table 6.2 Top 25 Employment Estimates, Chemical Engineers by Industry and Province (2015-2025)

Province	Industry	Average 2015-19	Average 2020-25
ALBERTA	Architectural, Engineering and Related Services	1425	1524
ONTARIO	Architectural, Engineering and Related Services	1393	1446
ONTARIO	Chemical manufacturing	959	954
ALBERTA	Conventional Oil	829	679
QUEBEC	Architectural, Engineering and Related Services	507	514
BRITISH COLUMBIA	Architectural, Engineering and Related Services	418	439
ALBERTA	Chemical manufacturing	357	344
ONTARIO	Wholesale Trade	306	319
ONTARIO	Other Professional, Scientific and Technical Services	290	302
QUEBEC	Chemical manufacturing	253	230
ALBERTA	Support activities for mining and oil and gas extraction	240	242
ALBERTA	Wholesale Trade	215	228
ALBERTA	Other Transportation	202	214
ALBERTA	Oil Sands	186	203
QUEBEC	Other Professional, Scientific and Technical Services	186	187
ONTARIO	Federal government public administration	164	171
ALBERTA	Management, Scientific and Technical Consulting Services	163	174
ONTARIO	Petroleum and coal products manufacturing	159	145
ONTARIO	Utilities	150	153
ONTARIO	Plastic products manufacturing	141	138
ONTARIO	Management, Scientific and Technical Consulting Services	137	142
QUEBEC	Federal government public administration	133	140
ALBERTA	Petroleum and coal products manufacturing	128	121
QUEBEC	Wholesale Trade	123	122
ONTARIO	Paper manufacturing	120	118

Age Structure

The average age of chemical engineers ranges from 32 in Newfoundland and Labrador to 46 in British Columbia. The average age of chemical engineers in British Columbia is expected to trend lower over the forecast and to trend higher in the Atlantic Provinces where data is available.

Table 6.3 Average Age of Chemical Engineers (2015-2025)

	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
British Columbia	46	45	45	45	44	44	44	44	44	44	43
Alberta	41	41	42	42	42	42	42	43	43	43	43
Saskatchewan	42	42	42	42	43	43	44	44	44	44	44
Manitoba	-	-	-	-	-	-	-	-	-	-	-
Ontario	42	42	42	42	42	42	42	42	42	42	42
Quebec	44	44	44	44	44	44	44	44	44	44	44
New Brunswick	38	39	39	40	40	40	41	41	42	42	42
Nova Scotia	34	35	36	36	37	37	38	37	38	39	39
Prince Edward Island	-	-	-	-	-	-	-	-	-	-	-
Newfoundland & Labrador	-	-	-	-	-	-	-	-	-	-	-

Median annual wage data for chemical engineers is shown in Table 6.4, below. The data in the table represents thousands of dollars. Median annual wage for chemical engineers are quite high in Alberta, Newfoundland and Labrador and Saskatchewan. The forecast is for sizeable increases in annual wages in these three provinces. The lowest median wage for chemical engineers is in Nova Scotia where there is very little demand generated by industry.

Table 6.4 Median Annual Wage ($ 000s) 2015-2025

	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
British Columbia	86.1	88.7	91.8	95.6	99.6	103.7	107.7	111.4	115.0	118.5	122.0
Alberta	127.8	130.2	132.7	136.4	140.8	145.7	150.8	155.6	160.1	164.5	168.7
Saskatchewan	101.3	104.8	107.9	110.7	112.9	114.8	116.3	117.9	119.5	121.8	124.9
Manitoba	-	-	-	-	-	-	-	-	-	-	-
Ontario	85.6	88.1	90.7	93.5	96.0	98.5	100.8	103.2	105.8	108.6	111.9
Quebec	79.4	81.8	84.5	87.6	90.5	93.3	95.8	98.2	100.6	103.0	105.7
New Brunswick	77.0	78.6	80.9	83.8	86.9	90.3	93.5	96.7	99.9	103.1	106.5
Nova Scotia	39.9	41.2	42.8	44.4	46.1	47.7	49.4	51.0	52.7	54.5	56.4
Prince Edward Island	-	-	-	-	-	-	-	-	-	-	-
Newfoundland & Labrador	-	-	-	-	-	-	-	-	-	-	-

Sources of Demand

Expansion Demand and Replacement Demand

Total demand (total job openings) is composed of expansion demand and replacement demand (retirements and deaths). Figure 6.1 shows the importance of replacement to total demand change for chemical engineers by province over the forecast period. Total demand change is nearly zero in the Atlantic Provinces and in Manitoba and Saskatchewan. Expansion demand for chemical engineers in Ontario, Alberta and British Columbia is significant over the forecast, but replacement dominates. There is negative expansion demand in Quebec due to weakness in the industries employing chemical engineers but a significant amount of replacement demand forecasted.

Figure 6.1 Sources of Demand for Chemical Engineers (Annual Average 2015-2025)

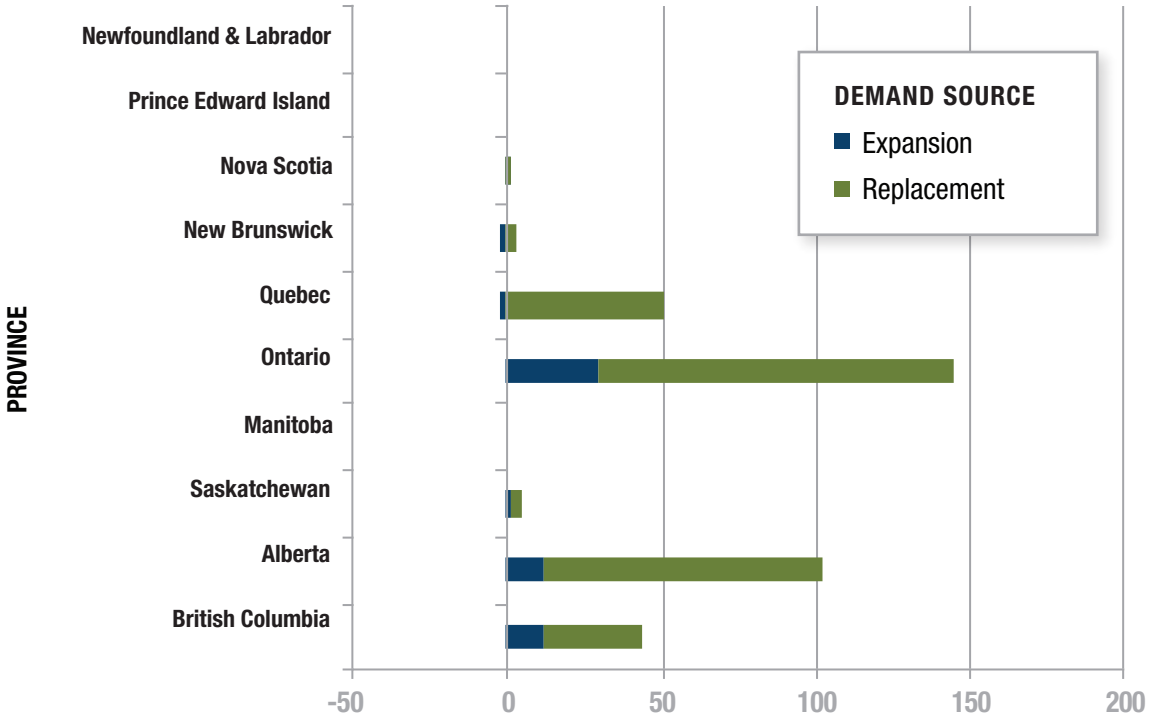


Table 6.5, below, shows that average job openings for chemical engineers in Ontario over the next five years is 165 per year.[14] Replacement demand related to retirements is expected to contribute 70 per cent of total job openings over that period in Ontario and the importance of replacement demand will increase to 90 per cent of total job openings during the last five years. Job openings for chemical engineers will be significant in Alberta and there will be a few in Quebec and British Columbia over the next five years but will taper off sharply during the latter five years.

14 Due to random rounding, expansion demand plus replacement demand may not equal total job openings

Table 6.5 Sources of Demand for Chemical Engineers (Annual Average 2015-19 and 2020-25)

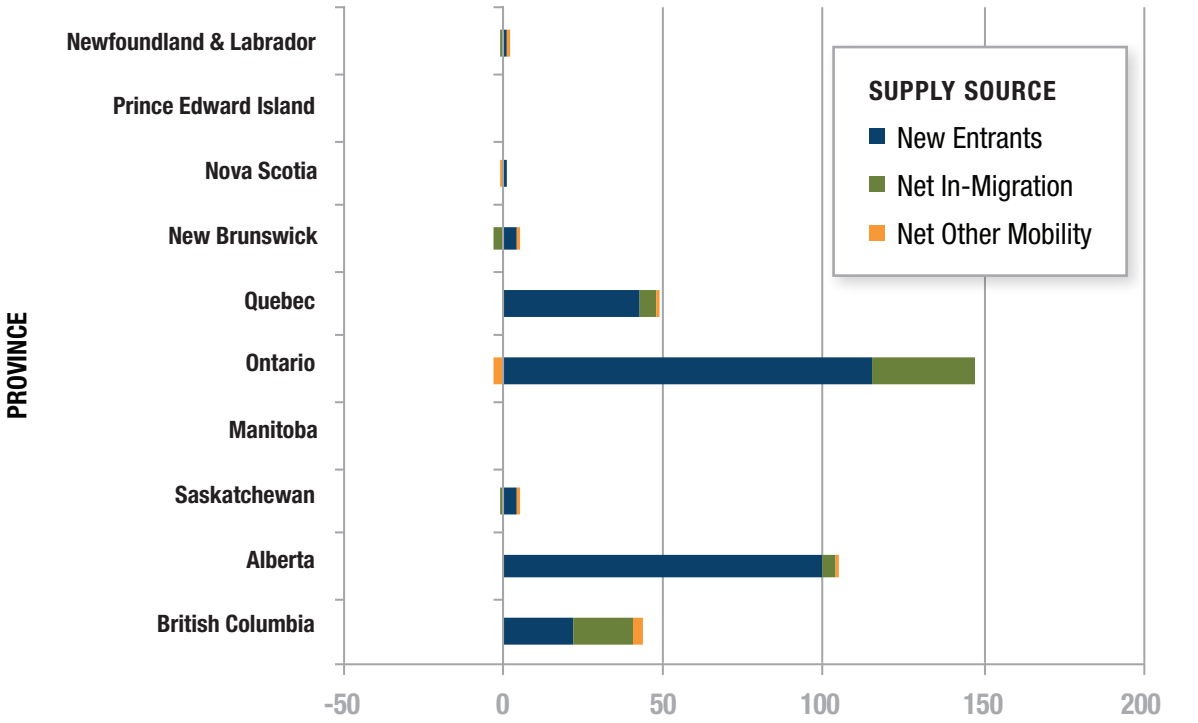
	Average 2015-19			Average 2020-25		
	Expansion	Replacement	Job Openings	Expansion	Replacement	Job Openings
British Columbia	26	33	59	1	31	31
Alberta	31	83	113	-2	94	92
Saskatchewan	1	3	4	1	3	4
Manitoba	-	-	-	-	-	-
Ontario	49	116	165	14	115	128
Quebec	13	48	60	-15	54	39
New Brunswick	1	2	4	-2	4	2
Nova Scotia	1	1	2	-1	1	0
Prince Edward Island	-	-	-	-	-	-
Newfoundland & Labrador	-	-	-	-	-	-

Sources of Supply

New Entrants, Migration and Other Mobility

Figure 6.2 below shows the sources of supply for chemical engineers. The number of new entrants to the occupation over the forecast period in Ontario is very large, followed by Alberta and then Quebec. The number of new entrants is insignificant in the Atlantic Provinces, Manitoba and Saskatchewan. Ontario and British Columbia are receiving nearly all the net in-migration.

Figure 6.2 Sources of Supply for Chemical Engineers (Annual Average 2015-2025)



Total supply requirements and the components of supply for chemical engineers are provided in Table 6.6. Over the next five years, Ontario's supply requirements for chemical engineers average 164 per year followed by Alberta with 113. The new entrants' share of the total supply requirement is highest in Alberta followed by Ontario and Quebec. Net in-migration is very low relative to the total supply requirement in Quebec. Net in-migration matches new entrants in British Columbia during the first five years. The total supply requirements for chemical engineers are more moderate during the last five years of the forecast for all provinces.

Table 6.6 Source of Supply for Chemical Engineers (Annual Average 2015-19 and 2020-25)

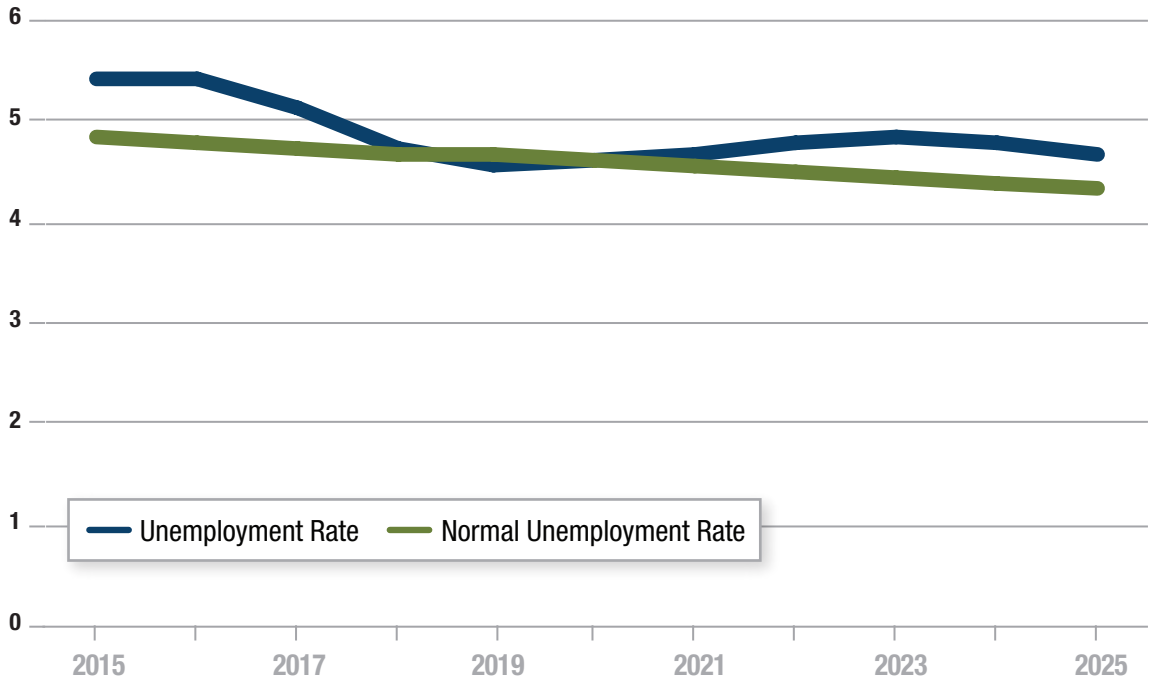
	Average 2015-19				Average 2020-25			
	New Entrants	Net In-Migration	Net Other Mobility	Total Supply	New Entrants	Net In-Migration	Net Other Mobility	Total Supply
British Columbia	23	23	9	54	22	14	-2	34
Alberta	99	14	-1	113	100	-4	1	97
Saskatchewan	4	1	0	5	4	-1	2	4
Manitoba	-	-	-	-	-	-	-	-
Ontario	117	46	2	164	113	21	-7	127
Quebec	43	11	3	57	43	-1	1	42
New Brunswick	4	-1	-1	2	4	-4	3	2
Nova Scotia	2	0	0	2	1	0	-1	0
Prince Edward Island	-	-	-	-	-	-	-	-
Newfoundland & Labrador	-	-	-	-	-	-	-	-

Labour Market Tightness

Actual vs. Normal Unemployment Rates and Gap

Figure 6.3 below shows the actual and the normal unemployment rate for chemical engineers in Canada. Unemployment rates near the normal unemployment rate suggests a normal labour market, while unemployment rates noticeably above or below the normal rate suggests either a loose or tight market, respectively. The chart suggests a normal market situation. The actual unemployment rate drops slightly below the normal rate over the medium-term of the forecast, but not by a significant amount.

Figure 6.3 Unemployment Rate for Chemical Engineers (%), Canada (2015-2025)



The labour market for chemical engineers in the country as a whole seems to suggest a normal market situation, the outlook by province could vary significantly. The labour market tightness rankings for chemical engineers across the provinces are shown in Table 6.7. Rankings of 3 are colour coded in red and represent excess demand (not seen in this occupation), a rank of 2 is a normal situation for the labour market, and a 1 (not seen in this occupation) is a situation of excess supply. All provinces will experience normal labour market tightness for chemical engineers over the forecast.

Table 6.7 Weighted Labour Market Tightness Rank (1-3) for Chemical Engineers (2015-2025)

	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
British Columbia	2	2	2	2	2	2	2	2	2	2	2
Alberta	2	2	2	2	2	2	2	2	2	2	2
Saskatchewan	2	2	2	2	2	2	2	2	2	2	2
Manitoba	-	-	-	-	-	-	-	-	-	-	-
Ontario	2	2	2	2	2	2	2	2	2	2	2
Quebec	2	2	2	2	2	2	2	2	2	2	2
New Brunswick	2	2	2	2	2	2	2	2	2	2	2
Nova Scotia	2	2	2	2	2	2	2	2	2	2	2
Prince Edward Island	-	-	-	-	-	-	-	-	-	-	-
Newfoundland & Labrador	-	-	-	-	-	-	-	-	-	-	-

Table 6.8 below provides a breakdown of international and inter-provincial in-migration for chemical engineers by province. Given the forecasted level of new entrants, requirements for in-migration of chemical engineers is very low. There should be no difficulties in obtaining the required workforce.

Table 6.8 International and Inter-Provincial In-Migration of Chemical Engineers (2015-2025)

	Average 2015-19		Average 2020-25	
	International	Inter-Provincial	International	Inter-Provincial
British Columbia	17	5	11	3
Alberta	10	4	-2	-2
Saskatchewan	0	0	-2	0
Manitoba	-	-	-	-
Ontario	52	-6	23	-3
Quebec	13	-2	-1	0
New Brunswick	-1	1	-4	0
Nova Scotia	0	0	0	0
Prince Edward Island	-	-	-	-
Newfoundland & Labrador	-	-	-	-

7 INDUSTRIAL AND MANUFACTURING ENGINEERS

According to the projections, the Canadian economy will produce about 584 job openings for industrial and manufacturing engineers annually over the next five years. Ontario employs the vast majority of these engineers and is expected to produce about 305 of these jobs annually. Nearly 70 per cent of these openings will be driven by replacement demand.

Since there are not enough new entrants to satisfy expansion and replacement demand in the short- to medium-term, net in-migration and net other mobility will be important sources of supply. In the long run, new entrants exceed the number of job openings, and in response, the requirement for net in-migration becomes negative.

Occupation Characteristics

Graduates

Industrial and manufacturing engineering degrees by province are presented in Table 7.1. The annual number of graduates in Ontario and Quebec greatly outweigh that of any other province. Graduates in 2013 for the two provinces were 116 and 179, respectively. Notably, graduates in Alberta have fallen from an annual average of 25 during the early 2000's to 0, while the number of graduates in Nova Scotia and Saskatchewan have remained relatively constant over the period, both producing near 30 graduates per year. The greater supply of graduates in Ontario and Quebec may be helpful for provinces such as Alberta, British Columbia and Manitoba, where the level of industrial and manufacturing engineering graduates falls short of average annual job openings expected. Over the ten year period from 2003 to 2013, visa graduates as a per cent of total graduates rose quite quickly, from about 8.6 per cent in 2003 to 16.1 per cent in 2013[15]. The proportion of female industrial and manufacturing engineering graduates has fallen since the early 2000's, from around 25 per cent, to 20 per cent in 2013.

15 Source: Engineers Canada. Visa data in this report refers to undergraduates only.

Table 7.1 Degrees Granted, Industrial and Manufacturing Engineering (2000-2013)

	Average 2000-04	Average 2005-09	2010	2011	2012	2013
British Columbia	0	0	0	0	0	0
Alberta	25	31	5	5	0	0
Saskatchewan	33	28	20	42	28	33
Manitoba	16	7	5	2	0	1
Ontario	86	117	131	108	135	116
Quebec	216	226	211	168	180	179
New Brunswick	4	2	0	0	0	0
Nova Scotia	23	23	19	25	26	32
Prince Edward Island	0	0	0	0	0	0
Newfoundland & Labrador	0	0	0	0	0	0

Source: Engineers Canada's 2014 Enrolment and Degrees Awarded Report

Industry Employment

A ranking of employment by industry and by province for Industrial and Manufacturing engineers is presented in Table 7.2. Most industrial and manufacturing engineers work in the Transportation, Equipment and Manufacturing industry. The majority of these are in Ontario, but there are also significant numbers in Quebec. A large number of industrial and manufacturing engineers also work in the Architectural Engineering, Machinery Manufacturing, and Computer and Electronic Product Manufacturing industries; again Ontario and Quebec host the vast majority of these positions.

Table 7.2 Top 25 Employment Estimates, Industrial and Manufacturing Engineers by Industry and Province (2015-2025)

Province	Industry	Average 2015-19	Average 2020-25
ONTARIO	Transportation equipment manufacturing	2369	2281
QUEBEC	Transportation equipment manufacturing	976	917
ONTARIO	Architectural, Engineering and Related Services	872	905
QUEBEC	Architectural, Engineering and Related Services	725	734
ONTARIO	Machinery manufacturing	620	646
ONTARIO	Computer and electronic product manufacturing	617	648
ONTARIO	Wholesale Trade	476	497
ALBERTA	Architectural, Engineering and Related Services	424	454
ONTARIO	Fabricated metal product manufacturing	417	418
ONTARIO	Primary metal manufacturing	376	366
ONTARIO	Electrical equipment appliance and component manufacturing	341	338
ONTARIO	Chemical manufacturing	327	326
BRITISH COLUMBIA	Architectural, Engineering and Related Services	312	327
ALBERTA	Conventional Oil	292	240
ONTARIO	Management, Scientific and Technical Consulting Services	274	284
QUEBEC	Machinery manufacturing	257	242
ONTARIO	Plastic products manufacturing	226	221
ONTARIO	Other Manufacturing	215	213
QUEBEC	Computer and electronic product manufacturing	202	190
ONTARIO	Other Professional, Scientific and Technical Services	199	207
QUEBEC	Primary metal manufacturing	171	156
ALBERTA	Machinery manufacturing	170	172
QUEBEC	Chemical manufacturing	160	145
MANITOBA	Transportation equipment manufacturing	157	168
QUEBEC	Fabricated metal product manufacturing	149	139

Age Structure

Average age for each year of the forecast period for industrial and manufacturing engineers, by province is presented in Table 7.3. The average age ranges from 37 in Nova Scotia, to 49 in New Brunswick. Over the forecast, the average age for industrial and manufacturing engineers is expected to remain relatively constant within the provinces where the occupation is most prevalent. Notably Quebec's average age rises from 42 to only 44 over the forecast. The skills

gap between retirees and new entrants is an ongoing issue, as new entrants do not have the skill set that retirees have acquired during their work experience. Provinces may attempt to bring in experienced workers through inter-provincial or international migration, creating upwards pressure on the average age of workers.

Table 7.3 Average Age of Industrial and Manufacturing Engineers (2015-2025)

	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
British Columbia	44	44	44	44	44	44	44	44	44	44	44
Alberta	42	42	42	42	42	43	43	43	43	43	43
Saskatchewan	42	42	42	42	42	43	43	43	43	43	43
Manitoba	45	45	45	44	44	44	44	44	44	44	44
Ontario	44	44	44	44	44	44	44	44	44	44	44
Quebec	42	42	42	42	43	43	43	44	44	44	44
New Brunswick	49	49	48	48	48	47	47	47	46	46	46
Nova Scotia	37	37	38	38	39	39	40	38	40	40	41
Prince Edward Island	-	-	-	-	-	-	-	-	-	-	-
Newfoundland & Labrador	40	40	40	41	41	41	41	41	42	42	42

Median annual wage data for industrial and manufacturing engineers is shown in Table 7.4, below. The data in the table represents thousands of dollars. Alberta has the highest medium annual wage for industrial and manufacturing engineering, which is indicative of strong demand. Newfoundland and Labrador follows with the second highest median wage among the provinces. The lowest wage for these engineers is in Quebec despite employing large numbers of industrial and manufacturing engineers and having a large number of degrees granted and an abundant supply of new entrants.

Table 7.4 Median Annual Wage ($ 000s) 2015-2025

	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
British Columbia	79.3	81.6	84.5	88.1	91.9	95.7	99.2	102.5	105.7	108.8	111.9
Alberta	109.6	111.8	114.1	117.5	121.5	125.8	130.1	134.3	138.1	141.8	145.5
Saskatchewan	85.2	88.2	90.8	93.2	95.2	96.9	98.2	99.4	100.8	102.7	105.3
Manitoba	73.6	75.7	77.8	80.0	81.9	83.6	85.1	86.6	88.2	90.1	92.1
Ontario	75.0	77.3	79.6	82.1	84.3	86.4	88.4	90.4	92.6	95.1	97.9
Quebec	73.7	76.0	78.5	81.4	84.1	86.6	88.9	91.1	93.2	95.4	97.8
New Brunswick	81.8	83.5	86.0	89.1	92.4	96.0	99.4	102.8	106.1	109.5	113.2
Nova Scotia	78.2	80.8	83.8	87.0	90.2	93.5	96.6	99.8	103.1	106.6	110.4
Prince Edward Island	-	-	-	-	-	-	-	-	-	-	-
Newfoundland & Labrador	91.3	93.7	96.1	99.2	102.1	105.5	109.2	113.1	116.7	120.0	123.2

Sources of Demand

Expansion Demand and Replacement Demand

Total demand (total job openings) is composed of expansion demand and replacement demand (retirements and deaths). Figure 7.1 shows average annual job openings in industrial and manufacturing engineering over the forecast period, indicating the proportions that are due to expansion and replacement. Ontario, by far has the greatest demand for industrial and manufacturing engineers, most of which is replacement demand. Quebec follows, relying entirely on replacement demand. The industry forecast for Quebec suggests a reduction in demand in the province. In the Atlantic Provinces total demand change is very minimal. The importance of replacement demand to total demand change, with a breakdown of the components into the short to medium and long-term, is further shown in Table 7.5, below.[16]

16 Due to random rounding, expansion demand plus replacement demand may not equal total job openings

Figure 7.1 Sources of Demand for Industrial and Manufacturing Engineers (Annual Average 2015-2025)

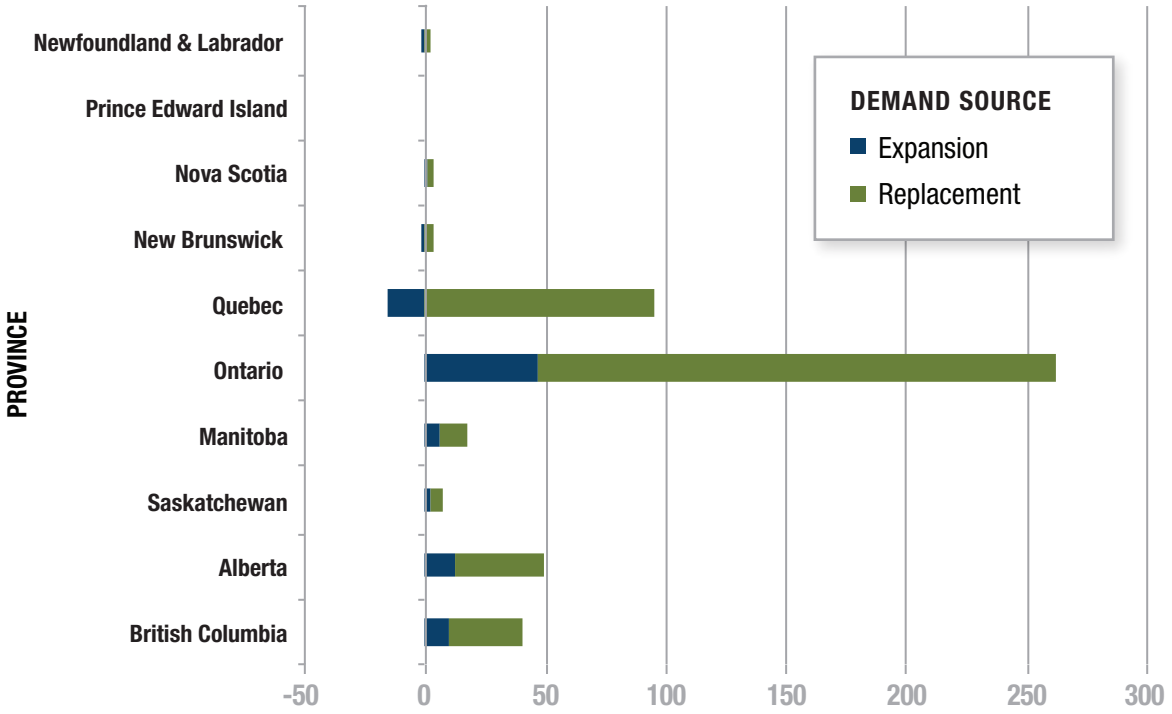


Table 7.5 Sources of Demand for Industrial and Manufacturing Engineers (Annual Average 2015-19 and 2020-25)

	Average 2015-19			Average 2020-25		
	Expansion	Replacement	Job Openings	Expansion	Replacement	Job Openings
British Columbia	31	28	59	-7	31	24
Alberta	29	35	63	-2	40	38
Saskatchewan	4	4	8	1	5	6
Manitoba	11	11	22	2	12	14
Ontario	97	208	305	4	223	227
Quebec	28	87	115	-53	102	49
New Brunswick	0	3	3	-1	4	2
Nova Scotia	4	3	7	-3	4	1
Prince Edward Island	-	-	-	-	-	-
Newfoundland & Labrador	-1	2	2	0	2	3

Sources of Supply

New Entrants, Migration and Other Mobility

Figure 7.2 shows the supply of industrial and manufacturing engineers, and the proportions that arise from new entrants, migrants and net other mobility. It can be seen from the level of new entrants in each province that young people are being drawn into the occupation. There is also strong net in-migration required in Ontario and unfavorable industry conditions that will result in some out-migration by workers from Quebec.

Figure 7.2 Sources of Supply for Industrial and Manufacturing Engineers (Annual Average 2015-2025)

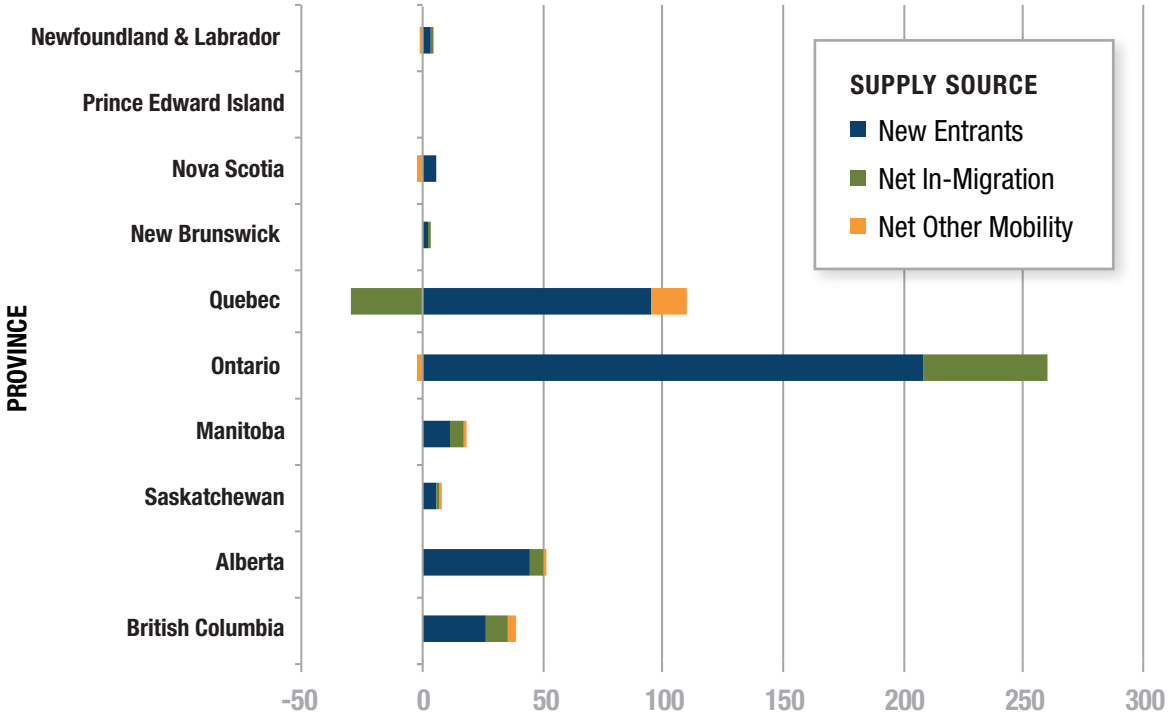


Table 7.6 Sources of Supply for Industrial and Manufacturing Engineers (Annual Average 2015-19 and 2020-25)

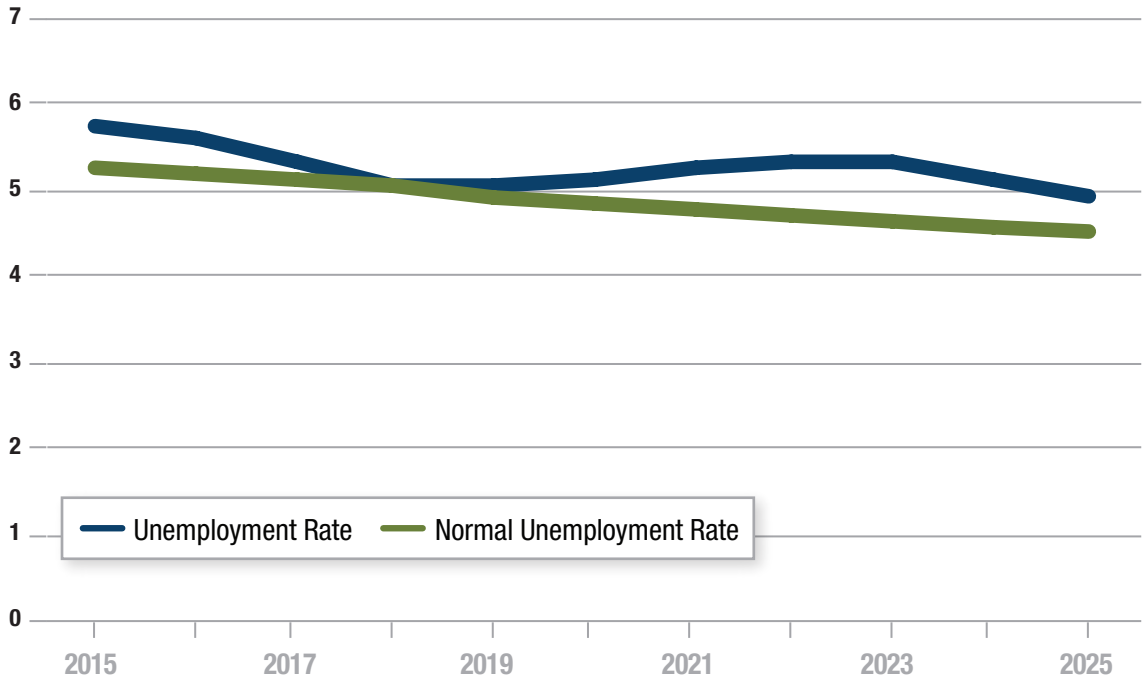
	Average 2015-19				Average 2020-25			
	New Entrants	Net In-Migration	Net Other Mobility	Total Supply	New Entrants	Net In-Migration	Net Other Mobility	Total Supply
British Columbia	27	21	7	55	26	1	1	27
Alberta	44	19	1	63	45	-6	1	41
Saskatchewan	6	3	0	9	6	-2	1	6
Manitoba	11	10	1	22	11	3	0	14
Ontario	214	79	6	299	204	28	-10	223
Quebec	96	9	3	108	94	-63	26	57
New Brunswick	2	0	1	3	2	1	-1	3
Nova Scotia	6	0	1	7	5	-1	-4	0
Prince Edward Island	-	-	-	-	-	-	-	-
Newfoundland & Labrador	3	0	-1	2	3	0	0	3

Labour Market Tightness

Actual vs. Normal Unemployment Rates and Gap

Unemployment rates near the normal unemployment rate suggests a normal labour market, while unemployment rates noticeably above or below the normal rate suggests either a loose or tight market, respectively. The figure suggests a relatively normal market situation.

Figure 7.3 Unemployment Rate for Industrial and Manufacturing Engineers (%), Canada (2015-2025)



Although the labour market for industrial and manufacturing engineers in Canada as a whole seems to suggest a normal market situation, the outlook by province could vary significantly.

As can be seen from Table 7.7 below, most provinces will experience normal labour market tightness for industrial and manufacturing engineers in the future. The excess demand ranking in Manitoba likely reflects upcoming electric power projects in the province. The ranking of 3 suggests a slightly higher than normal rate of difficulty in finding industrial and manufacturing engineers in the provinces during this period. Given that the labour market will be tight during a single year in the medium-term, the difficulty in finding sufficient numbers of workers should not be too substantial. If they were to look outside the province however, the degree of difficulty in this effort will depend on the demand-supply situation in other provinces.

Table 7.7 Weighted Labour Market Tightness Rank (1-3) for Industrial and Manufacturing Engineers (2015-2025)

	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
British Columbia	2	2	2	2	2	2	2	2	2	2	2
Alberta	2	2	2	2	2	2	2	2	2	2	2
Saskatchewan	2	2	2	2	2	2	2	2	2	2	2
Manitoba	2	2	2	3	2	2	2	2	2	2	2
Ontario	2	2	2	2	2	2	2	2	2	2	2
Quebec	2	2	2	2	2	2	2	2	2	2	2
New Brunswick	2	2	2	2	2	2	2	2	2	2	2
Nova Scotia	2	2	2	2	2	2	2	2	2	2	2
Prince Edward Island	-	-	-	-	-	-	-	-	-	-	-
Newfoundland & Labrador	2	2	2	2	2	2	2	2	2	2	2

The breakdown of in-migration into international and inter-provincial in-migration is shown in Table 7.8 below. International in-migration is the larger source of in-migration across the country. As the average age of industrial and manufacturing engineers rises in a number of provinces, including Nova Scotia, Quebec, Newfoundland and Labrador, Alberta and Saskatchewan, there will be excess demand in the short to medium-term. Given the current level of degrees granted, the forecasted new entrants levels and international in-migration of industrial and manufacturing engineers to the provinces, there should be no difficulties in obtaining the required workforce. Mobility of new entrants across the country may be the greatest challenge given that the majority of new entrants are coming from Quebec universities while demand is strongest in Ontario.

Table 7.8 International and Inter-Provincial In-Migration of Industrial and Manufacturing Engineers (2015-2025)

	Average 2015-19		Average 2020-25	
	International	Inter-Provincial	International	Inter-Provincial
British Columbia	15	5	1	0
Alberta	13	6	-3	-3
Saskatchewan	2	0	-3	1
Manitoba	13	-3	5	-2
Ontario	88	-9	30	-2
Quebec	11	-2	-68	5
New Brunswick	0	0	1	0
Nova Scotia	0	0	-1	0
Prince Edward Island	-	-	-	-
Newfoundland & Labrador	-1	1	0	1

8 METALLURGICAL AND MATERIALS ENGINEERS

According to the projections, the Canadian economy will produce about 104 job openings for metallurgical and materials engineers annually over the next five years. Ontario has the highest concentration of the occupation and is expected to produce about 41 of these jobs annually – over 70 per cent of these openings will be driven by replacement demand.

Total demand will be filled primarily by new entrants; however, forecasted levels are not totally adequate, particularly in British Colombia and Alberta, so net in-migration and net mobility will be an essential supply component for metallurgical and materials engineers in all provinces.

British Colombia will experience brief excess demand in the short-term due to a number of major projects that will increase demand for the occupation.

Occupation Characteristics

Graduates

Metallurgical and materials engineering degrees granted by province are presented in Table 8.1 below. Ontario universities granted 91 degrees to metallurgical and materials engineers in 2013 – slightly less than in 2010. There was a moderate increase in the number of these degrees granted by universities in Alberta, British Columbia and Nova Scotia. The number granted by universities in Quebec has remained relatively constant, with 30 graduates in 2013. The recent level of metallurgical and materials engineering graduates exceeds the estimate of the average number of job openings created by the forecast in all provinces over the next five years. Of course some of these students may go on to graduate school or may not remain in the province or in the country. The proportion of female metallurgical and materials engineering graduates has fallen since the early 2000's, from around 28 per cent, to 20 per cent in 2013. Over the ten year period from 2003 to 2013, visa graduates as a per cent of total graduates rose quite quickly, from about 2.2 per cent in 2003 to 13.4 per cent in 2013[17].

17 Source: Engineers Canada. Visa data in this report refers to undergraduates only.

Table 8.1 Degrees Granted, Metallurgical and Materials Engineering (2000-2013)

	Average 2000-04	Average 2005-09	2010	2011	2012	2013
British Columbia	30	33	37	34	37	33
Alberta	23	25	34	45	48	40
Saskatchewan	0	0	0	0	0	0
Manitoba	0	0	0	0	0	0
Ontario	71	68	100	83	92	91
Quebec	35	38	37	37	22	30
New Brunswick	0	0	0	0	0	0
Nova Scotia	7	14	13	12	8	22
Prince Edward Island	0	0	0	0	0	0
Newfoundland & Labrador	0	0	0	0	0	0

Source: Engineers Canada's 2014 Enrolment and Degrees Awarded Report

Industry Employment

Table 8.2 below shows a ranking of employment by industry and province for metallurgical and materials engineers over the forecast period. Most of these engineers work in Architectural, Engineering and Related Services, Primary Metal Manufacturing, and Transportation Equipment Manufacturing. All of these jobs are located in Ontario, Alberta, Quebec and British Colombia.

Table 8.2 Top 25 Employment Estimates, Metallurgical and Materials Engineers by Industry and Province (2015-2025)

Province	Industry	Average 2015-19	Average 2020-25
ONTARIO	Architectural, Engineering and Related Services	286	297
ONTARIO	Primary metal manufacturing	275	269
ALBERTA	Architectural, Engineering and Related Services	222	238
QUEBEC	Architectural, Engineering and Related Services	151	152
QUEBEC	Transportation equipment manufacturing	144	135
BRITISH COLUMBIA	Primary metal manufacturing	139	126
QUEBEC	Primary metal manufacturing	127	116
BRITISH COLUMBIA	Architectural, Engineering and Related Services	112	118
ONTARIO	Transportation equipment manufacturing	90	86
ONTARIO	Other Manufacturing	90	89
ONTARIO	Fabricated metal product manufacturing	84	85
QUEBEC	Fabricated metal product manufacturing	64	60
ALBERTA	Oil Sands	59	65
QUEBEC	Other Manufacturing	54	51
ALBERTA	Support activities for mining and oil and gas extraction	44	44
ONTARIO	Management, Scientific and Technical Consulting Services	40	41
ALBERTA	Other Manufacturing	39	40
ONTARIO	Utilities	39	40
ONTARIO	Other Professional, Scientific and Technical Services	38	39
ALBERTA	Primary metal manufacturing	37	38
ALBERTA	Heavy and Civil Engineering Construction	35	37
QUEBEC	Other Professional, Scientific and Technical Services	33	33
QUEBEC	Management, Scientific and Technical Consulting Services	32	33
ALBERTA	Conventional Oil	31	26
ONTARIO	Computer and electronic product manufacturing	29	31

Age Structure

Metallurgical and materials engineers in Quebec have the lowest average age in 2015 at 42 years. For all other provinces the average age is 45. The projections show a rise in the average age in Quebec over the forecast. In Ontario, where the occupation is most prevalent, it is expected that the average age will decline to 43 by the end of the forecast. Average age for metallurgical and materials engineers is presented below, in Table 8.3.

Table 8.3 Average Age of Metallurgical and Materials Engineers (2015-2025)

	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
British Columbia	45	44	44	44	43	43	43	44	44	44	44
Alberta	45	45	45	45	44	44	44	44	44	44	44
Saskatchewan	-	-	-	-	-	-	-	-	-	-	-
Manitoba	-	-	-	-	-	-	-	-	-	-	-
Ontario	45	44	44	44	44	44	44	44	44	44	43
Quebec	42	42	43	43	43	43	44	44	44	45	45
New Brunswick	-	-	-	-	-	-	-	-	-	-	-
Nova Scotia	-	-	-	-	-	-	-	-	-	-	-
Prince Edward Island	-	-	-	-	-	-	-	-	-	-	-
Newfoundland & Labrador	-	-	-	-	-	-	-	-	-	-	-

Median annual wage data for metallurgical and materials engineers is shown in Table 8.4 below. The data in the table represents thousands of dollars. Median annual wage for metallurgical and materials engineers is highest in Alberta, followed by Ontario and Quebec. Metallurgical and materials engineers in British Colombia receive the lowest median annual wage.

Table 8.4 Median Annual Wage ($ 000s) 2015-2025

	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
British Columbia	62.0	64.4	67.1	70.0	72.9	75.8	78.6	81.1	83.6	86.0	88.4
Alberta	105.8	108.0	110.4	113.8	117.7	122.0	126.3	130.6	134.5	138.3	142.0
Saskatchewan	-	-	-	-	-	-	-	-	-	-	-
Manitoba	-	-	-	-	-	-	-	-	-	-	-
Ontario	92.2	94.9	97.7	100.7	103.4	106.0	108.5	111.1	113.8	116.8	120.3
Quebec	89.1	91.8	94.9	98.4	101.6	104.7	107.5	110.2	112.7	115.4	118.4
New Brunswick	-	-	-	-	-	-	-	-	-	-	-
Nova Scotia	-	-	-	-	-	-	-	-	-	-	-
Prince Edward Island	-	-	-	-	-	-	-	-	-	-	-
Newfoundland & Labrador	-	-	-	-	-	-	-	-	-	-	-

Sources of Demand

Expansion Demand and Replacement Demand

Total demand (total job openings) is composed of expansion demand and replacement demand (retirements and deaths). Figure 8.1 shows the importance of replacement demand relative to total demand change over the forecast period. In Quebec total demand change is comprised entirely of replacement demand. In Ontario, British Columbia and Alberta, replacement demand accounts for the majority of total demand change.

Table 8.5 shows job openings for metallurgical and materials engineers.[18] Average annual job openings will be highest in Ontario at an annual average of 41 over the next five year period. The projections have average annual job openings for these engineers at 24 in Alberta and 21 in British Columbia over the same period. Job openings will tail off significantly during the last five years due to significantly less expansion demand.

18 Due to random rounding, expansion demand plus replacement demand may not equal total job openings

Figure 8.1 Sources of Demand for Metallurgical and Materials Engineers (Annual Average 2015-2025)

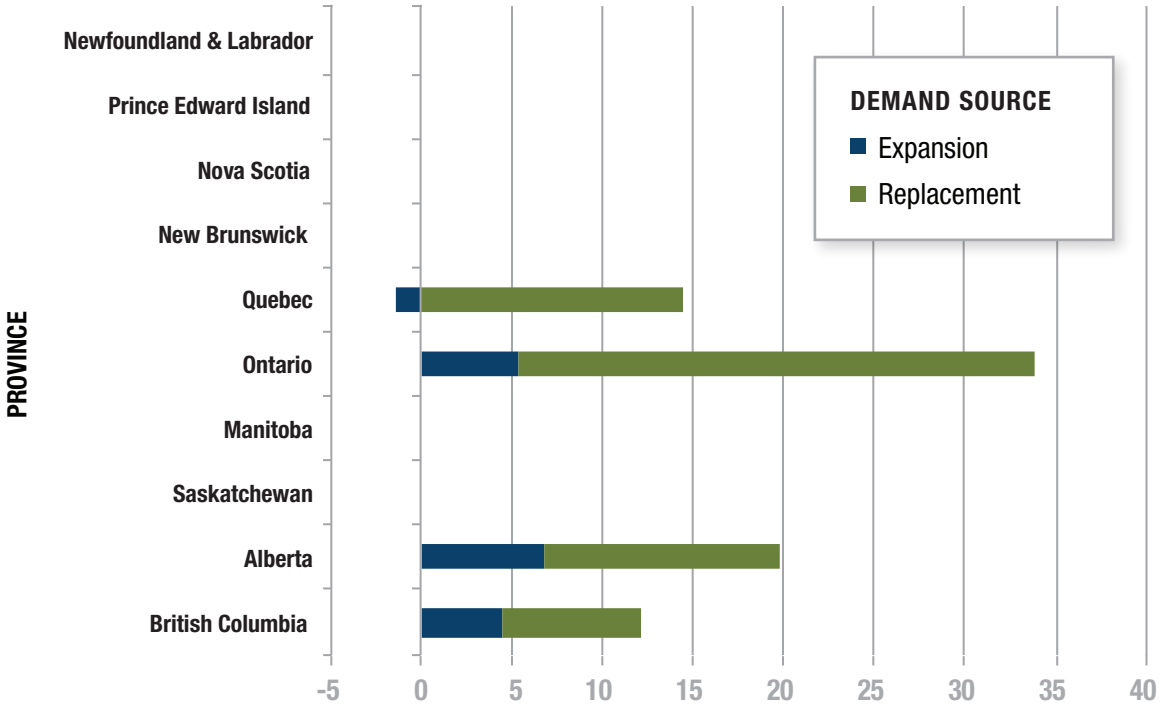


Table 8.5 Sources of Demand for Metallurgical and Materials Engineers (Annual Average 2015-19 and 2020-25)

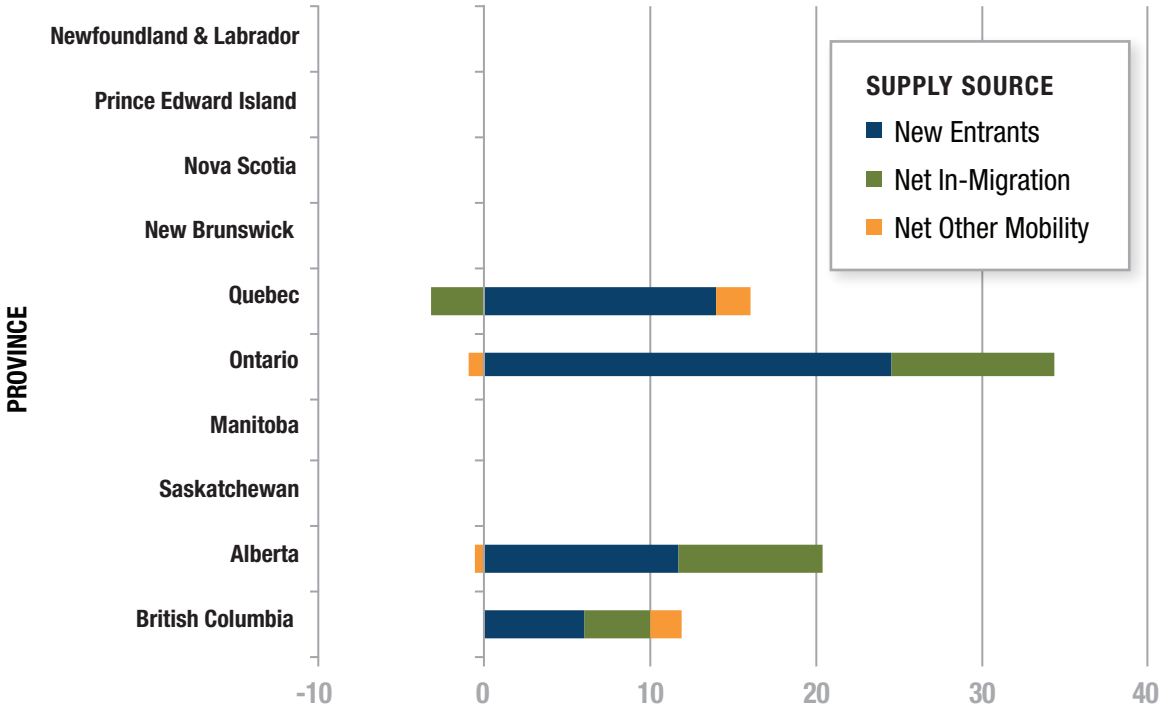
	Average 2015-19			Average 2020-25		
	Expansion	Replacement	Job Openings	Expansion	Replacement	Job Openings
British Columbia	13	8	21	-3	7	5
Alberta	11	13	24	3	13	17
Saskatchewan	-	-	-	-	-	-
Manitoba	-	-	-	-	-	-
Ontario	10	30	41	1	27	28
Quebec	6	13	18	-7	16	9
New Brunswick	-	-	-	-	-	-
Nova Scotia	-	-	-	-	-	-
Prince Edward Island	-	-	-	-	-	-
Newfoundland & Labrador	-	-	-	-	-	-

Sources of Supply

New Entrants, Migration and Other Mobility

Figure 8.2 shows the sources of supply for metallurgical and materials engineers. Over the forecast, new entrants will be the primary source of supply in Ontario, Quebec and Alberta. In British Colombia, new entrants will comprise about half of the source of supply, the other half being a combination of net in-migration and net other mobility. Net other mobility will contribute to total supply requirements for metallurgical and materials engineers in Quebec.

Figure 8.2 Sources of Supply for Metallurgical and Materials Engineers (Annual Average 2015-2025)



Average annual supply requirements and the components of supply of metallurgical and materials engineers are provided in Table 8.6 below. Over the next five years Ontario's total supply requirements for metallurgical and materials engineers averages 40 per year - followed by Alberta with 23 and British Colombia with 20. New entrants' share of the total supply requirement is highest in Quebec at 82 per cent. Net in-migration exceeds new entrants in British Columbia and Alberta. Total supply requirements drop sharply during the last five years of the forecast in all provinces – particularly in British Colombia.

Table 8.6 Sources of Supply for Metallurgical and Materials Engineers (Annual Average 2015-19 and 2020-25)

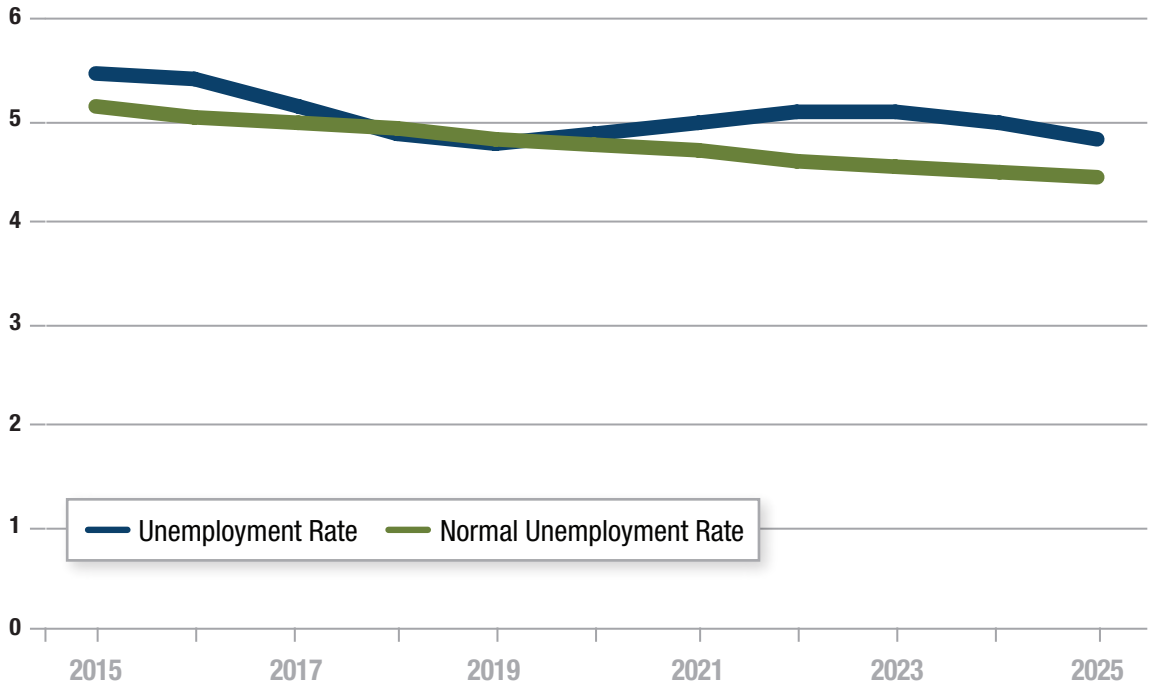
	Average 2015-19				Average 2020-25			
	New Entrants	Net In-Migration	Net Other Mobility	Total Supply	New Entrants	Net In-Migration	Net Other Mobility	Total Supply
British Columbia	6	9	4	20	6	-1	0	6
Alberta	11	12	0	23	12	6	-1	17
Saskatchewan	-	-	-	-	-	-	-	-
Manitoba	-	-	-	-	-	-	-	-
Ontario	25	14	1	40	24	6	-2	28
Quebec	14	2	0	17	14	-8	3	10
New Brunswick	-	-	-	-	-	-	-	-
Nova Scotia	-	-	-	-	-	-	-	-
Prince Edward Island	-	-	-	-	-	-	-	-
Newfoundland & Labrador	-	-	-	-	-	-	-	-

Labour Market Tightness

Actual vs. Normal Unemployment Rates and Gap

The actual and the normal unemployment rate for metallurgical and materials engineers in Canada are shown in Figure 8.3. Unemployment rates near the normal unemployment rate suggests a normal labour market, while unemployment rates noticeably above or below the normal rate suggests either a loose or tight market, respectively. The chart suggests a normal market situation. The actual unemployment rate drops slightly below the normal rate over the medium-term of the forecast it then increases into the long-term.

Figure 8.3 Unemployment Rate for Metallurgical and Materials Engineers (%), Canada (2015-2025)



Labour market tightness rankings for metallurgical and materials engineers across the provinces are shown in Table 8.7 below. Rankings of 3 are colour coded in red and represent excess demand, a rank of 2 is a normal situation for the labour market, and a 1 (not seen in this occupation) is a situation of excess supply.

Table 8.7 Weighted Labour Market Tightness Rank (1-3) for Metallurgical and Materials Engineers (2015-2025)

	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
British Columbia	3	3	2	2	2	2	2	2	2	2	2
Alberta	2	2	2	2	2	2	2	2	2	2	2
Saskatchewan	-	-	-	-	-	-	-	-	-	-	-
Manitoba	-	-	-	-	-	-	-	-	-	-	-
Ontario	2	2	2	2	2	2	2	2	2	2	2
Quebec	2	2	2	2	2	2	2	2	2	2	2
New Brunswick	-	-	-	-	-	-	-	-	-	-	-
Nova Scotia	-	-	-	-	-	-	-	-	-	-	-
Prince Edward Island	-	-	-	-	-	-	-	-	-	-	-
Newfoundland & Labrador	-	-	-	-	-	-	-	-	-	-	-

Most provinces will experience normal labour market tightness for metallurgical and materials engineers in the future. The excess demand rankings in British Colombia likely reflect a number of major projects in the province, placing pressure on the demand for these workers.

The labour market tightness rank of 3 over the short-term of the forecast in British Columbia suggests a higher than normal rate of difficulty in finding metallurgical and materials engineers in the province over the period.

The breakdown of in-migration into international and inter-provincial in-migration is shown in Table 8.8, below. As you can see in the table, international in-migration is the larger source of in-migration across the country in the short to medium-term.

Table 8.8 International and Inter-Provincial In-Migration of Metallurgical and Materials Engineers (2015-2025)

	Average 2015-19		Average 2020-25	
	International	Inter-Provincial	International	Inter-Provincial
British Columbia	7	2	-1	0
Alberta	8	4	3	3
Saskatchewan	-	-	-	-
Manitoba	-	-	-	-
Ontario	16	-2	7	-1
Quebec	3	0	-8	1
New Brunswick	-	-	-	-
Nova Scotia	-	-	-	-
Prince Edward Island	-	-	-	-
Newfoundland & Labrador	-	-	-	-

9 MINING ENGINEERS

British Columbia, Ontario and Saskatchewan have the highest concentration of mining engineers across Canada. The new entrant levels in these provinces are not adequate to meet total demand. The excess demand, particularly in British Columbia and Ontario, reflects a number of major mining projects scheduled for construction. Net in-migration will be an essential supply component for mining engineers in these provinces, particularly British Columbia and Ontario.

Occupation Characteristics

Graduates

Graduates in mining engineering across the country from 2000 to 2013 are presented in Table 9.1. The first two columns of the table show a five year average, while the last four columns represent annual data. As of 2013, the annual number of graduates in Ontario and Quebec from mining engineering has more than doubled since 2009. Female graduates have generally been rising since 2009 and in 2013 accounted for about 17 per cent of total mining engineering graduates. Over the ten year period from 2003 to 2013, visa graduates as a per cent of total graduates rose quite quickly, from about 1.4 per cent in 2003 to 14.5 per cent in 2013[19]. The recent level of graduates for Quebec and Ontario far exceeds the average number of job openings for these provinces, which will be shown in the subsequent section on Sources of Demand. This supply of graduates may be helpful for provinces such as British Columbia where the level of graduates falls short of the level of average annual job openings expected. Though, as was noted in the introduction, many of these graduates may go on to graduate school or may not remain in the province or in Canada, and therefore may not be available for work.

19 Source: Engineers Canada. Visa data in this report refers to undergraduates only.

Table 9.1 Degrees Granted, Mining Engineering (2000-2013)

	Average 2000-04	Average 2005-09	2010	2011	2012	2013
British Columbia	18	19	34	32	39	34
Alberta	16	17	39	43	34	32
Saskatchewan	-	-	-	-	-	-
Manitoba	-	-	-	-	-	-
Ontario	40	44	78	103	101	101
Quebec	25	16	40	23	46	40
New Brunswick	-	-	-	-	-	-
Nova Scotia	10	13	18	21	17	13
Prince Edward Island	-	-	-	-	-	-
Newfoundland & Labrador	-	-	-	-	-	-

Source: Engineers Canada's 2014 Enrolment and Degrees Awarded Report

Industry Employment

A ranking of employment by industry and by province for mining engineers is presented in Table 9.2. Not surprisingly, most mining engineers work in the Mining industry. The majority of these are in Ontario and British Columbia, but there are significant numbers in Saskatchewan, Alberta, and Quebec as well. A large number of mining engineers also work in the Architectural, Engineering and Related Services industry.

Table 9.2 Top 25 Employment Estimates, Mining Engineers by Industry and Province (2015-2025)

Province	Industry	Average 2015-19	Average 2020-25
ONTARIO	Mining	540	625
BRITISH COLUMBIA	Mining	416	461
ONTARIO	Architectural, Engineering and Related Services	371	385
BRITISH COLUMBIA	Support activities for mining and oil and gas extraction	338	345
BRITISH COLUMBIA	Architectural, Engineering and Related Services	293	308
SASKATCHEWAN	Mining	277	290
ONTARIO	Support activities for mining and oil and gas extraction	196	221
ALBERTA	Architectural, Engineering and Related Services	181	193
QUEBEC	Architectural, Engineering and Related Services	173	175
QUEBEC	Mining	170	160
ALBERTA	Oil Sands	133	145
ALBERTA	Mining	111	113
MANITOBA	Mining	96	92
ALBERTA	Support activities for mining and oil and gas extraction	73	74
NEW BRUNSWICK	Mining	68	80
ONTARIO	Management, Scientific and Technical Consulting Services	57	59
BRITISH COLUMBIA	Management, Scientific and Technical Consulting Services	55	57
ALBERTA	Conventional Oil	54	45
NEWFOUNDLAND & LABRADOR	Mining	54	56
ONTARIO	Other Professional, Scientific and Technical Services	48	50
SASKATCHEWAN	Architectural, Engineering and Related Services	45	46
BRITISH COLUMBIA	Primary metal manufacturing	42	38
ALBERTA	Wholesale Trade	35	37
NOVA SCOTIA	Architectural, Engineering and Related Services	31	31
BRITISH COLUMBIA	Computer Systems Design and Related Services	28	29

Age Structure

The age distribution of a population has an important influence on workforce supply. An aging population reduces the growth in the supply through increased retirements and deaths. Engineers in Canada are generally in the 30 to 55 year old age range. Average age for each year of the forecast period for mining engineers, by province is presented in Table 9.3. Mining engineers in Ontario and Quebec have the highest average age in 2015 at 45 years, followed by British Columbia at 43 years of age. The projections show a noticeable decline in the average age

for mining engineers in Ontario over the period. As mining engineers in Ontario reach retirement age, new entrants or migrants of a younger age are brought into the workforce and the average age begins to decline. In the eastern provinces where demand for mining engineers is very low, the current labour force ages and the average age continues to rise to 2025. For provinces bringing in new entrants to the occupation, there is the ongoing issue of the skills gap between retirees and new entrants, in that new entrants do not have the skills set that retirees have acquired during their work experience. Provinces may attempt to bring in experienced workers through inter-provincial or international migration.

Table 9.3 Average Age of Mining Engineers (2015-2025)

	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
British Columbia	43	43	42	42	42	42	42	42	42	42	42
Alberta	40	40	40	41	41	41	41	41	41	41	41
Saskatchewan	38	38	38	39	39	40	40	40	40	40	41
Manitoba	42	43	43	43	43	43	44	44	44	44	44
Ontario	45	44	44	43	43	42	42	42	42	42	42
Quebec	45	45	45	44	44	44	44	44	44	44	44
New Brunswick	35	36	37	38	38	38	39	40	39	40	40
Nova Scotia	39	39	40	40	40	40	41	41	41	42	42
Prince Edward Island	-	-	-	-	-	-	-	-	-	-	-
Newfoundland & Labrador	33	34	35	35	35	36	37	38	38	39	40

Median annual wage data for mining engineers across the provinces is shown in Table 9.4, below. The data in the table represents thousands of dollars. Alberta shows the highest wage paid for mining engineers in Canada, followed by British Columbia and Saskatchewan. Currently the lowest wage for these engineers is in Nova Scotia where there is very little demand for mining engineers.

Table 9.4 Median Annual Wage ($ 000s) 2015-2025

	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
British Columbia	116.5	120.2	124.4	129.3	134.9	140.8	146.3	151.5	156.6	161.6	166.7
Alberta	132.2	134.9	138.0	142.1	146.7	151.8	157.1	162.4	167.3	172.2	176.9
Saskatchewan	114.9	119.2	122.7	126.0	128.6	130.8	132.7	134.6	136.7	139.2	142.7
Manitoba	74.1	76.1	77.7	79.7	81.5	82.9	84.2	85.5	86.9	88.4	90.2
Ontario	92.2	94.9	97.8	100.9	103.8	106.9	109.9	112.8	115.8	119.2	122.9
Quebec	110.0	113.3	117.1	121.4	125.4	129.1	132.5	136.0	139.4	142.8	146.5
New Brunswick	104.6	108.0	112.1	116.4	120.8	125.7	130.7	135.3	140.0	145.0	150.0
Nova Scotia	66.7	68.8	71.3	74.0	76.7	79.4	82.1	84.9	87.7	90.7	93.9
Prince Edward Island	-	-	-	-	-	-	-	-	-	-	-
Newfoundland & Labrador	110.0	113.0	116.2	119.8	122.9	126.8	131.3	136.1	140.8	145.2	149.3

Sources of Demand

Expansion Demand and Replacement Demand

Total demand (total job openings) is composed of expansion demand and replacement demand (retirements and deaths). Figure 9.1 shows the importance of replacement to total demand change (job openings) in all provinces across the forecast period. In Quebec, total demand change is comprised almost entirely of replacement demand. In Ontario and British Columbia, replacement demand is approximately half of total demand change. The importance of replacement demand to total demand change, with a breakdown of the components into the short to medium and long-term, is further shown in Table 9.5 below.[20] There is a significant rise in job openings for mining engineers in British Columbia and Ontario over the short to medium-term, nearly half of which are comprised of expansion demand. The rise in expansion demand for mining engineers in Ontario and British Columbia reflects several major mining projects in the provinces.

20 Due to random rounding, expansion demand plus replacement demand may not equal total job openings

Figure 9.1 Sources of Demand for Mining Engineers (Annual Average 2015-2025)

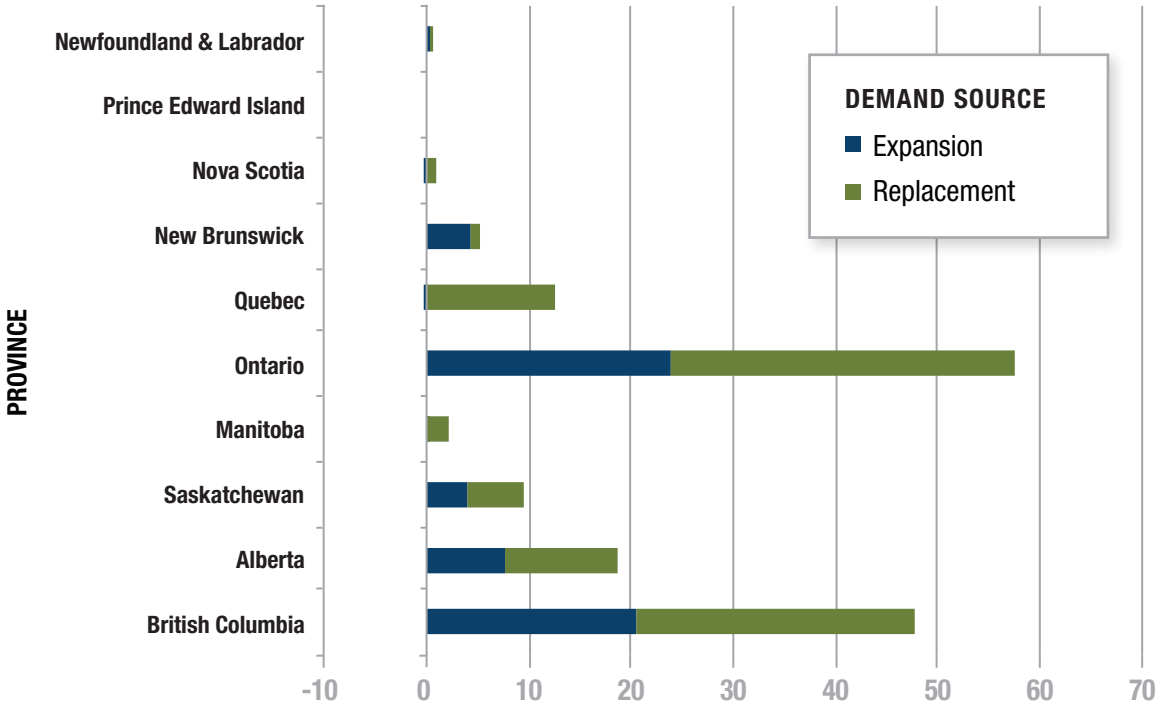


Table 9.5 Sources of Demand for Mining Engineers (Annual Average 2015-19 and 2020-25)

	Average 2015-19			Average 2020-25		
	Expansion	Replacement	Job Openings	Expansion	Replacement	Job Openings
British Columbia	34	28	62	10	26	36
Alberta	10	10	20	5	12	17
Saskatchewan	6	5	11	2	6	8
Manitoba	1	2	3	-1	2	1
Ontario	22	37	58	26	31	57
Quebec	3	13	16	-3	13	10
New Brunswick	6	0	7	3	1	4
Nova Scotia	0	1	1	0	1	1
Prince Edward Island	-	-	-	-	-	-
Newfoundland & Labrador	0	0	0	1	0	1

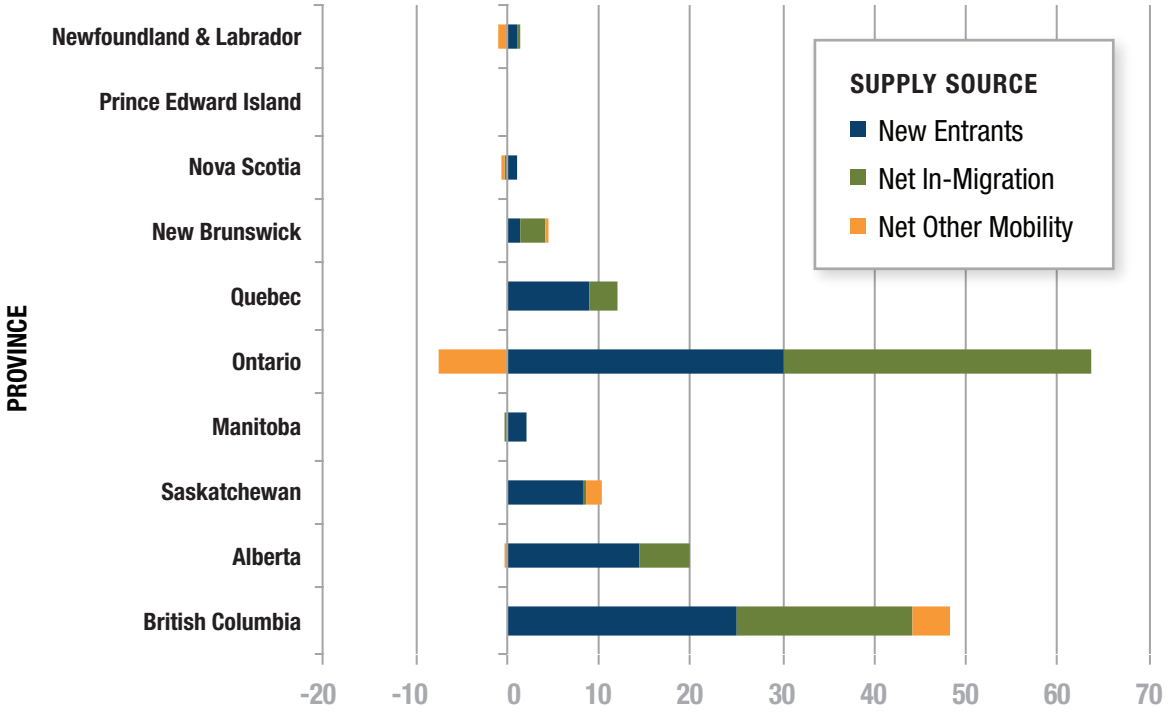
Sources of Supply

New Entrants, Migration and Other Mobility

The sources of supply change shown in Figure 9.2 are new entrants, net in-migration and net other mobility, the latter two being the components of net in-mobility. Net other mobility includes workers moving from other occupations – inter-occupation mobility – and other factors that impact the participation rate of the population in the labour force such as the availability of higher wages and decisions to postpone retirement.

As was seen previously in Figure 9.1, there is strong demand for mining engineers in Ontario and British Columbia. Supply for mining engineers is shown in Figure 9.2 below. It can be seen from the level of new entrants in the forecast period that young people are being drawn into the occupation for Ontario and British Columbia where demand is high. There is also strong net in-migration required for mining engineers to the aforementioned provinces. A large number of mining projects in British Columbia will be required the province to pull in mining engineers through net other mobility.

Figure 9.2 Sources of Supply for Mining Engineers (Annual Average 2015-2025)



The number of new entrants is the more stable source of supply and easier to target. Expected new entrants for mining engineers across the country are shown in Table 9.6 below. As one would expect they are found in the larger provinces and with relatively large demands for mining engineers. British Columbia stands out as a location from which new entrants could be obtained.

The model assumes that an occupation will get its share of total new entrants to the provincial economy based on its share of employment in the provincial economy as a whole. This is only an assumption and it is important for organizations requiring mining engineers to try their best to attract young people into the occupation. Total new entrants across the country are not enough to meet job openings over the forecast period. Net in-migration will be required to meet this demand.

Table 9.6 Sources of Supply for Mining Engineers (Annual Average 2015-19 and 2020-25)

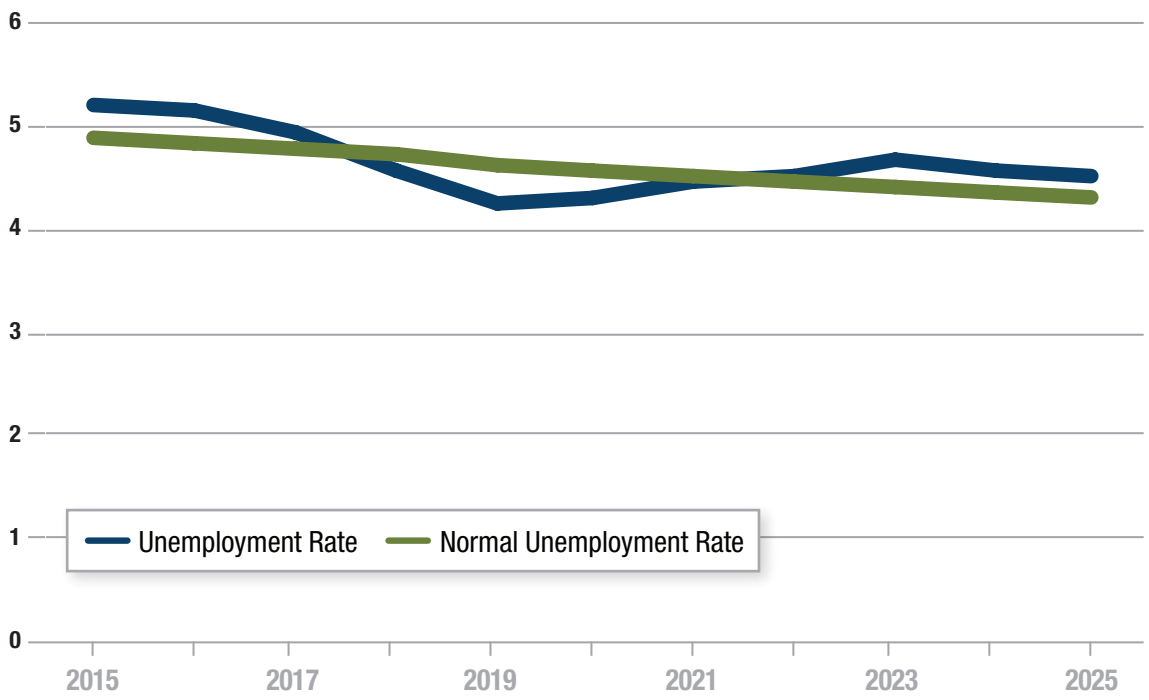
	Average 2015-19				Average 2020-25			
	New Entrants	Net In-Migration	Net Other Mobility	Total Supply	New Entrants	Net In-Migration	Net Other Mobility	Total Supply
British Columbia	25	23	10	58	25	16	-2	40
Alberta	14	7	0	21	15	4	-1	18
Saskatchewan	8	4	0	13	9	-3	3	8
Manitoba	2	1	0	3	2	-1	0	1
Ontario	29	27	0	56	31	39	-14	56
Quebec	9	4	1	14	9	2	-1	10
New Brunswick	1	2	2	6	2	3	-1	4
Nova Scotia	1	0	-1	0	1	-1	0	1
Prince Edward Island	-	-	-	-	-	-	-	-
Newfoundland & Labrador	1	0	-2	0	1	0	0	1

Labour Market Tightness

Actual vs. Normal Unemployment Rates and Gap

The actual and the normal unemployment rate for mining engineers in Canada are shown in Figure 9.3 below. Unemployment rates near the normal unemployment rate suggests a normal labour market, while unemployment rates noticeably above or below the normal rate suggests either a loose or tight market, respectively. The chart suggests a normal market situation. The actual unemployment rate drops below the normal rate over the medium-term of the forecast, but not by a significant amount.

Figure 9.3 Unemployment Rate for Mining Engineers (%), Canada (2015-2025)



Although the labour market for mining engineers in Canada as a whole seems to suggest a normal market situation, the outlook by province could vary significantly. The labour market tightness rankings for mining engineers across the provinces are shown in Table 9.7, below. Rankings of 3 are colour coded in red and represent excess demand, a rank of 2 is a normal situation for the labour market, and a 1 (not seen in this occupation) is a situation of excess supply.

Most provinces will experience normal labour market tightness for mining engineers in the future, as can be seen from Table 9.7, below. The excess demand rankings in British Columbia, Ontario, Manitoba and New Brunswick, reflect major mining projects in these provinces, which places pressure on the demand for these workers.

The labour market tightness ranks of 3 in these provinces suggest a slightly higher than normal rate of difficulty in finding mining engineers in these provinces. The demand levels for New Brunswick are relatively small numbers and therefore, the excess demand seen below for New Brunswick reflects a very small number of workers and the province should not have difficulty in acquiring the necessary workforce. As a number of mining projects come underway in British Columbia and Ontario, there will be excess demand in these provinces. Given the current graduate levels, the forecasted new entrants levels and international in-migration of mining engineers to the provinces, there should not be great difficulty in obtaining the required workforce. Net in-migration will be the essential supply component for mining engineers in British Columbia and Ontario.

Table 9.7 Weighted Labour Market Tightness Rank (1-3) for Mining Engineers (2015-2025)

	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
British Columbia	3	2	2	2	3	2	2	2	2	3	2
Alberta	2	2	2	2	2	2	2	2	2	2	2
Saskatchewan	2	2	2	2	2	2	2	2	2	2	2
Manitoba	2	2	2	3	2	2	2	2	2	2	2
Ontario	2	2	2	2	3	3	3	2	2	2	2
Quebec	2	2	2	2	2	2	2	2	2	2	2
New Brunswick	3	3	3	2	2	3	3	2	3	3	2
Nova Scotia	2	2	2	2	2	2	2	2	2	2	2
Prince Edward Island	-	-	-	-	-	-	-	-	-	-	-
Newfoundland & Labrador	2	2	2	2	2	2	2	2	2	2	2

The breakdown of in-migration into international and inter-provincial in-migration is shown in Table 9.8 below. As you can see from the table, international in-migration is the larger source of in-migration across the country for mining engineers.

Table 9.8 International and Inter-Provincial In-Migration of Mining Engineers (2015-2025)

	Average 2015-19		Average 2020-25	
	International	Inter-Provincial	International	Inter-Provincial
British Columbia	17	6	14	3
Alberta	5	2	2	2
Saskatchewan	4	1	-2	-1
Manitoba	1	0	-3	1
Ontario	31	-4	48	-9
Quebec	5	-1	2	0
New Brunswick	3	-1	3	0
Nova Scotia	0	0	-1	0
Prince Edward Island	-	-	-	-
Newfoundland & Labrador	-1	1	0	0

10 GEOLOGICAL ENGINEERS

The forecast is for the Canadian economy to produce about 135 job openings for geological engineers annually over the next five years. Job openings will taper off to 85 openings annually over the latter five years as expansion demand is diminished.

New entrants to the occupation will average about 60 annually over the next five years and will generate about half of total supply requirements. Net in-migration will have to average about 55 annually to meet demand requirements over that period and all of this will come from international in-migration. Pressures on international in-migration for geological engineers will not be high. During the latter 5 year period those pressures will be reduced to about 30 annually.

Occupation Characteristics

Graduates

Geological engineering degrees granted by province are presented in Table 10.1. Universities in Ontario, Quebec, Saskatchewan and British Columbia grant nearly all the geological engineering degrees. New Brunswick universities grant a few of these degrees. There are either no degrees granted by universities in the Atlantic Provinces, or data is not available. The number of geological engineering degrees granted to women has increased from 49 in 2000 to 58 in 2013. An insignificant number of these degrees are earned by visa students[21].

21 Source: Engineers Canada. Visa data in this report refers to undergraduates only.

Table 10.1 Degrees Granted, Geological Engineering (2000-2013)

	Average 2000-04	Average 2005-09	2010	2011	2012	2013
British Columbia	17	20	29	38	26	28
Alberta	0	0	0	0	0	0
Saskatchewan	12	13	19	16	23	27
Manitoba	1	0	0	0	0	0
Ontario	24	34	35	34	47	65
Quebec	39	22	38	37	20	37
New Brunswick	7	4	6	3	5	7
Nova Scotia	0	0	0	0	0	0
Prince Edward Island	0	0	0	0	0	0
Newfoundland & Labrador	0	0	0	0	0	0

Source: Engineers Canada's 2014 Enrolment and Degrees Awarded Report

Industry Employment

Table 10.2, below, shows a ranking of employment by industry and province for geological engineers over the forecast period. A very large number of geological engineers work in the Architectural, Engineering and Related Services industry. The majority of these are in British Columbia, Ontario and Alberta but there are a few in Quebec, Saskatchewan and Newfoundland and Labrador. The Mining, Oil Sands and Utilities industries each employ a number of geological engineers.

Table 10.2 Top 25 Employment Estimates, Geological Engineers by Industry and Province (2015-2025)

Province	Industry	Average 2015-19	Average 2020-25
BRITISH COLUMBIA	Architectural, Engineering and Related Services	692	727
ONTARIO	Architectural, Engineering and Related Services	586	608
ALBERTA	Architectural, Engineering and Related Services	410	439
QUEBEC	Architectural, Engineering and Related Services	229	231
SASKATCHEWAN	Architectural, Engineering and Related Services	83	85
QUEBEC	Provincial and territorial public administration	63	66
NEWFOUNDLAND & LABRADOR	Architectural, Engineering and Related Services	54	54
QUEBEC	Management, Scientific and Technical Consulting Services	54	54
ALBERTA	Support activities for mining and oil and gas extraction	51	52
QUEBEC	Mining	48	46
MANITOBA	Architectural, Engineering and Related Services	48	51
ALBERTA	Other Professional, Scientific and Technical Services	39	42
QUEBEC	Utilities	38	39
ALBERTA	Oil Sands	35	39
BRITISH COLUMBIA	Support activities for mining and oil and gas extraction	31	32
BRITISH COLUMBIA	Provincial and territorial public administration	30	33
SASKATCHEWAN	Mining	30	31
BRITISH COLUMBIA	Utilities	29	31
NEW BRUNSWICK	Architectural, Engineering and Related Services	28	28
ONTARIO	Provincial and territorial public administration	26	27
ONTARIO	Management, Scientific and Technical Consulting Services	23	24
BRITISH COLUMBIA	Mining	20	22
BRITISH COLUMBIA	Other Professional, Scientific and Technical Services	20	20
ALBERTA	Conventional Oil	18	14
ONTARIO	Local municipal and regional public administration	16	17

Age Structure

British Columbia has the highest average age for geological engineers at 49. The average age is also quite high in Manitoba and New Brunswick – 44 in both provinces. The average age of mechanical engineers is lower in Saskatchewan, Quebec and Newfoundland and Labrador.

The projections show a decline in the average age for mechanical engineers in British Columbia over the forecast. As mechanical engineers in British Columbia retire and new entrants or younger migrants are brought into the workforce the average age will begin to decline. The average age of

geological engineers will also decline in Manitoba and New Brunswick over the forecast while they will remain stable in other provinces.

Table 10.3 Average Age of Geological Engineers (2015-2025)

	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
British Columbia	49	48	47	46	46	45	45	45	44	44	44
Alberta	40	40	40	40	40	41	41	41	41	41	41
Saskatchewan	43	42	42	42	43	43	43	43	43	43	43
Manitoba	47	46	45	44	44	43	43	43	43	43	43
Ontario	42	42	42	42	42	42	42	42	42	42	42
Quebec	45	44	44	44	44	44	44	44	44	44	44
New Brunswick	48	47	47	46	45	45	45	44	44	43	43
Nova Scotia	-	-	-	-	-	-	-	-	-	-	-
Prince Edward Island	-	-	-	-	-	-	-	-	-	-	-
Newfoundland & Labrador	39	39	40	40	40	41	41	41	41	41	41

Median annual wage data for geological engineers across the provinces is shown in Table 10.4 below. The data in the table represents thousands of dollars. Saskatchewan and Manitoba have the highest wage paid for geological engineers followed closely by Newfoundland and Labrador. A sizeable increase in the median annual wage over the forecast is expected in those provinces as well as in British Columbia and Alberta. The lowest wage for these engineers is in New Brunswick where there is relatively little demand for the occupation.

Table 10.4 Median Annual Wage ($ 000s) 2015-2025

	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
British Columbia	98.1	101.4	105.4	110.0	114.8	119.7	124.4	128.8	133.1	137.2	141.4
Alberta	97.7	99.7	102.0	105.2	108.8	112.8	116.9	120.9	124.6	128.1	131.5
Saskatchewan	116.1	120.2	123.8	127.0	129.6	131.8	133.7	135.5	137.4	140.1	143.7
Manitoba	117.7	121.5	125.2	128.7	131.6	134.2	136.7	139.2	142.0	145.1	148.6
Ontario	87.0	89.6	92.2	95.1	97.8	100.4	102.9	105.4	108.0	111.0	114.4
Quebec	74.0	76.4	79.1	82.0	84.8	87.5	90.0	92.4	94.7	97.2	99.8
New Brunswick	41.6	42.4	43.6	45.2	46.9	48.6	50.4	52.1	53.8	55.6	57.4
Nova Scotia	-	-	-	-	-	-	-	-	-	-	-
Prince Edward Island	-	-	-	-	-	-	-	-	-	-	-
Newfoundland & Labrador	104.3	106.8	109.2	112.5	116.1	120.1	124.1	128.4	132.3	136.1	139.6

Sources of Demand

Expansion Demand and Replacement Demand

Total demand (total job openings) is composed of expansion demand and replacement demand (retirements and deaths). Figure 10.1 shows the importance of replacement to total demand change for geological engineers by province over the forecast period. Expansion demand for geological engineers is highest in British Columbia followed by Alberta and Ontario. Replacement demand will be considerable in British Columbia, Ontario, Quebec and Alberta and will exceed expansion demand by a wide margin in those provinces.

Figure 10.1 Sources of Demand for Geological Engineers (Annual Average 2015-2025)

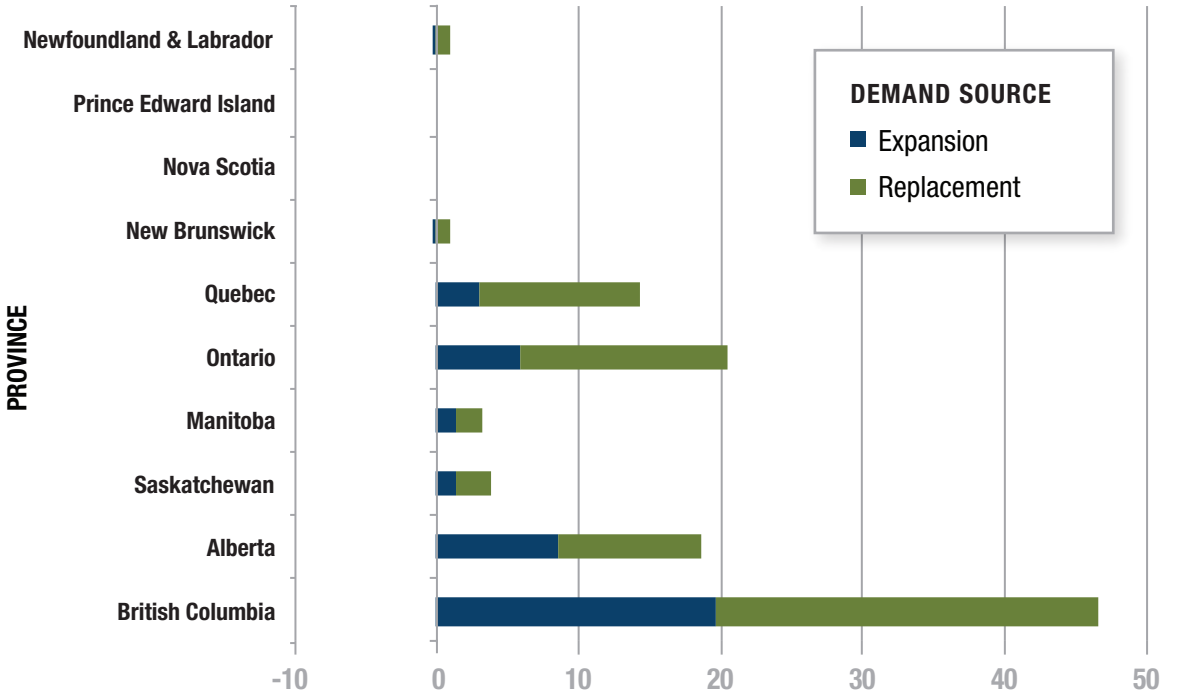


Table 10.5 below shows average annual job openings across the provinces for geological engineers. Job openings are highest in British Columbia to 2019, at an annual average of 65.[22] Replacement demand is expected to contribute about 40 per cent of total job openings over that period. The importance of replacement demand will increase to 80 per cent of total job openings in British Columbia during the last five years. Alberta, Ontario and Quebec will provide some job openings for geological engineers as well over the next five years but these opportunities will taper off as expansion demand wanes during the last five years

22 Due to random rounding, expansion demand plus replacement demand may not equal total job openings

Table 10.5 Sources of Demand for Geological Engineers (Annual Average 2015-19 and 2020-25)

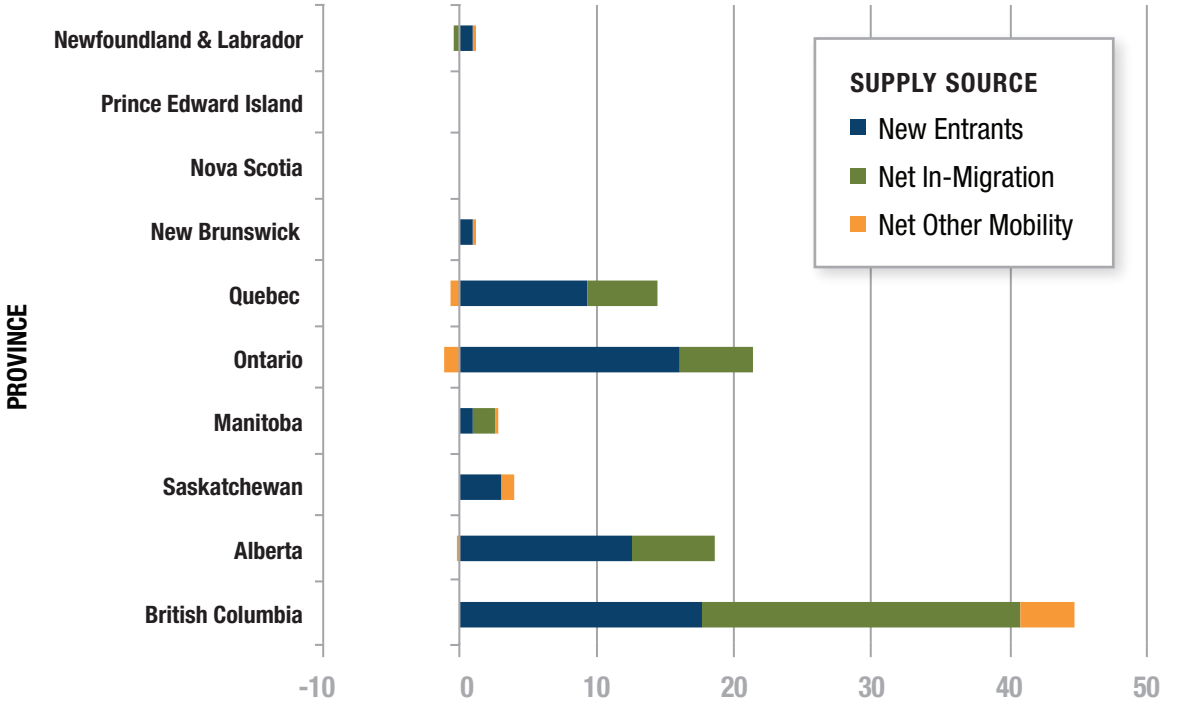
	Average 2015-19			Average 2020-25		
	Expansion	Replacement	Job Openings	Expansion	Replacement	Job Openings
British Columbia	37	28	65	5	26	31
Alberta	13	10	23	5	10	15
Saskatchewan	2	2	4	1	3	3
Manitoba	2	2	4	1	2	2
Ontario	7	14	21	5	15	20
Quebec	6	11	18	0	12	12
New Brunswick	-1	1	1	0	1	1
Nova Scotia	-	-	-	-	-	-
Prince Edward Island	-	-	-	-	-	-
Newfoundland & Labrador	-1	1	0	0	1	1

Sources of Supply

New Entrants, Migration and Other Mobility

Figure 10.2 shows the sources of supply for geological engineers. The number of new entrants to the occupation over the forecast period will be the highest in British Columbia and Ontario, followed by Alberta and Quebec. The number of new entrants is relatively insignificant in the Atlantic Provinces. British Columbia is also expected to receive the most of net in-migration, followed by Ontario, Alberta and Quebec. Net other mobility will also be required in British Columbia to meet total demand requirements.

Figure 10.2 Sources of Supply for Geological Engineers (Annual Average 2015-2025)



Total supply requirements and the components of supply of geological engineers are provided in Table 10.6 below. Supply requirements for geological engineers in British Columbia over the next 5 years averages 58 per year. In British Columbia net in-migration provides about 50 per cent of total supply requirements while new entrants contribute only 30 per cent. Total supply requirements tapers off during the last 5 years of the forecast and is primarily met by new entrants. From 2015 to 2019, total supply requirements in Ontario and Alberta average 22 per year.

Table 10.6 Sources of Supply for Geological Engineers (Annual Average 2015-19 and 2020-25)

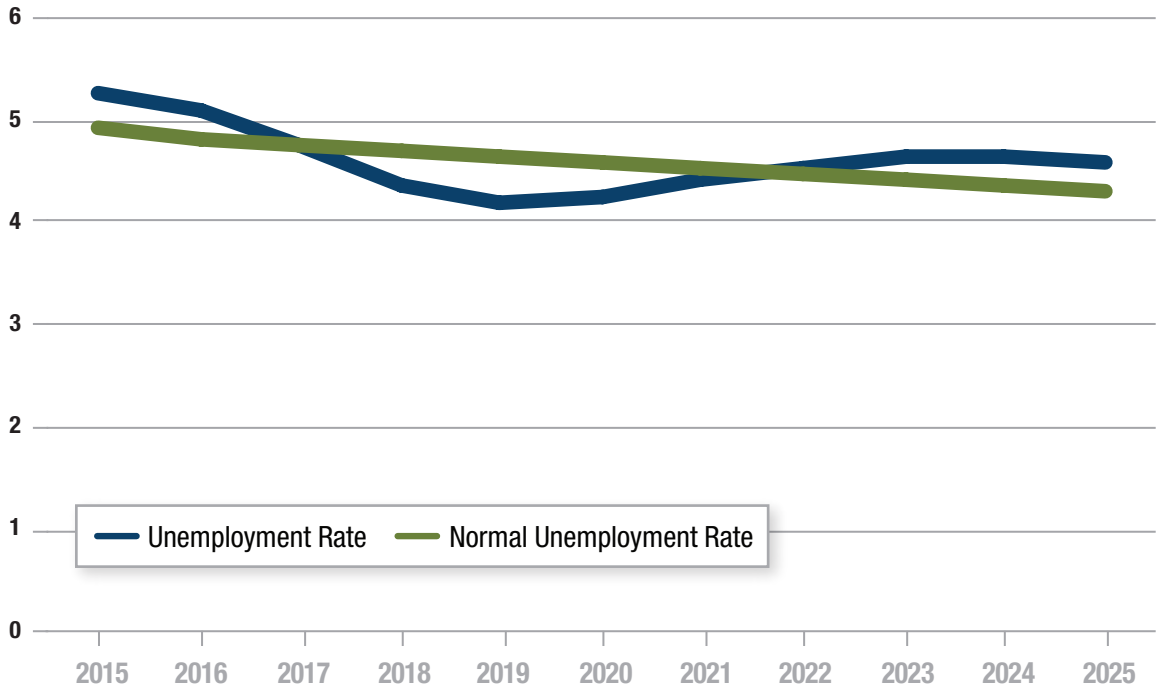
	Average 2015-19				Average 2020-25			
	New Entrants	Net In-Migration	Net Other Mobility	Total Supply	New Entrants	Net In-Migration	Net Other Mobility	Total Supply
British Columbia	17	30	11	58	18	18	-2	34
Alberta	12	10	0	22	13	3	-1	15
Saskatchewan	3	1	0	4	3	-1	2	4
Manitoba	1	2	0	3	1	1	0	2
Ontario	16	6	0	22	16	5	-2	19
Quebec	9	6	1	16	10	5	-2	12
New Brunswick	1	0	0	1	1	0	0	1
Nova Scotia	-	-	-	-	-	-	-	-
Prince Edward Island	-	-	-	-	-	-	-	-
Newfoundland & Labrador	1	-1	1	0	1	0	0	1

Labour Market Tightness

Actual vs. Normal Unemployment Rates and Gap

Figure 10.3 shows the actual and the normal unemployment rate for geological engineers in Canada. Unemployment rates near the normal unemployment rate suggests a normal labour market, while unemployment rates noticeably above or below the normal rate suggests either a loose or tight market, respectively. The chart suggests a normal market situation. The actual unemployment rate drops below the normal rate over the medium-term of the forecast, but not by a significant amount.

Figure 10.3 Unemployment Rate for Geological Engineers (%), Canada (2015-2025)



Although the labour market for geological engineers in Canada as a whole seems to suggest a normal market situation, the outlook by province could vary significantly. The labour market tightness rankings for geological engineers across the provinces are shown in Table 10.7 below. Rankings of 3 are colour coded in red and represent excess demand, a rank of 2 is a normal situation for the labour market, and a 1 (not seen in this occupation) is a situation of excess supply.

Most provinces will experience normal labour market tightness for geological engineers in the future, as can be seen from Table 10.7 below. The excess demand rankings in British Columbia, Manitoba and New Brunswick likely reflect upcoming major projects in these provinces, placing pressure on the demand for these workers.

Table 10.7 Weighted Labour Market Tightness Rank (1-3) for Geological Engineers (2015-2025)

	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
British Columbia	3	3	3	3	3	2	2	2	2	2	2
Alberta	2	2	2	2	2	2	2	2	2	2	2
Saskatchewan	2	2	2	2	2	2	2	2	2	2	2
Manitoba	3	3	3	2	2	2	2	2	2	2	2
Ontario	2	2	2	2	2	2	2	2	2	2	2
Quebec	2	2	2	2	2	2	2	2	2	2	2
New Brunswick	2	2	2	3	2	2	2	2	2	2	2
Nova Scotia	-	-	-	-	-	-	-	-	-	-	-
Prince Edward Island	-	-	-	-	-	-	-	-	-	-	-
Newfoundland & Labrador	2	2	2	2	2	2	2	2	2	2	2

The breakdown of in-migration into international and inter-provincial in-migration is shown in Table 10.8 below. Some degree of international in-migration will be required in British Columbia during over the next 5 years with minimal requirements from this source in the last five years. International and inter-provincial in-migration requirements are minimal in the other provinces.

Table 10.8 International and Inter-Provincial In-Migration of Geological Engineers (2015-2025)

	Average 2015-19		Average 2020-25	
	International	Inter-Provincial	International	Inter-Provincial
British Columbia	22	7	15	3
Alberta	7	3	1	2
Saskatchewan	1	0	-1	0
Manitoba	3	-1	1	-1
Ontario	7	-1	7	-1
Quebec	7	-1	5	0
New Brunswick	0	0	0	0
Nova Scotia	-	-	-	-
Prince Edward Island	-	-	-	-
Newfoundland & Labrador	0	-2	0	0

11 PETROLEUM ENGINEERS

The conventional oil industry in Alberta is the largest employer of petroleum engineers in Canada. With growth in the conventional oil industry slowing over the forecast period, expansion demand for petroleum engineers is negative. The average age for petroleum engineers is rising in Alberta and Newfoundland and Labrador, where participation rates among the 50+ age groups is rising and the overall population is aging. Replacement demand is critical for petroleum engineers in Alberta and, to a lesser extent, in Newfoundland and Labrador. New entrant levels for petroleum engineers in these two oil dominated provinces is forecasted to be high enough to account for the job openings available for the occupation. Net in-migration is not required for petroleum engineers and generally declines to 2025.

Occupation Characteristics

Graduates

Table 11.1 Degrees Granted, Petroleum Engineers (2000-2013)

There is no Table 11.1 as no data is available for petroleum engineer graduates. For consistency this chapter will begin with Table 11.2 on the next page.

Industry Employment

A ranking of employment by industry and by province for petroleum engineers is presented in Table 11.2. It is no surprise that most petroleum engineers work in the oil and gas extraction industry[23]. Petroleum engineers are prevalent in all oil and gas producing provinces, though the majority of these are located in Alberta and Newfoundland and Labrador. A large number of petroleum engineers also work in the Architectural, Engineering and Related Services industry.

Table 11.2 Top 25 Employment Estimates, Petroleum Engineers by Industry and Province (2015-2025)

Province	Industry	Average 2015-19	Average 2020-25
ALBERTA	Conventional Oil	5170	4238
ALBERTA	Architectural, Engineering and Related Services	1947	2082
ALBERTA	Support activities for mining and oil and gas extraction	1470	1484
NEWFOUNDLAND & LABRADOR	Oil and gas extraction	691	726
ALBERTA	Oil Sands	341	373
ALBERTA	Management, Scientific and Technical Consulting Services	334	355
ALBERTA	Wholesale Trade	305	324
NEWFOUNDLAND & LABRADOR	Support activities for mining and oil and gas extraction	225	230
ALBERTA	Petroleum and coal products manufacturing	197	187
ALBERTA	Machinery manufacturing	188	190
ALBERTA	Other Transportation	173	183
ALBERTA	Fabricated metal product manufacturing	160	165
BRITISH COLUMBIA	Oil and gas extraction	103	126
ONTARIO	Utilities	92	94
ALBERTA	Utilities	86	92
ONTARIO	Oil and gas extraction	82	93
ALBERTA	Heavy and Civil Engineering Construction	77	82
BRITISH COLUMBIA	Architectural, Engineering and Related Services	75	79
ONTARIO	Architectural, Engineering and Related Services	65	68
BRITISH COLUMBIA	Support activities for mining and oil and gas extraction	54	55
SASKATCHEWAN	Oil and gas extraction	53	48
NEWFOUNDLAND & LABRADOR	Architectural, Engineering and Related Services	46	46
NOVA SCOTIA	Oil and gas extraction	44	34
SASKATCHEWAN	Support activities for mining and oil and gas extraction	40	34
ONTARIO	Support activities for mining and oil and gas extraction	39	44

23 In Alberta the oil and gas extraction industry is divided into oil sands and conventional oil

Age Structure

The age distribution of a population has an important influence on workforce supply. An aging population reduces the growth in the supply through increased retirements and deaths. Engineers in Canada are generally in the 30 to 55 year old age range. Average age for each year of the forecast period for petroleum engineers, by province is presented in Table 11.3, below. Petroleum engineers in British Columbia have the highest average age in 2015 at 45 years, followed by Quebec at 44 years of age. The projections show a slight decline in the average age for petroleum engineers in British Columbia and Quebec over the period. As petroleum engineers in these provinces retire and new entrants or migrants of a younger age are brought into the workforce the average age will begin to decline. There is the ongoing issue of the skills gap between retirees and new entrants, in that new entrants do not have the skills set that retirees have acquired during their work experience. Provinces may attempt to bring in experienced workers through inter-provincial or international migration. Aside from British Columbia and Quebec, petroleum engineers in other provinces shown in Table 11.3 are facing a rising average age. This pattern reflects the rising participation rates among the older age groups in these provinces.

Table 11.3 Average Age of Petroleum Engineers (2015-2025)

	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
British Columbia	45	45	44	44	44	44	44	43	43	43	43
Alberta	41	42	42	43	43	44	44	44	45	45	45
Saskatchewan	39	39	40	40	40	41	41	41	41	41	41
Manitoba	-	-	-	-	-	-	-	-	-	-	-
Ontario	42	42	42	42	42	42	42	42	42	42	42
Quebec	44	44	43	43	43	42	42	42	42	42	42
New Brunswick	-	-	-	-	-	-	-	-	-	-	-
Nova Scotia	42	42	42	42	42	43	44	38	41	41	42
Prince Edward Island	-	-	-	-	-	-	-	-	-	-	-
Newfoundland & Labrador	39	40	40	41	42	42	42	43	43	44	43

Median annual wage data for petroleum engineers across the provinces is shown in Table 11.4, below. The data in the table represents thousands of dollars. Newfoundland and Labrador shows the highest wage paid for petroleum engineers in Canada in 2015, followed closely by Alberta. Towards the end of the forecast period Newfoundland and Labrador continues to rank the highest in median annual wage and wages in Nova Scotia rise to meet levels seen in Alberta. The lowest wage for these engineers as of 2015 is in Quebec, though these wages rise steadily over the forecast Quebec remains the lowest median annual wage, reflecting the lack of demand growth for the occupation in this particular province.

Table 11.4 Median Annual Wage for Petroleum Engineers ($ 000s) 2015-2025

	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
British Columbia	84.3	86.9	89.8	93.2	96.9	101.0	105.3	109.7	113.9	117.7	121.3
Alberta	138.2	140.4	142.4	145.6	149.6	154.3	159.3	164.1	168.6	172.9	177.1
Saskatchewan	92.0	95.0	97.4	99.8	101.7	103.4	104.7	105.8	107.0	108.7	111.2
Manitoba	-	-	-	-	-	-	-	-	-	-	-
Ontario	94.3	97.3	100.3	103.5	106.6	109.6	112.3	115.0	118.0	121.3	125.1
Quebec	73.4	75.7	78.2	81.2	83.9	86.7	89.1	91.4	93.7	96.1	98.7
New Brunswick	-	-	-	-	-	-	-	-	-	-	-
Nova Scotia	126.3	130.6	135.4	140.6	145.6	150.7	155.5	160.3	165.3	170.8	176.9
Prince Edward Island	-	-	-	-	-	-	-	-	-	-	-
Newfoundland & Labrador	159.2	163.3	167.5	173.9	181.1	188.3	195.1	201.5	206.8	211.2	217.2

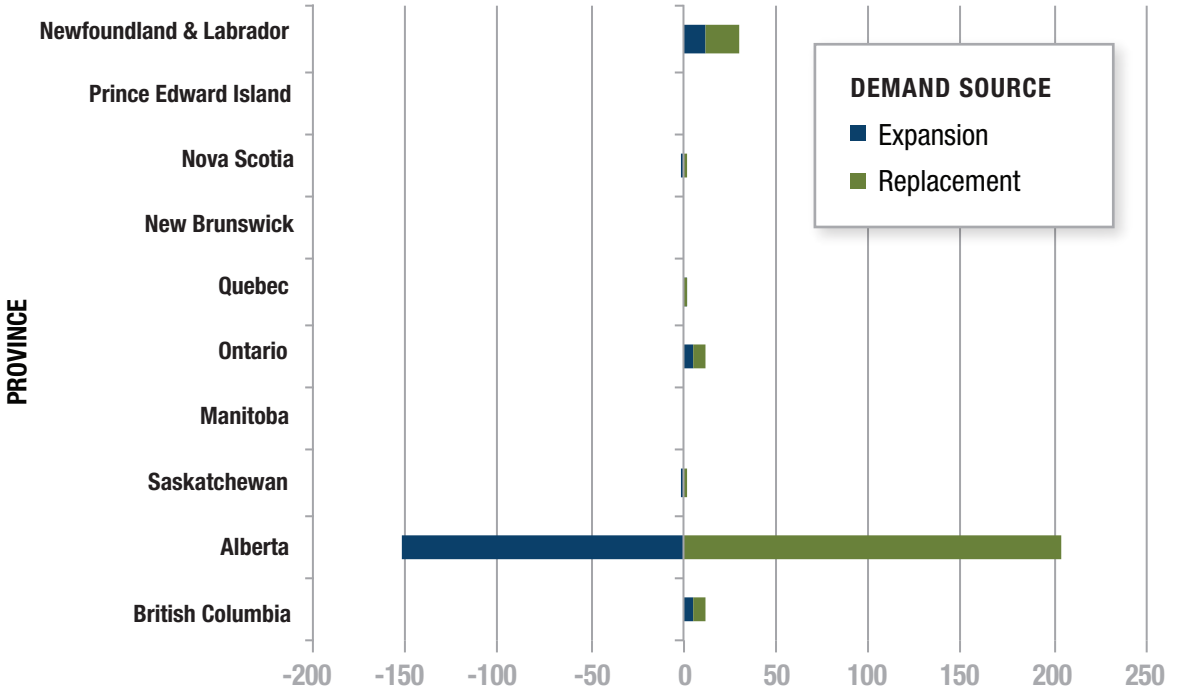
Sources of Demand

Expansion Demand and Replacement Demand

Total demand (total job openings) is composed of expansion demand and replacement demand (retirements and deaths). Figure 11.1 shows the importance of replacement to total demand change in all provinces across the forecast period. Though there is a small number in Nova Scotia, Newfoundland and Labrador is the only province among the Atlantic region where petroleum engineers are prevalent. In Newfoundland and Labrador, total demand change is comprised almost entirely of replacement demand as the population ages.

In Alberta, replacement demand is critical. Due to a large decline in expansion demand in Alberta, total job openings are declining to 2019, though a sizable portion of the workforce in Alberta is aging and there is a large requirement for replacement demand. The importance of replacement demand to total demand change, with a breakdown of the components into the short to medium and long-term, is further shown in Table 11.5, below.[24] Replacement demand far exceeds the decline in expansion demand over the long-term and total job openings for petroleum engineers in Alberta rise significantly.

Figure 11.1 Sources of Demand for Petroleum Engineers (Annual Average 2015-2025)



24 Due to random rounding, expansion demand plus replacement demand may not equal total job openings

Table 11.5 Sources of Demand for Petroleum Engineers (Annual Average 2015-19 and 2020-25)

	Average 2015-19			Average 2020-25		
	Expansion	Replacement	Job Openings	Expansion	Replacement	Job Openings
British Columbia	4	7	11	6	6	12
Alberta	-202	189	-13	-109	216	107
Saskatchewan	-1	2	1	-2	3	1
Manitoba	-	-	-	-	-	-
Ontario	7	7	14	3	7	11
Quebec	0	1	2	0	1	1
New Brunswick	-	-	-	-	-	-
Nova Scotia	1	2	3	-2	2	-1
Prince Edward Island	-	-	-	-	-	-
Newfoundland & Labrador	26	13	39	-1	24	23

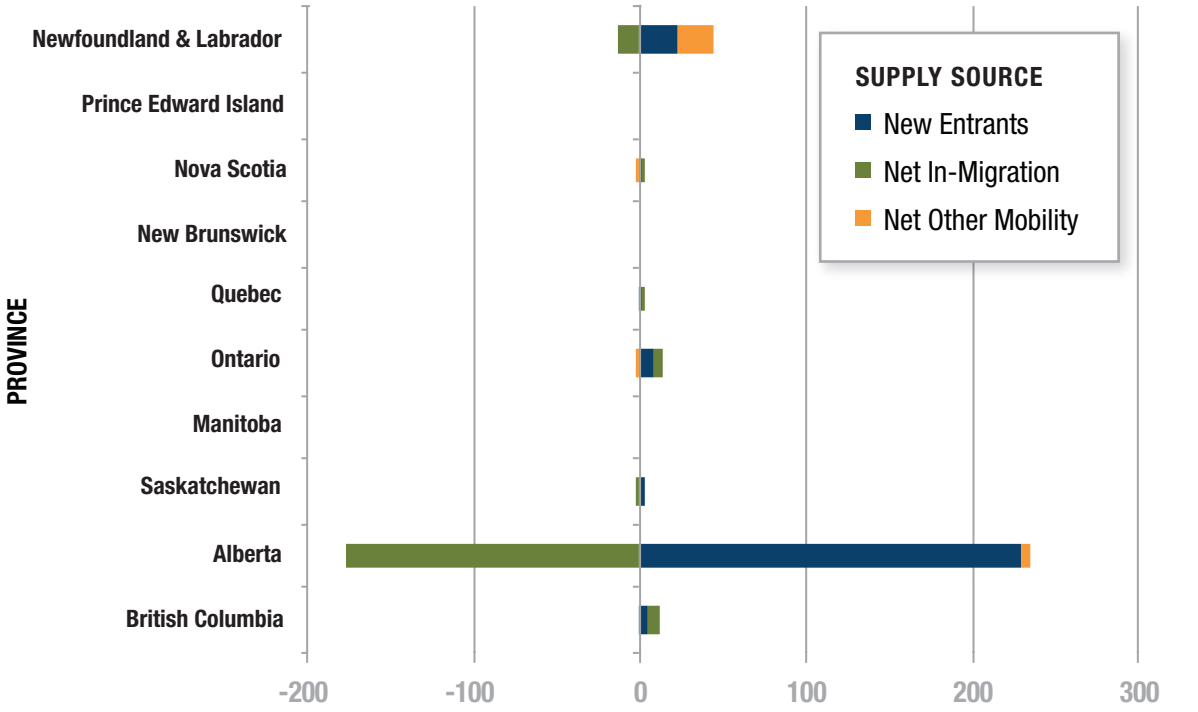
Sources of Supply

New Entrants, Migration and Other Mobility

The sources of supply change shown in Figure 11.2 are new entrants, net in-migration and net other mobility, the latter two being the components of net in-mobility. Net other mobility includes workers moving from other occupations – inter-occupation mobility – and other factors that impact the participation rate of the population in the labour force such as the availability of higher wages and decisions to postpone retirement.

As was seen previously in Figure 11.1, demand for petroleum engineers is strongest in Newfoundland and Labrador in the short to medium-term and Alberta becomes the highest in demand growth over the long-term. The supply of petroleum engineers is presented in Figure 11.2 below. It can be seen from the level of new entrants across the forecast period that young people are being drawn into the occupation, namely in Alberta. With the level of new entrants being drawn into petroleum engineering in Alberta, net in-migration will not be required and will actually decline significantly.

Figure 11.2 Sources of Supply for Petroleum Engineers (Annual Average 2015-2025)



The number of new entrants is the more stable source of supply and is easier to target. Expected new entrants for petroleum engineers across the country are shown in Table 11.6, below. As one would expect they are found largely in Alberta where there is higher demand for petroleum engineers. With oil and gas being a dominant industry in Newfoundland and Labrador, there is also a relatively strong pull of new entrants to the eastern province.

The model assumes that an occupation will get its share of total new entrants to the provincial economy based on its share of employment in the provincial economy as a whole. This is only an assumption and it is important for organizations requiring petroleum engineers to try their best to attract young people into the occupation. Total new entrants across the country far exceed the job openings forecasted, as the conventional oil industry declines in the short-term leading to a decline in expansion demand. This says that there are more than enough young people coming into the labour force as a whole to meet expansion and replacement demand.

Table 11.6 Sources of Supply for Petroleum Engineers (Annual Average 2015-19 and 2020-25)

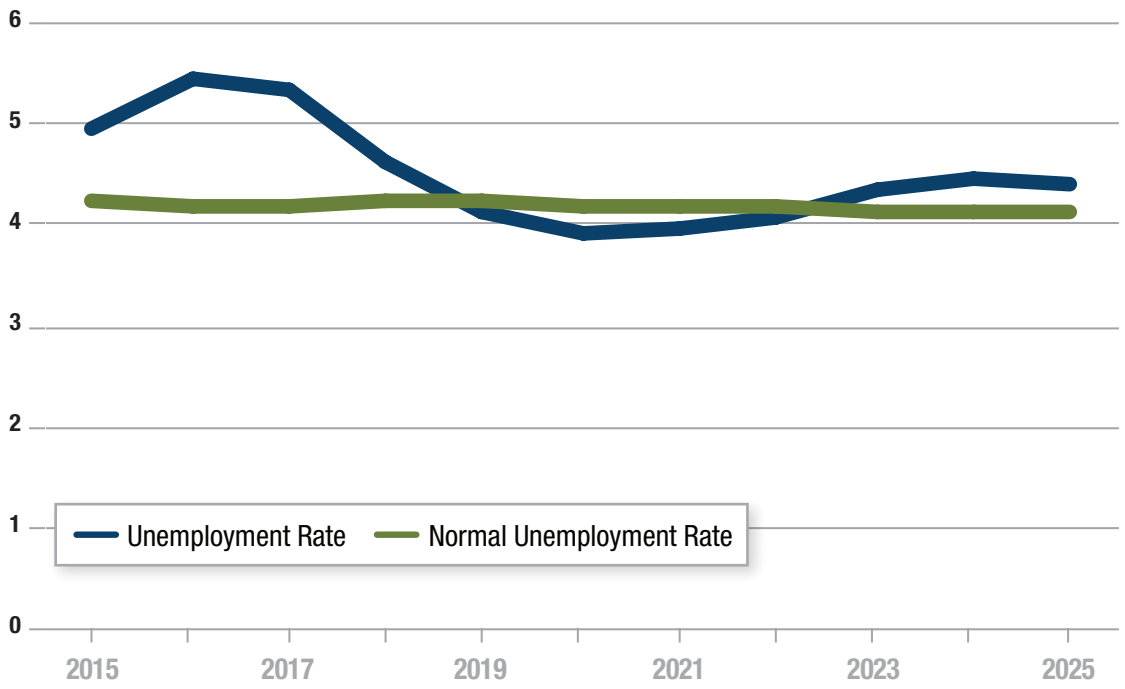
	Average 2015-19				Average 2020-25			
	New Entrants	Net In-Migration	Net Other Mobility	Total Supply	New Entrants	Net In-Migration	Net Other Mobility	Total Supply
British Columbia	5	3	2	10	6	9	-2	13
Alberta	239	-233	-14	-8	220	-130	23	112
Saskatchewan	3	-2	0	1	3	-2	0	1
Manitoba	-	-	-	-	-	-	-	-
Ontario	8	6	0	14	8	5	-2	11
Quebec	1	1	0	2	1	0	0	1
New Brunswick	-	-	-	-	-	-	-	-
Nova Scotia	2	0	1	3	1	3	-5	-1
Prince Edward Island	-	-	-	-	-	-	-	-
Newfoundland & Labrador	22	-28	43	37	23	-2	3	24

Labour Market Tightness

Actual vs. Normal Unemployment Rates and Gap

The actual and the normal unemployment rate for petroleum engineers in Canada are shown below in Figure 11.3. Unemployment rates near the normal unemployment rate suggests a normal labour market, while unemployment rates noticeably above or below the normal rate suggests either a loose or tight market, respectively. The chart suggests a relatively normal market situation for most of the forecast. The actual rate rises about a per cent above the normal rate over the next couple of years, which reflects the recent decline in the conventional oil industry in the west. The actual unemployment rate begins to decline once again in 2017 and remains near the normal rate over the remainder of the forecast.

Figure 11.3 Unemployment Rate for Petroleum Engineers (%), Canada (2015-2025)



Although the labour market for petroleum engineers in Canada as a whole seems to suggest a normal market situation, the outlook by province could vary significantly. The labour market tightness rankings for petroleum engineers across the provinces are shown in Table 11.7, below. Rankings of 3 are colour coded in red and represent excess demand, a rank of 2 is a normal situation for the labour market, and a 1 (not seen in this occupation) is a situation of excess supply.

Most provinces will experience normal labour market tightness for petroleum engineers in the future – see Table 11.7. The excess demand rankings in Alberta and Newfoundland and Labrador reflect upcoming major projects in these provinces, placing pressure on the demand for these workers.

The labour market tightness rank of 3 in 2015 and later in the long-term in Alberta suggests a slightly higher than normal rate of difficulty in finding petroleum engineers in Alberta during these periods. Given that it appears that the labour market for petroleum engineers in Alberta will be only slightly tight in the immediate short-term and later in the long-term it may not be necessary for the province to look elsewhere in Canada to acquire the workforce it needs. If the province of Alberta was to look outside the province however, the degree of difficulty in this effort will depend on the demand-supply situation in the other provinces.

Table 11.7 Weighted Labour Market Tightness Rank (1-3) for Petroleum Engineers (2015-2025)

	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
British Columbia	3	2	2	2	2	3	3	3	2	2	2
Alberta	2	2	2	2	2	2	2	2	2	2	2
Saskatchewan	2	2	2	2	2	2	2	2	2	2	2
Manitoba	-	-	-	-	-	-	-	-	-	-	-
Ontario	2	2	2	2	2	2	2	2	2	2	2
Quebec	2	2	2	2	2	2	2	2	2	2	2
New Brunswick	-	-	-	-	-	-	-	-	-	-	-
Nova Scotia	2	2	2	2	2	2	2	2	2	2	2
Prince Edward Island	-	-	-	-	-	-	-	-	-	-	-
Newfoundland & Labrador	2	2	2	2	2	2	2	2	2	2	3

The breakdown of in-migration into international and inter-provincial in-migration is shown in Table 11.8, below. As you can see in the table, international and inter-provincial migration generally decline across the country. Any excess demand that is created as the result of rising deaths and retirements in Alberta and Newfoundland and Labrador will be able to be filled by new entrants. Given the forecasted new entrant levels of petroleum engineers to these provinces, there should be no difficulties in obtaining the required workforce.

Table 11.8 International and Inter-Provincial In-Migration of Petroleum Engineers (2015-2025)

	Average 2015-19		Average 2020-25	
	International	Inter-Provincial	International	Inter-Provincial
British Columbia	2	1	7	2
Alberta	-149	-84	-61	-69
Saskatchewan	-2	0	-6	4
Manitoba	-	-	-	-
Ontario	7	-1	5	-1
Quebec	1	0	0	0
New Brunswick	-	-	-	-
Nova Scotia	0	-1	5	-2
Prince Edward Island	-	-	-	-
Newfoundland & Labrador	10	-38	-3	0

12 AEROSPACE ENGINEERS

Aerospace engineering is dominated by the transportation equipment manufacturing industry in Quebec. As the average age of aerospace engineers rises in Quebec, there will be excess demand in the short to medium-term. Given the forecasted new entrants levels and net other migration levels for aerospace engineers to Quebec, in-migration is not a strong requirement for the province and there should be no major difficulties in obtaining the required workforce for aerospace engineers.

Occupation Characteristics

Graduates

Table 12.1 Degrees Granted, Aerospace Engineers (2000-2013)

There is no Table 12.1 as no data is available for petroleum engineer graduates. For consistency purposes this chapter will begin with Table 12.2 on the next page.

Industry Employment

A ranking of employment by industry and by province for aerospace engineers is presented in Table 12.2 above. Most aerospace engineers work in the Transportation Equipment Manufacturing industry. The majority of these are in Quebec but there is also a significant number in Ontario. A large number of aerospace engineers also work in the Architectural, Engineering and Related Services industry. Quebec has the highest concentration of aerospace engineers.

Table 12.2 Top 25 Employment Estimates, Aerospace Engineers by Industry and Province (2015-2025)

Province	Industry	Average 2015-19	Average 2020-25
QUEBEC	Transportation equipment manufacturing	3102	2914
ONTARIO	Transportation equipment manufacturing	1468	1414
ONTARIO	Architectural, Engineering and Related Services	332	345
QUEBEC	Architectural, Engineering and Related Services	301	305
ONTARIO	Federal government public administration	239	249
MANITOBA	Transportation equipment manufacturing	236	253
QUEBEC	Federal government public administration	187	196
ONTARIO	Computer and electronic product manufacturing	180	189
QUEBEC	Machinery manufacturing	160	150
QUEBEC	Support activities for transportation	147	144
NOVA SCOTIA	Transportation equipment manufacturing	127	126
BRITISH COLUMBIA	Support activities for transportation	104	109
ONTARIO	Air transportation	85	86
QUEBEC	Computer and electronic product manufacturing	83	78
ALBERTA	Transportation equipment manufacturing	78	81
QUEBEC	Computer Systems Design and Related Services	74	75
BRITISH COLUMBIA	Transportation equipment manufacturing	71	70
ONTARIO	Computer Systems Design and Related Services	68	70
QUEBEC	Management, Scientific and Technical Consulting Services	54	54
ONTARIO	Support activities for transportation	46	47
ONTARIO	Management, Scientific and Technical Consulting Services	45	47
BRITISH COLUMBIA	Architectural, Engineering and Related Services	44	46
NOVA SCOTIA	Support activities for transportation	40	37
ALBERTA	Other Professional, Scientific and Technical Services	39	42
QUEBEC	Air transportation	37	36

Age Structure

Average age for aerospace engineers is presented in Table 12.3. Aerospace engineers in Alberta have the highest average age in 2015 at 46 years, followed by Ontario at 44 years of age. The projections show a noticeable rise in the average age for aerospace engineers in Quebec, where the occupation is most prevalent. As aerospace engineers in Quebec reach retirement age, new entrants or migrants are required. Most new entrants or migrants into an occupation are of a younger age bracket and will reduce the average age of the labour force for that

occupation. There is the ongoing issue of the skills gap between retirees and new entrants, in that new entrants do not have the skills set that retirees have acquired during their work experience. Provinces may attempt to bring in experienced workers through inter-provincial or international migration.

Table 12.3 Average Age of Aerospace Engineers (2015-2025)

	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
British Columbia	43	43	43	44	44	44	44	44	44	44	44
Alberta	46	46	45	45	45	45	45	45	45	45	45
Saskatchewan	-	-	-	-	-	-	-	-	-	-	-
Manitoba	43	43	43	43	43	43	43	43	43	43	43
Ontario	44	44	44	44	44	44	44	44	44	44	44
Quebec	41	41	41	42	42	42	43	43	44	44	44
New Brunswick	-	-	-	-	-	-	-	-	-	-	-
Nova Scotia	39	39	40	40	41	41	42	40	42	42	43
Prince Edward Island	-	-	-	-	-	-	-	-	-	-	-
Newfoundland & Labrador	-	-	-	-	-	-	-	-	-	-	-

Median annual wage data for aerospace engineers is shown in Table 12.4, below. The data in the table represents thousands of dollars. Quebec shows the highest wage paid for aerospace engineers in Canada, followed closely by British Columbia. The lowest wage for these engineers is in Alberta where there is very little demand for the occupation.

Table 12.4 Median Annual Wage ($ 000s) 2015-2025

	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
British Columbia	87.0	89.4	92.6	96.4	100.5	104.7	108.8	112.6	116.2	119.8	123.4
Alberta	59.1	60.6	62.3	64.5	66.9	69.4	71.9	74.3	76.4	78.4	80.5
Saskatchewan	-	-	-	-	-	-	-	-	-	-	-
Manitoba	80.9	83.2	85.4	87.7	89.9	91.8	93.6	95.3	97.2	99.3	101.7
Ontario	81.5	83.9	86.5	89.1	91.3	93.6	95.7	97.9	100.2	102.9	105.9
Quebec	88.8	91.7	94.7	98.2	101.4	104.5	107.2	109.7	112.3	114.9	117.8
New Brunswick	-	-	-	-	-	-	-	-	-	-	-
Nova Scotia	72.1	74.5	77.3	80.3	83.4	86.4	89.3	92.2	95.3	98.5	102.0
Prince Edward Island	-	-	-	-	-	-	-	-	-	-	-
Newfoundland & Labrador	-	-	-	-	-	-	-	-	-	-	-

Sources of Demand

Expansion Demand and Replacement Demand

Total demand (total job openings) is composed of expansion demand and replacement demand (retirements and deaths). Figure 12.1 shows the importance of replacement to total demand change in all provinces across the forecast period. In Ontario and Quebec, total demand change is comprised entirely or almost entirely of replacement demand. The importance of replacement demand to total demand change, with a breakdown of the components into the short to medium and long-term, is further shown in Table 12.5 below.[25] In the long-term of the forecast, total demand change is entirely due to replacement demand, as expansion demand withers.

25 Due to random rounding, expansion demand plus replacement demand may not equal total job openings

Figure 12.1 Sources of Demand for Aerospace Engineers (Annual Average 2015-2025)

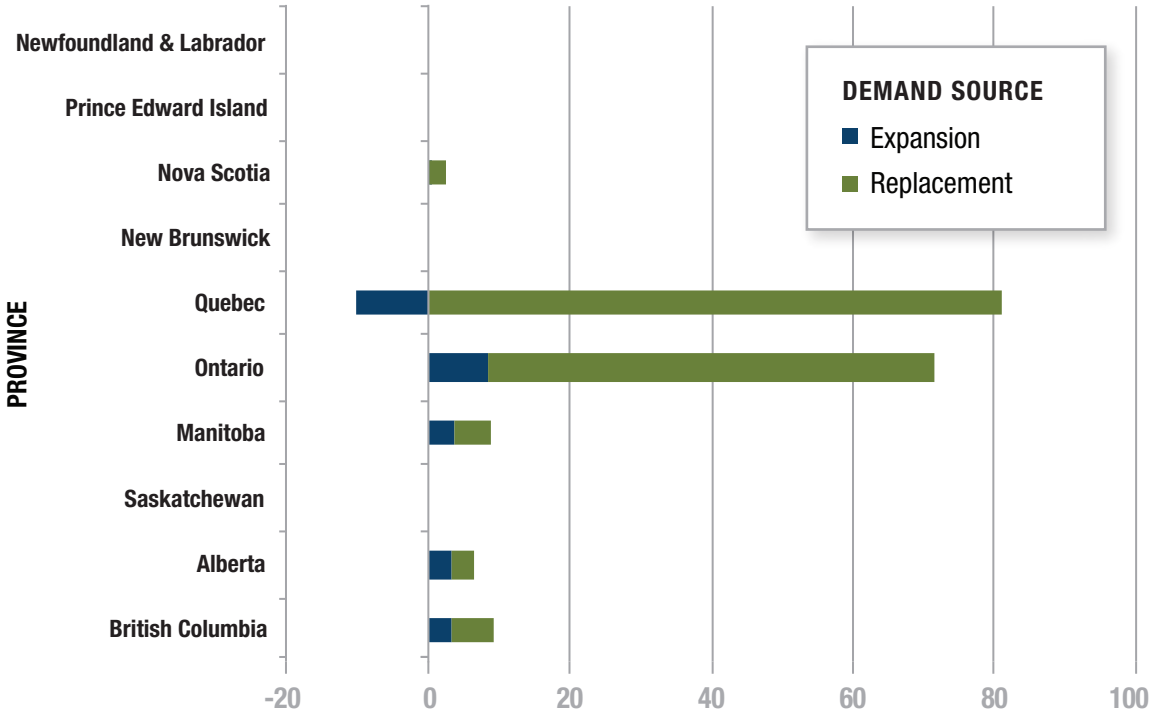


Table 12.5 Sources of Demand for Aerospace Engineers (Annual Average 2015-19 and 2020-25)

	Average 2015-19			Average 2020-25		
	Expansion	Replacement	Job Openings	Expansion	Replacement	Job Openings
British Columbia	6	5	11	1	7	8
Alberta	7	3	10	0	4	4
Saskatchewan	-	-	-	-	-	-
Manitoba	5	4	10	2	6	8
Ontario	22	62	84	-3	64	61
Quebec	43	71	114	-55	89	35
New Brunswick	-	-	-	-	-	-
Nova Scotia	4	2	5	-3	3	0
Prince Edward Island	-	-	-	-	-	-
Newfoundland & Labrador	-	-	-	-	-	-

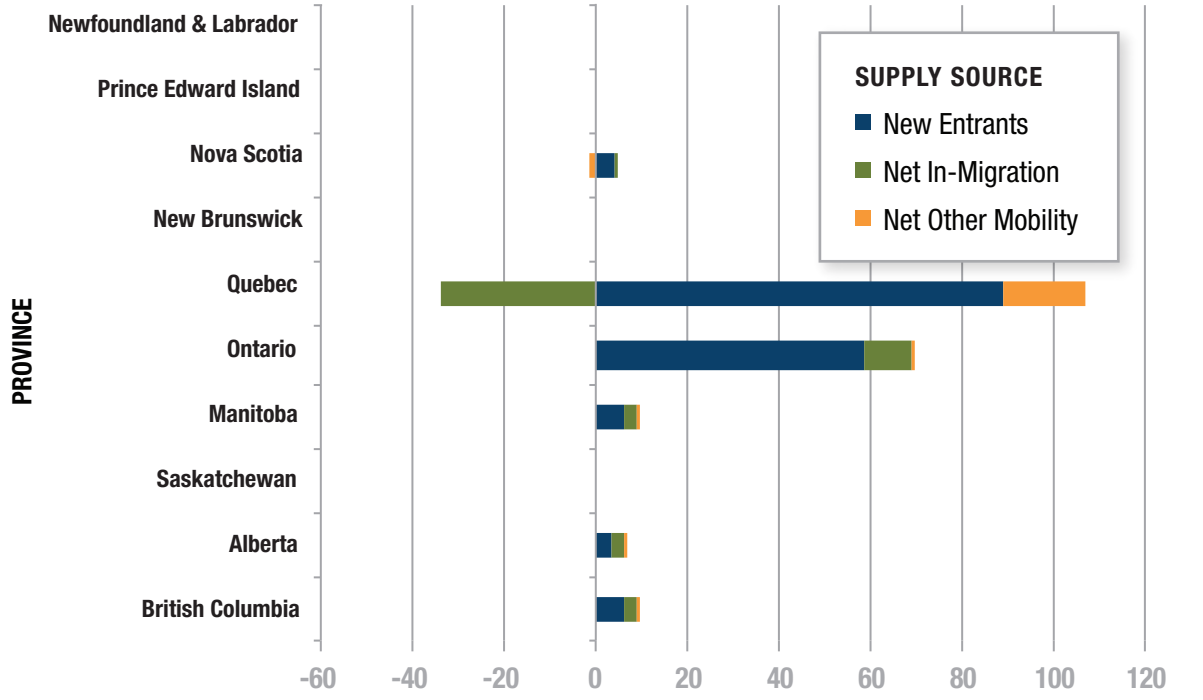
Sources of Supply

New Entrants, Migration and Other Mobility

The sources of supply change shown in Figure 12.2 are new entrants, net in-migration and net other mobility, the latter two being the components of net in-mobility. Net other mobility includes workers moving from other occupations – inter-occupation mobility – and other factors that impact the participation rate of the population in the labour force such as the availability of higher wages and decisions to postpone retirement.

There is strong demand for aerospace engineers in Ontario and Quebec. Figure 3.3 below shows the supply of aerospace engineers. It can be seen from the level of new entrants in the forecast period that young people are being drawn into the occupation, especially in Ontario and Quebec where aerospace is a dominant industry. There is also a substantial requirement for net in-migration of aerospace engineers to Ontario. Quebec shows strong net other mobility for aerospace engineers. Quebec has the highest median wage rate for aerospace engineers across the country. It is perhaps not surprising that aerospace engineers in other provinces may choose to move to Quebec. As a result of this other mobility in Quebec, net in-migration is not a strong requirement.

Figure 12.2 Sources of Supply for Aerospace Engineers (Annual Average 2015-2025)



The number of new entrants is the more stable source of supply and easier to target. Expected new entrants for aerospace engineers across the country are shown in Table 12.6 below. As one would expect they are found in the larger provinces and with relatively large demands for aerospace engineers. Quebec and Ontario stand out as locations from which new entrants could be obtained.

The model assumes that an occupation will get its share of total new entrants to the provincial economy based on its share of employment in the provincial economy as a whole. This is only an assumption and it is important for organizations requiring aerospace engineers to try their best to attract young people into the occupation. Total new entrants across the country amount to about half of the job openings forecasted across the country. This says that there are not enough young people coming into the labour force as a whole to meet expansion and replacement demand.

Table 12.6 Sources of Supply for Aerospace Engineers (Annual Average 2015-19 and 2020-25)

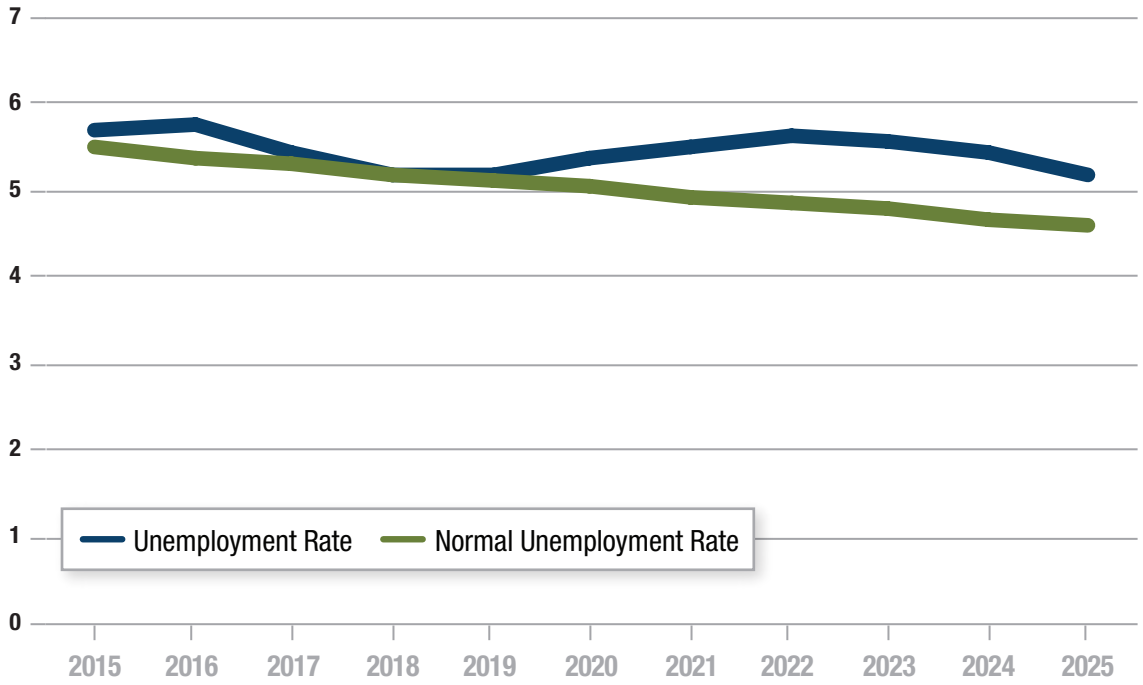
	Average 2015-19				Average 2020-25			
	New Entrants	Net In-Migration	Net Other Mobility	Total Supply	New Entrants	Net In-Migration	Net Other Mobility	Total Supply
British Columbia	6	3	1	10	6	2	0	8
Alberta	3	6	0	9	3	1	0	4
Saskatchewan	-	-	-	-	-	-	-	-
Manitoba	6	4	1	11	6	2	0	8
Ontario	61	19	3	82	57	3	-1	59
Quebec	90	18	3	112	88	-77	31	42
New Brunswick	-	-	-	-	-	-	-	-
Nova Scotia	4	0	0	5	4	0	-3	1
Prince Edward Island	-	-	-	-	-	-	-	-
Newfoundland & Labrador	-	-	-	-	-	-	-	-

Labour Market Tightness

Actual vs. Normal Unemployment Rates and Gap

The actual and the normal unemployment rate for aerospace engineers in Canada are shown in Figure 12.3, below. Unemployment rates near the normal unemployment rate suggests a normal labour market, while unemployment rates noticeably above or below the normal rate suggests either a loose or tight market, respectively. The chart suggests a normal market situation. The actual unemployment rate rises above the normal rate over the long-term of the forecast, but not by a significant amount.

Figure 12.3 Unemployment Rate for Aerospace Engineers (%), Canada (2015-2025)



The labour market tightness rankings for aerospace engineers across the provinces are shown in Table 12.7, below. Rankings of 3 are colour coded in red and represent excess demand, a rank of 2 is a normal situation for the labour market, and a 1 (not seen in this occupation) is a situation of excess supply.

Most provinces will experience normal labour market tightness for aerospace engineers in the future – see Table 12.7. The excess demand rankings in Alberta and Manitoba likely reflect upcoming major projects in these provinces, resulting in higher than normal expansion demand for these workers.

The labour market tightness rank of 3 over the short to medium-term of the forecast in Alberta and Manitoba suggests a slightly higher than normal rate of difficulty in finding aerospace engineers

in these provinces during this period. Given that it appears that the labour market for aerospace engineers in these two provinces will be only slightly tight in a few years it may not be necessary to go outside the provinces to find them. If they were to look outside the province however, the degree of difficulty in this effort will depend on the demand-supply situation in other provinces.

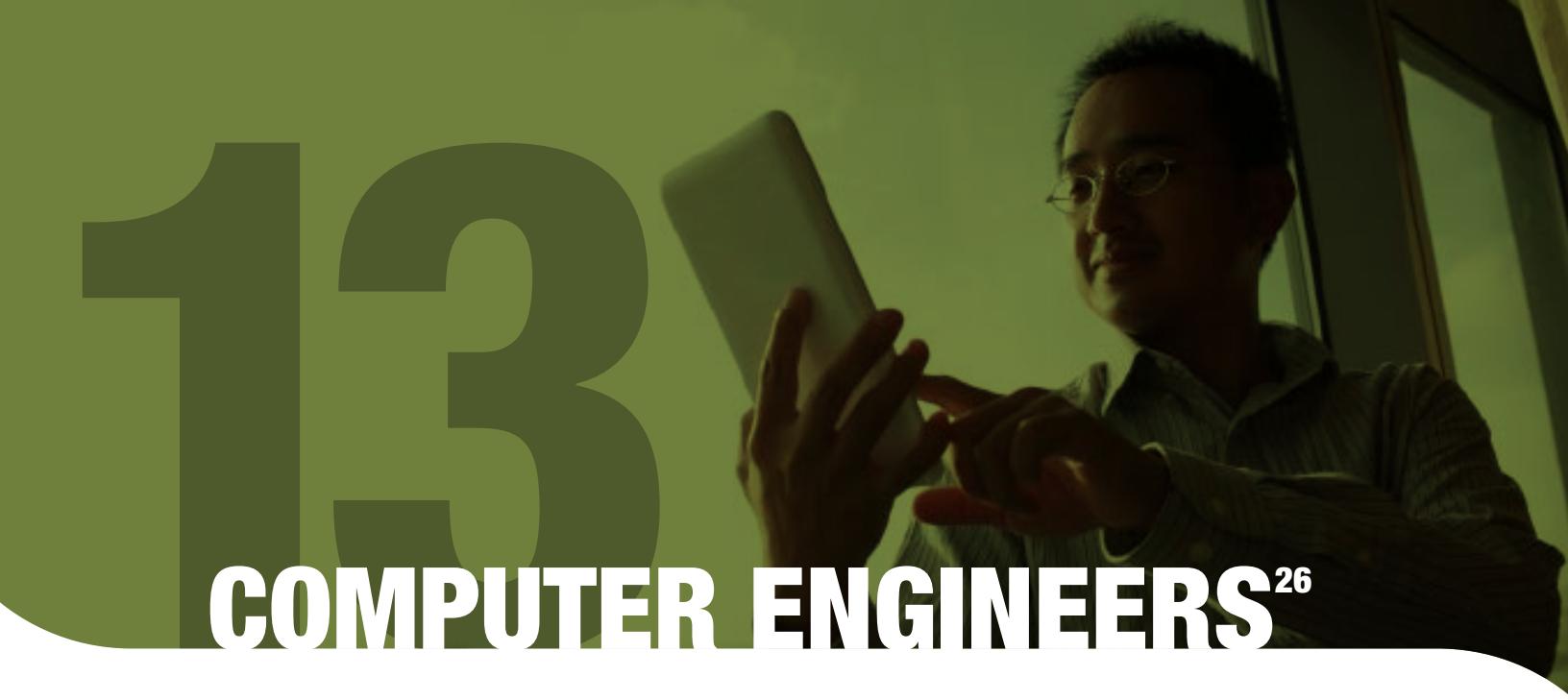
Table 12.7 Weighted Labour Market Tightness Rank (1-3) for Aerospace Engineers (2015-2025)

	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
British Columbia	2	2	2	2	2	2	2	2	2	2	2
Alberta	3	3	3	3	2	2	2	2	2	2	2
Saskatchewan	-	-	-	-	-	-	-	-	-	-	-
Manitoba	2	2	2	3	2	2	2	2	2	2	2
Ontario	2	2	2	2	2	2	2	2	2	2	2
Quebec	2	2	2	2	2	2	2	2	2	2	2
New Brunswick	-	-	-	-	-	-	-	-	-	-	-
Nova Scotia	2	2	2	2	2	2	2	2	2	2	2
Prince Edward Island	-	-	-	-	-	-	-	-	-	-	-
Newfoundland & Labrador	-	-	-	-	-	-	-	-	-	-	-

The breakdown of in-migration into international and inter-provincial in-migration is shown in Table 12.8, below. International in-migration is the largest source of in-migration across the country, though neither component of in-migration is an important requirement for the occupation. As the average age of aerospace engineers rises in Quebec, there will be excess demand in the short to medium-term. Given the forecasted new entrants levels and international in-migration of aerospace engineers to the provinces, there should be no major difficulties in obtaining the required workforce.

Table 12.8 International and Inter-Provincial In-Migration of Aerospace Engineers (2015-2025)

	Average 2015-19		Average 2020-25	
	International	Inter-Provincial	International	Inter-Provincial
British Columbia	2	1	2	0
Alberta	4	2	0	0
Saskatchewan	-	-	-	-
Manitoba	6	-1	4	-2
Ontario	20	-1	3	0
Quebec	24	-6	-83	6
New Brunswick	-	-	-	-
Nova Scotia	0	1	0	0
Prince Edward Island	-	-	-	-
Newfoundland & Labrador	-	-	-	-



13 COMPUTER ENGINEERS[26]

The vast majority of computer engineering positions are in Ontario and Quebec. Together they account for over 75 per cent of the average annual job openings forecasted for Canada in the next 5 years – Over 60 per cent of which will be due to replacement demand.

New entrants supply over 80 per cent of total job openings in Ontario and Quebec, inter-provincial and international migration will be required to supply remaining labour demand. The relatively high number of computer engineering degrees granted by Ontario universities is producing a solid stream of new entrants into the market for this occupation. Though, international in-migration of computer engineers will still be a relatively strong requirement for Ontario, where demand for the occupation is the highest across the country.

The projections suggest that no excess demand should be expected over the forecast.

Occupation Characteristics

Graduates

University degrees granted for computer engineering by province are presented in Table 13.1 below. Ontario universities grant by far the largest number of computer engineering degrees, however, the number has declined significantly since 2000. Universities in Quebec and British Colombia also grant a significant number of computer engineering graduates. The number of graduates in British Colombia has been relatively stable since the early 2000's, however Quebec has seen a significant drop – from an average of 436 from 2000-2004 to only120 in 2013. Alberta and Manitoba universities are also producing far fewer computer engineering graduates in recent years. Not only did the total number of graduates fall, the proportion of female graduates had also decreased. During 2000-2004, females on average accounted for 13 per cent of all computer engineering graduates, in 2013 they accounted for 10 per cent. Over the ten year period from 2003 to 2013, visa graduates as a per cent of total graduates rose significantly from about 6.5 per cent in 2003 to 11.4 per cent in 2013[27].

26 Computer Engineers category does not include Software Engineers.
27 Source: Engineers Canada. Visa data in this report refers to undergraduates only.

Table 13.1 Degrees Granted, Computer Engineering (2000-2013)

	Average 2000-04	Average 2005-09	2010	2011	2012	2013
British Columbia	112	86	75	92	81	104
Alberta	86	86	47	59	53	38
Saskatchewan	49	37	25	21	39	23
Manitoba	49	24	34	13	10	9
Ontario	567	580	290	256	242	348
Quebec	436	282	173	102	176	120
New Brunswick	16	12	3	9	3	15
Nova Scotia	11	4	6	3	11	8
Prince Edward Island	0	0	0	0	0	0
Newfoundland & Labrador	15	13	14	13	15	21

Source: Engineers Canada's 2014 Enrolment and Degrees Awarded Report

Industry Employment

A ranking of employment by industry and by province for computer engineers is presented in Table 13.2, below. A large number of computer engineers work in the Computer Systems Design and Related Services, Telecommunications, and Computer and Electronic Product Manufacturing industries. The majority of these jobs are in Ontario but there are significant number in Quebec, British Columbia, and Alberta. Computer engineers also work in the Wholesale trade sector, Other Professional, Scientific and Technical Services and Finance.

Table 13.2 Top 25 Employment Estimates, Computer Engineers by Industry and Province (2015-2025)

Province	Industry	Average 2015-19	Average 2020-25
ONTARIO	Computer Systems Design and Related Services	3987	4127
QUEBEC	Computer Systems Design and Related Services	2278	2304
ONTARIO	Telecommunications	2202	2251
ONTARIO	Computer and electronic product manufacturing	1510	1588
ONTARIO	Wholesale Trade	1145	1194
BRITISH COLUMBIA	Computer Systems Design and Related Services	1043	1085
ONTARIO	Other Professional, Scientific and Technical Services	1010	1050
QUEBEC	Telecommunications	916	919
QUEBEC	Other Professional, Scientific and Technical Services	821	828
ONTARIO	Finance	734	754
ALBERTA	Computer Systems Design and Related Services	680	723
ONTARIO	Architectural, Engineering and Related Services	644	669
BRITISH COLUMBIA	Telecommunications	594	646
ALBERTA	Telecommunications	560	576
ONTARIO	Federal government public administration	440	459
QUEBEC	Architectural, Engineering and Related Services	385	389
QUEBEC	Wholesale Trade	382	379
QUEBEC	Computer and electronic product manufacturing	326	307
ONTARIO	Other Retail Trade	311	322
ALBERTA	Architectural, Engineering and Related Services	299	320
ONTARIO	Management, Scientific and Technical Consulting Services	199	207
BRITISH COLUMBIA	Other Professional, Scientific and Technical Services	192	200
ALBERTA	Wholesale Trade	190	202
QUEBEC	Federal government public administration	180	189
ONTARIO	Trade contracting	176	176

Age Structure

The average age for computer engineers by province is presented in Table 13.3 below. Computer engineers in Alberta, Ontario, Manitoba and Newfoundland and Labrador have an average age of 43 in 2015; slightly higher than that of the rest of Canada. Computer engineers have very little variation in average age across provinces, the lowest being 40 in British Colombia and Nova Scotia. The projections are for a small increase in the average age of computer engineers over the forecast.

Table 13.3 Average Age of Computer Engineers (2015-2025)

	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
British Columbia	40	41	41	41	42	42	42	43	43	43	43
Alberta	43	43	43	43	43	44	44	44	44	44	44
Saskatchewan	42	43	43	43	43	43	44	44	44	44	44
Manitoba	43	44	44	44	44	44	44	44	44	44	44
Ontario	43	43	43	44	44	44	44	44	44	44	44
Quebec	42	42	43	43	43	43	43	44	44	44	44
New Brunswick	41	41	42	42	43	43	44	44	44	44	45
Nova Scotia	40	40	41	41	42	42	43	42	43	43	43
Prince Edward Island	-	-	-	-	-	-	-	-	-	-	-
Newfoundland & Labrador	43	43	41	42	42	42	42	42	42	43	43

Median annual wage data for computer engineers is shown in Table 13.4 below. The data in the table represents thousands of dollars. Alberta shows the highest wage paid for computer engineers in Canada, followed closely by Newfoundland and Labrador and Ontario. The lowest annual wage is in New Brunswick, where there is very little demand for the occupation. Sizeable increases in annual wages are expected in all provinces over the forecast.

Table 13.4 Median Annual Wage ($ 000s) 2015-2025

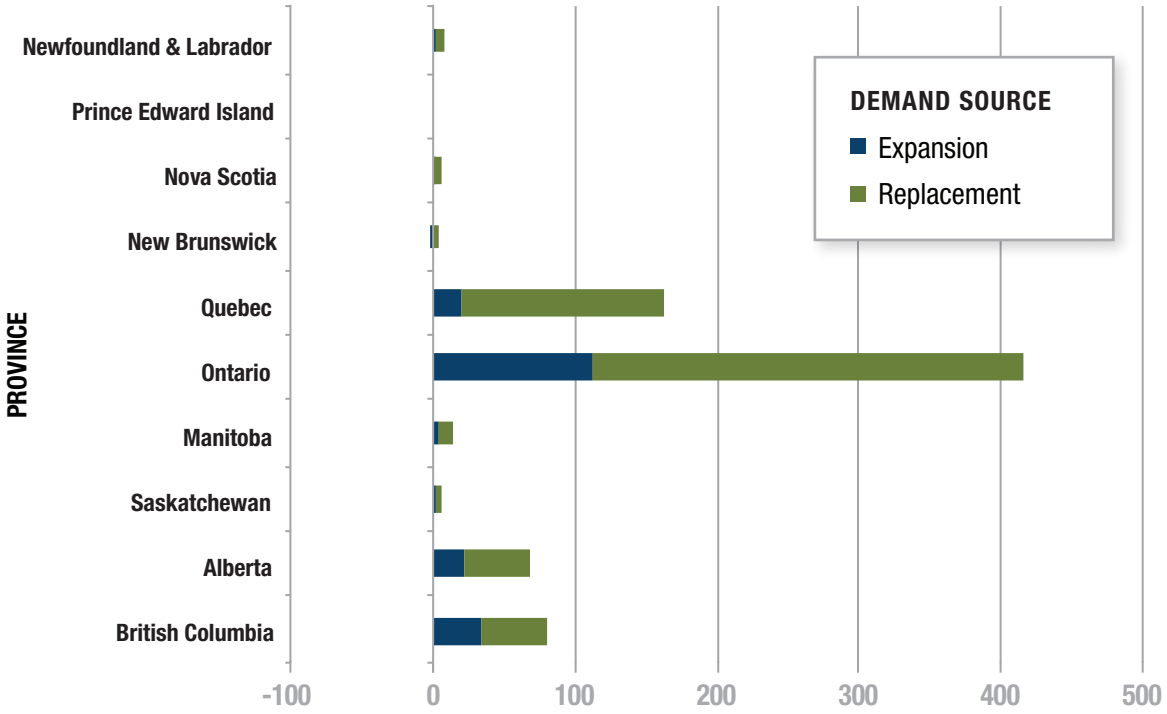
	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
British Columbia	86.2	88.4	91.5	95.3	99.4	103.6	107.6	111.5	115.2	118.8	122.4
Alberta	93.7	95.4	97.4	100.4	103.9	107.7	111.6	115.4	118.8	122.1	125.3
Saskatchewan	90.1	93.1	95.7	98.1	100.2	101.9	103.3	104.6	106.0	108.1	110.9
Manitoba	87.2	89.3	91.6	93.8	95.8	97.7	99.4	101.3	103.3	105.6	108.1
Ontario	91.0	93.7	96.4	99.4	102.2	104.8	107.4	110.0	112.7	115.8	119.4
Quebec	84.9	87.5	90.4	93.7	96.9	100.0	102.8	105.5	108.1	110.8	113.8
New Brunswick	73.9	75.4	77.7	80.5	83.4	86.6	89.8	92.9	95.9	99.0	102.3
Nova Scotia	76.9	79.4	82.3	85.5	88.7	91.9	95.0	98.2	101.4	104.9	108.7
Prince Edward Island	-	-	-	-	-	-	-	-	-	-	-
Newfoundland & Labrador	91.8	94.5	97.4	100.8	104.3	108.1	111.9	115.8	119.3	122.3	125.2

Sources of Demand

Expansion Demand and Replacement Demand

Total demand (total job openings) is composed of expansion demand and replacement demand (retirements and deaths). Figure 13.1 shows the importance of replacement to total demand change over the forecast period. Replacement demand is quite significant in Quebec and Ontario.

Figure 13.1 Sources of Demand for Computer Engineers (Annual Average 2015-2025)



New job openings for computer engineers will average 408 per year in Ontario over the next five years followed by Quebec with 185. This level will be maintained over the last five years of the projection; however, replacement demand will become relatively more important. In fact, replacement demand will exceed expansion demand in most provinces during that period. A breakdown of the components into the short to medium and long-term is further shown in Table 13.5 below.[28]

28 Due to random rounding, expansion demand plus replacement demand may not equal total job openings

Table 13.5 Sources of Demand for Computer Engineers (Annual Average 2015-19 and 2020-25)

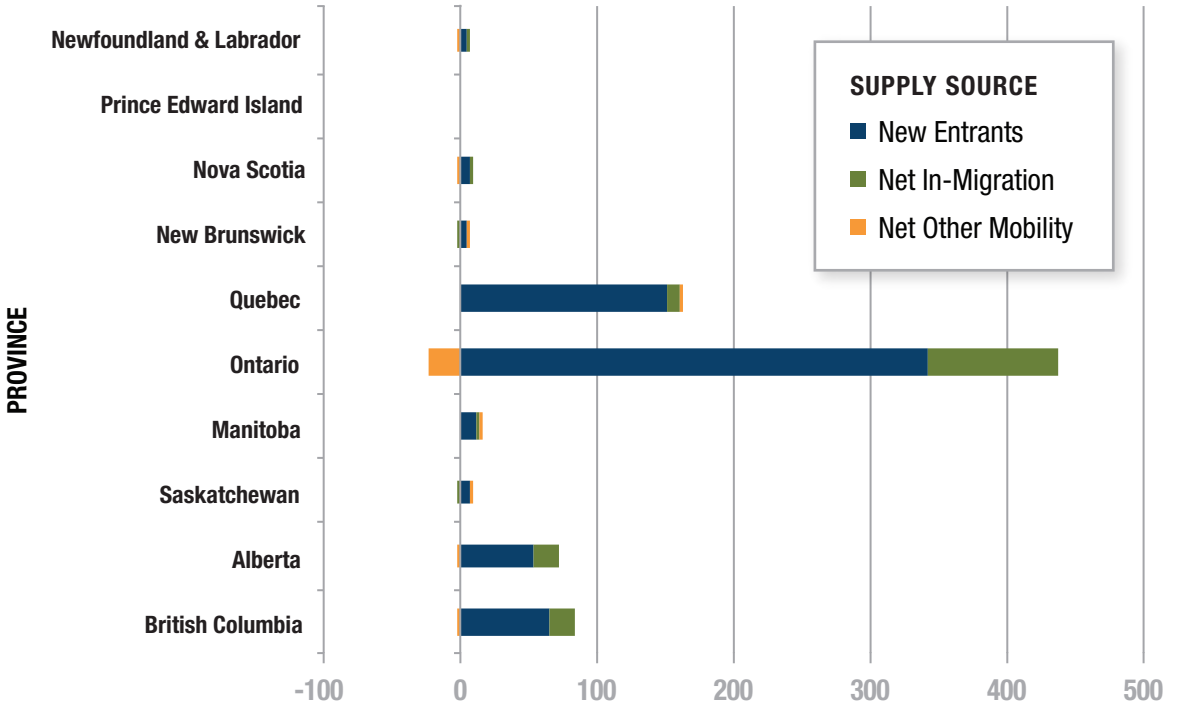
	Average 2015-19			Average 2020-25		
	Expansion	Replacement	Job Openings	Expansion	Replacement	Job Openings
British Columbia	48	38	86	22	55	77
Alberta	33	39	72	14	50	64
Saskatchewan	1	5	5	2	6	7
Manitoba	3	9	12	4	11	16
Ontario	144	264	408	87	336	423
Quebec	59	125	185	-14	160	146
New Brunswick	1	2	3	-1	4	3
Nova Scotia	4	4	8	-3	7	4
Prince Edward Island	-	-	-	-	-	-
Newfoundland & Labrador	6	6	11	-2	6	5

Sources of Supply

New Entrants, Migration and Other Mobility

Figure 13.2, below, shows the sources of supply for computer engineers. Young people are being drawn into the occupation and this is reflected in high levels of new entrants. There a requirement for net in-migration for computer engineers in Ontario.

Figure 13.2 Sources of Supply for Computer Engineers (Annual Average 2015-2025)



New entrants form a very large proportion of total supply requirement for computer engineers in all provinces, as shown in Table 13.6 below. Ontario, Quebec, British Columbia and Alberta stand out as locations in which the level of new entrants to the occupation is high.

Table 13.6 Sources of Supply for Computer Engineers (Annual Average 2015-19 and 2020-25)

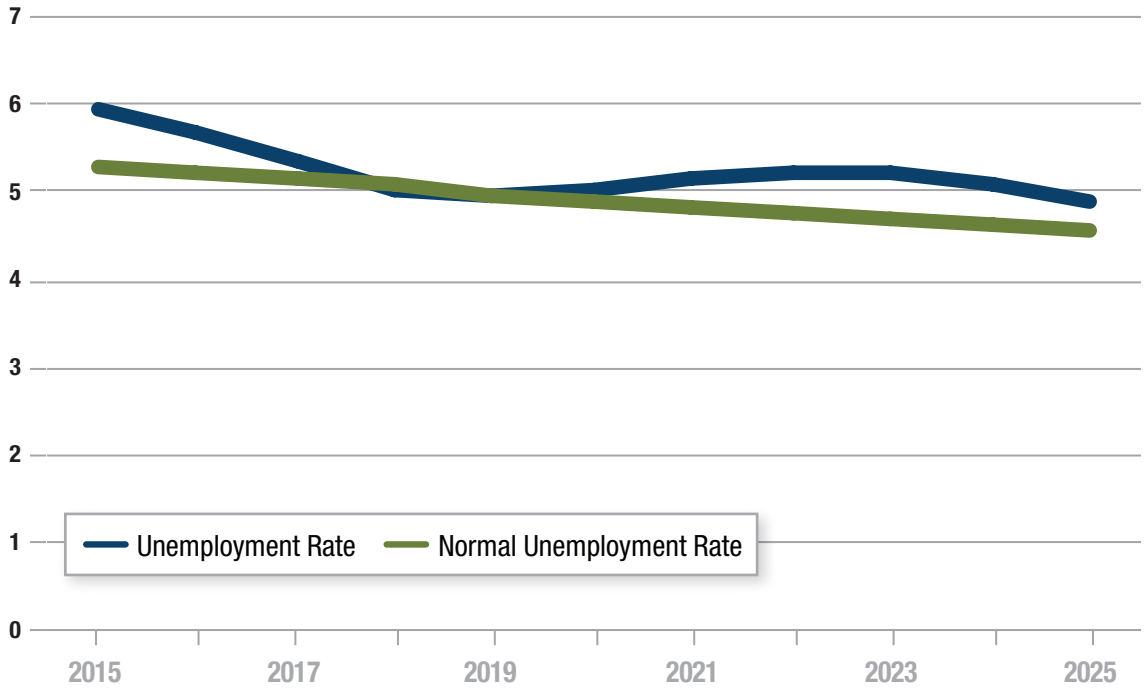
	Average 2015-19				Average 2020-25			
	New Entrants	Net In-Migration	Net Other Mobility	Total Supply	New Entrants	Net In-Migration	Net Other Mobility	Total Supply
British Columbia	65	12	1	79	65	22	-2	85
Alberta	51	22	1	75	54	15	-3	67
Saskatchewan	6	0	0	7	7	-1	2	7
Manitoba	11	0	0	12	12	4	0	16
Ontario	346	69	-2	413	340	119	-41	417
Quebec	150	13	6	169	154	6	-1	158
New Brunswick	4	-1	-1	2	4	-2	1	3
Nova Scotia	8	0	0	7	7	0	-4	4
Prince Edward Island	-	-	-	-	-	-	-	-
Newfoundland & Labrador	5	8	-3	11	6	-2	2	6

Labour Market Tightness

Actual vs. Normal Unemployment Rates and Gap

Figure 13.3 below shows the actual and the normal unemployment rate for computer engineers in Canada. Unemployment rates near the normal unemployment rate suggests a normal labour market, while unemployment rates noticeably above or below the normal rate suggests either a loose or tight market, respectively. The actual unemployment rate trends down towards the normal rate over the short-term, it briefly drops just below the normal rate before beginning a slow climb that once again begins to cycle downwards nearing the end of the forecast.

Figure 13.3 Unemployment Rate for Computer Engineers (%), Canada (2015-2025)



All provinces will experience normal labour market tightness for computer engineers in the future, as can be seen from Table 13.7.

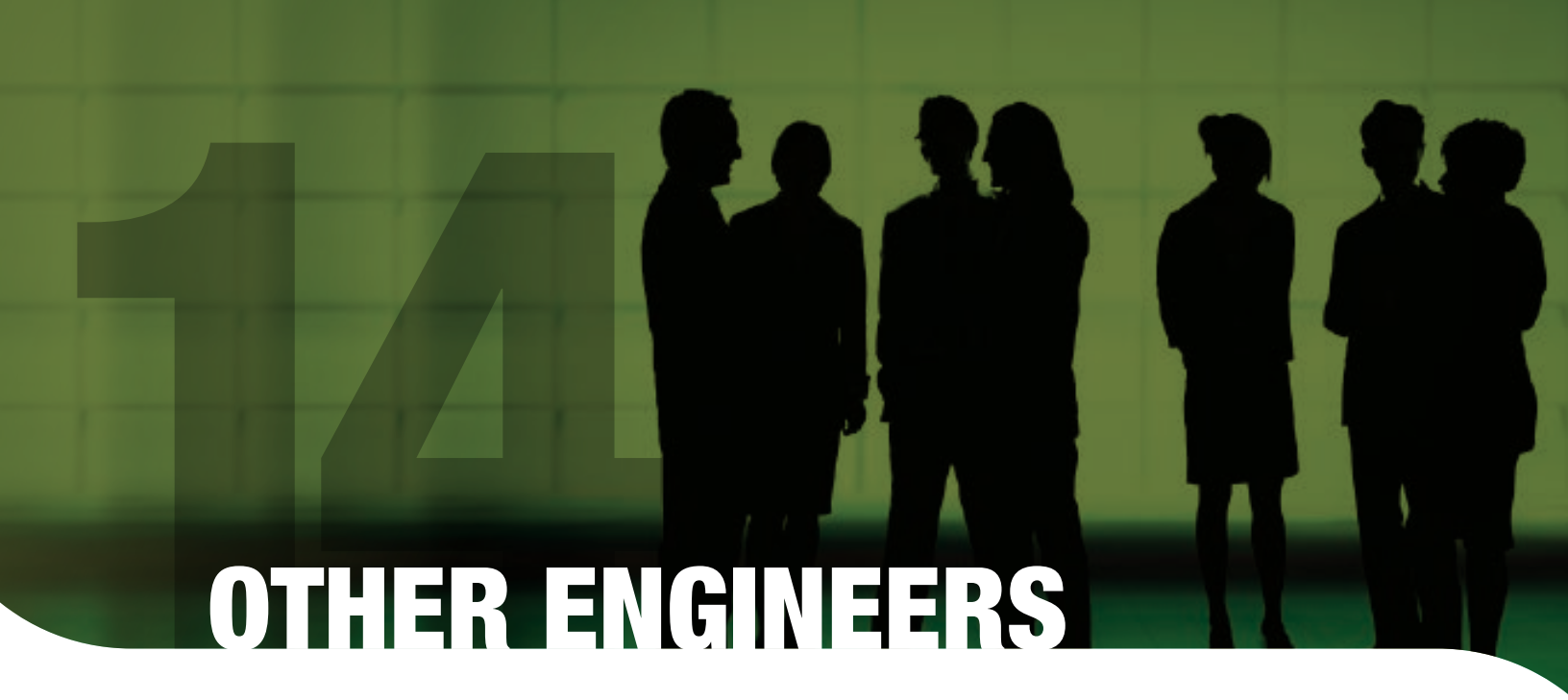
Table 13.7 Weighted Labour Market Tightness Rank (1-3) for Computer Engineers (2015-2025)

	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
British Columbia	2	2	2	2	2	2	2	2	2	2	2
Alberta	2	2	2	2	2	2	2	2	2	2	2
Saskatchewan	2	2	2	2	2	2	2	2	2	2	2
Manitoba	2	2	2	2	2	2	2	2	2	2	2
Ontario	2	2	2	2	2	2	2	2	2	2	2
Quebec	2	2	2	2	2	2	2	2	2	2	2
New Brunswick	2	2	2	2	2	2	2	2	2	2	2
Nova Scotia	2	2	2	2	2	2	2	2	2	2	2
Prince Edward Island	-	-	-	-	-	-	-	-	-	-	-
Newfoundland & Labrador	2	2	2	2	2	2	2	2	2	2	2

The breakdown of in-migration is shown in Table 13.8, below. International in-migration is the larger source of migration in every province. International in-migration is particularly strong in Ontario where higher international migration is required to offset negative net inter-provincial migration.

Table 13.8 International and Inter-Provincial In-Migration of Computer Engineers (2015-2025)

	Average 2015-19		Average 2020-25	
	International	Inter-Provincial	International	Inter-Provincial
British Columbia	9	4	19	4
Alberta	14	9	7	8
Saskatchewan	0	0	-2	1
Manitoba	1	0	6	-3
Ontario	81	-11	137	-19
Quebec	14	-1	6	-1
New Brunswick	-2	1	-2	0
Nova Scotia	-1	1	1	-1
Prince Edward Island	-	-	-	-
Newfoundland & Labrador	-5	13	-1	-2



14 OTHER ENGINEERS

The forecast is for the Canadian economy to produce about 285 job openings for other engineers annually over the next five years. It is expected that total job openings will taper off to about 190 per year during the latter 5 year period as expansion demand from industry is diminished.

The expectation is that new entrants to the occupation will average about 135 annually over the next five years. Net in-migration will have to average about 112 annually to meet demand requirements over that period. It is expected that international in-migration for other engineers will be required to meet demand and this requirement will average about 90 per year. During the latter 5 year period, the pressures on international in-migration will be reduced to about 58 annually.

Occupation Characteristics

Graduates

Other engineers, as defined by the National Occupation Classification System, include agricultural, biomedical, food processing, marine and textile engineers. Other engineering degrees granted by province are presented in Table 14.1 below. Ontario universities granted by far the largest number of degrees for other engineers. The increase in degrees granted in this category in Ontario since 2000 has been quite substantial. British Columbia universities granted far fewer degrees in this category but the increase was just as significant and the same has been the case in Alberta, Nova Scotia and Newfoundland and Labrador. Degrees granted in Quebec and Manitoba universities have seen minimal increases. The number of degrees granted in Saskatchewan and New Brunswick has declined from 2000 to 2013. The number of degrees granted to women in this category has increased sharply from 61 in 2000 to 162 in 2013. They accounted for 10 per cent of the total degrees granted in this category. Visa students earned 170 of these degrees in 2013[29].

29 Source: Engineers Canada. Visa data in this report refers to undergraduates only.

Table 14.1 Degrees Granted, Other Engineering (2000-2013)

	Average 2000-04	Average 2005-09	2010	2011	2012	2013
British Columbia	92	174	233	193	160	197
Alberta	27	44	44	37	37	137
Saskatchewan	30	28	37	38	29	50
Manitoba	12	11	22	12	13	22
Ontario	378	570	470	442	545	740
Quebec	104	241	257	239	279	138
New Brunswick	16	10	5	7	13	27
Nova Scotia	26	25	10	4	4	153
Prince Edward Island	0	0	0	0	0	0
Newfoundland & Labrador	0	0	0	0	0	68

Source: Engineers Canada's 2014 Enrolment and Degrees Awarded Report

Industry Employment

Table 4.2 below shows a ranking of employment by industry and province for other engineers over the forecast period. A large number of these engineers work in the Architectural, Engineering and Related Services industry. The majority of these are in Alberta, Ontario and British Columbia but there are significant numbers in Quebec, Nova Scotia and Saskatchewan. The Food and Chemical Manufacturing industry also employs a significant number of these engineers.

Table 14.2 Top 25 Employment Estimates, Other Engineers by Industry and Province (2015-2025)

Province	Industry	Average 2015-19	Average 2020-25
ALBERTA	Architectural, Engineering and Related Services	1515	1621
ONTARIO	Architectural, Engineering and Related Services	820	851
BRITISH COLUMBIA	Architectural, Engineering and Related Services	816	858
QUEBEC	Architectural, Engineering and Related Services	245	248
ONTARIO	Hospitals	206	227
ONTARIO	Federal government public administration	152	159
NOVA SCOTIA	Architectural, Engineering and Related Services	131	130
ONTARIO	Other Professional, Scientific and Technical Services	129	134
SASKATCHEWAN	Architectural, Engineering and Related Services	115	118
QUEBEC	Other Professional, Scientific and Technical Services	115	116
NEWFOUNDLAND & LABRADOR	Architectural, Engineering and Related Services	100	101
ONTARIO	Food manufacturing	99	98
BRITISH COLUMBIA	Hospitals	91	106
QUEBEC	Other Manufacturing	85	81
QUEBEC	Hospitals	83	98
BRITISH COLUMBIA	Other Professional, Scientific and Technical Services	79	82
ONTARIO	Wholesale Trade	74	77
ONTARIO	Chemical manufacturing	73	72
QUEBEC	Computer Systems Design and Related Services	59	60
NEW BRUNSWICK	Architectural, Engineering and Related Services	56	55
QUEBEC	Food manufacturing	54	50
MANITOBA	Architectural, Engineering and Related Services	48	51
ALBERTA	Local municipal and regional public administration	47	52
QUEBEC	Computer and electronic product manufacturing	47	44
ALBERTA	Other Professional, Scientific and Technical Services	45	47

Age Structure

New Brunswick and British Columbia have the highest average age for other engineers at 55 and 49 respectively. The average age it is expected to decline steadily in these two provinces over the forecast. The average age of other engineers is about 43 in most other provinces and is expected to remain stable.

Table 14.3 Average Age of Other Engineers (2015-2025)

	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
British Columbia	49	48	47	46	45	45	45	44	44	43	43
Alberta	43	43	43	43	43	43	43	43	43	43	43
Saskatchewan	41	41	41	41	41	41	41	41	41	41	41
Manitoba	43	42	42	41	40	40	40	39	39	39	38
Ontario	43	43	42	42	42	42	42	42	42	42	42
Quebec	43	43	43	43	44	44	44	44	44	44	44
New Brunswick	55	54	52	50	49	47	46	45	44	43	43
Nova Scotia	43	42	42	42	42	42	42	42	42	42	42
Prince Edward Island	-	-	-	-	-	-	-	-	-	-	-
Newfoundland & Labrador	37	37	38	38	38	38	38	38	38	38	38

Median wage data for other engineers by province is shown in Table 14.4, below. The data in the table represents thousands of dollars per year. Other engineers in Saskatchewan have median wages that are considerably higher than other provinces and are expected to be pushed considerably higher over the forecast. Other engineers are paid relatively poorly in Manitoba, Quebec, Nova Scotia and Newfoundland and Labrador.

Table 14.4 Median Annual Wage ($ 000s) 2015-2025

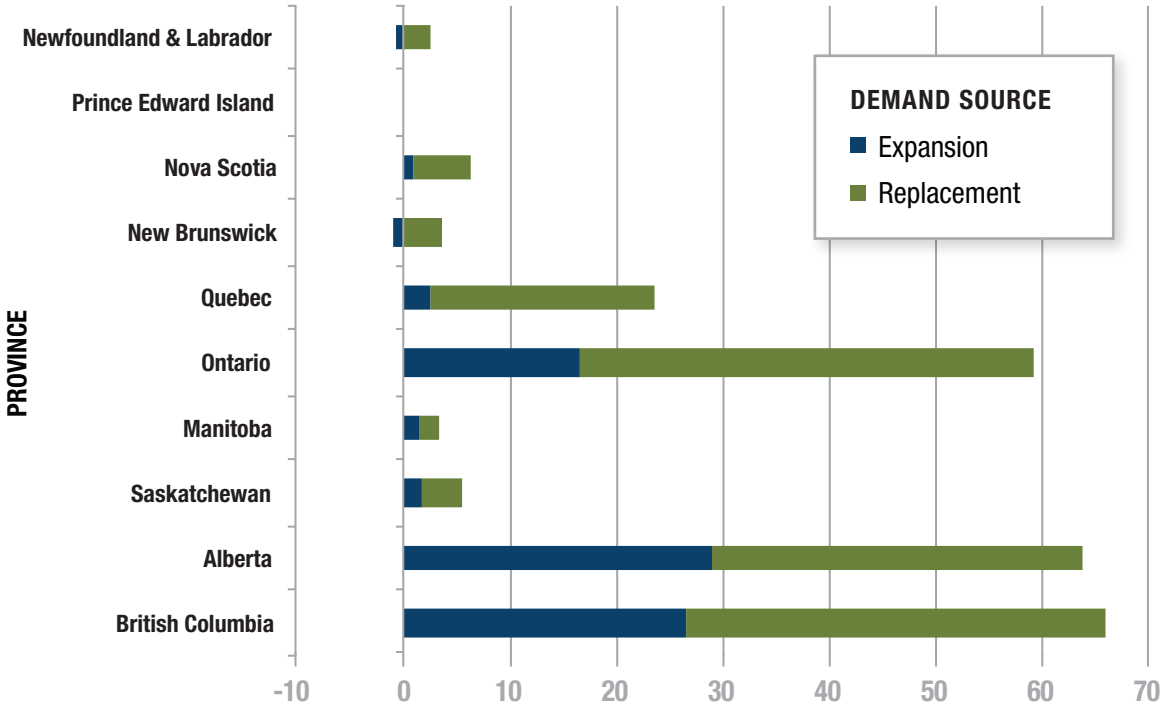
	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
British Columbia	68.2	70.4	73.2	76.3	79.7	83.1	86.4	89.4	92.4	95.3	98.2
Alberta	97.9	100.0	102.3	105.7	109.5	113.6	117.8	121.8	125.4	129.0	132.4
Saskatchewan	125.1	129.4	133.3	136.8	139.6	142.0	143.9	145.8	147.9	150.7	154.6
Manitoba	57.2	59.0	60.8	62.5	63.9	65.2	66.4	67.6	69.0	70.5	72.2
Ontario	84.0	86.5	89.1	91.9	94.4	96.9	99.3	101.8	104.3	107.2	110.5
Quebec	60.4	62.2	64.3	66.6	68.9	71.1	73.1	75.0	76.9	78.8	81.0
New Brunswick	83.3	84.9	87.4	90.5	93.9	97.5	100.9	104.4	107.8	111.3	115.0
Nova Scotia	68.0	70.2	72.8	75.6	78.4	81.2	84.0	86.9	89.8	92.9	96.2
Prince Edward Island	-	-	-	-	-	-	-	-	-	-	-
Newfoundland & Labrador	59.5	60.9	62.3	64.2	66.2	68.5	70.8	73.2	75.5	77.6	79.6

Sources of Demand

Expansion Demand and Replacement Demand

Total demand (total job openings) is composed of expansion demand and replacement demand (retirements and deaths). Figure 14.1 shows the importance of replacement to total demand change for other engineers by province over the forecast period. In the Atlantic Provinces total demand change is comprised almost entirely of replacement demand. Expansion demand for other engineers in Ontario, Alberta and British Columbia is significant over the forecast but replacement demand is considerably higher.

Figure 14.1 Sources of Demand for Other Engineers (Annual Average 2015-2025)



Average job openings for other engineers are highest in B.C. at 91 annually, over the next five years – see Table 14.5.[30] Replacement demand is expected to contribute 45 per cent of total job openings in British Columbia over that period. The importance of replacement demand will increase to 80 per cent of total job openings during the last five years. Job openings for other engineers will also be significant in Alberta and Ontario over the next five years at 81 and 65 respectively. These openings will taper off during the last five years as expansion demand is diminished.

30 Due to random rounding, expansion demand plus replacement demand may not equal total job openings

Table 14.5 Sources of Demand for Other Engineers (Annual Average 2015-19 and 2020-25)

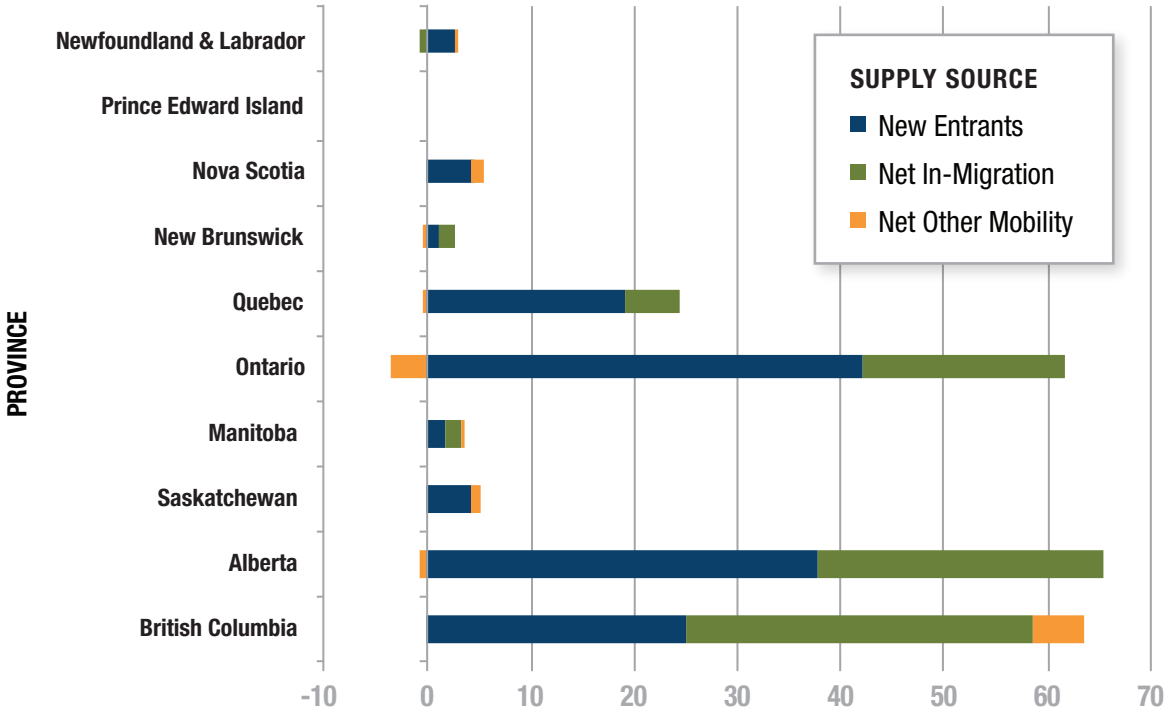
	Average 2015-19			Average 2020-25		
	Expansion	Replacement	Job Openings	Expansion	Replacement	Job Openings
British Columbia	49	42	91	8	38	46
Alberta	48	33	81	13	37	50
Saskatchewan	2	4	6	1	4	5
Manitoba	2	2	4	1	2	2
Ontario	21	44	65	13	41	55
Quebec	7	20	26	-1	22	21
New Brunswick	-1	4	3	-1	3	2
Nova Scotia	3	6	9	-1	5	4
Prince Edward Island	-	-	-	-	-	-
Newfoundland & Labrador	-1	3	2	0	2	2

Sources of Supply

New Entrants, Migration and Other Mobility

Figure 14.2 below, shows the sources of supply for other engineers. The number of new entrants to the occupation over the forecast period in Ontario is very large - followed by Alberta, British Columbia and Quebec. The number of new entrants is nearly insignificant in the Atlantic Provinces, Manitoba and Saskatchewan. Ontario, Alberta and British Columbia are receiving all the net in-migration. Net other mobility also contributes to supply requirements of other engineers in British Columbia – unlike the other provinces.

Figure 14.2 Sources of Supply for Other Engineers (Annual Average 2015-2025)



Total supply requirements and the components of supply of other engineers are provided in Table 14.6 below. Over the next five years, British Columbia's total supply requirements for other engineers average 82 per year followed by Alberta with 79 and Ontario with 64. The new entrants' share of the total supply requirement is highest in Ontario at 65 per cent. Net in-migration exceeds new entrants in British Columbia and Alberta. Total supply requirements drop sharply during the last five years of the forecast in both British Columbia and Alberta – less so in Ontario.

Table 14.6 Sources of Supply for Other Engineers (Annual Average 2015-19 and 2020-25)

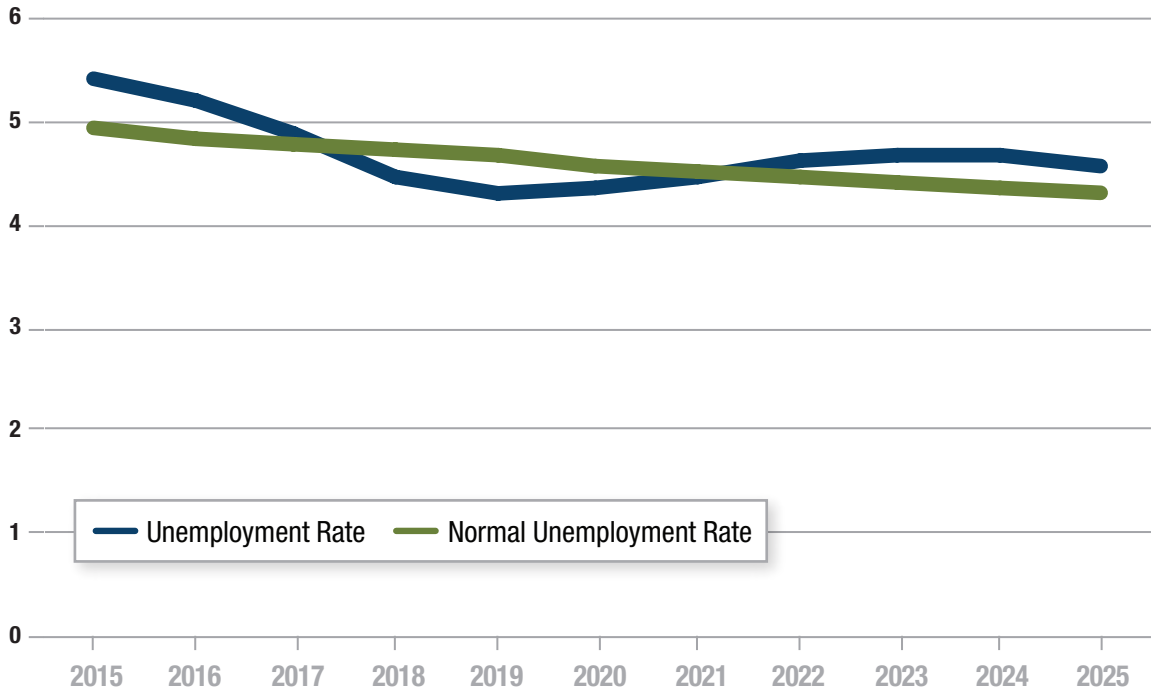
	Average 2015-19				Average 2020-25			
	New Entrants	Net In-Migration	Net Other Mobility	Total Supply	New Entrants	Net In-Migration	Net Other Mobility	Total Supply
British Columbia	25	41	15	82	25	27	-3	49
Alberta	36	41	1	79	39	16	-3	53
Saskatchewan	4	2	0	6	4	-2	2	5
Manitoba	1	2	0	4	2	1	0	3
Ontario	42	22	0	64	42	18	-7	54
Quebec	19	5	1	25	20	5	-2	23
New Brunswick	1	1	1	3	1	2	-1	2
Nova Scotia	4	0	3	7	4	0	0	4
Prince Edward Island	-	-	-	-	-	-	-	-
Newfoundland & Labrador	3	-2	1	2	3	0	0	3

Labour Market Tightness

Actual vs. Normal Unemployment Rates and Gap

Figure 14.3 below shows the actual and the normal unemployment rate for other engineers in Canada. Unemployment rates near the normal unemployment rate suggests a normal labour market, while unemployment rates noticeably above or below the normal rate suggests either a loose or tight market, respectively. The chart suggests a normal market situation. The actual unemployment rate drops below the normal rate during the medium-term of the forecast, but not by a significant amount.

Figure 14.3 Unemployment Rate for Other Engineers (%), Canada (2015-2025)



Labour market tightness rankings for other engineers across the provinces are shown in Table 14.7 below. Rankings of 3 are colour coded in red and represent excess demand, a rank of 2 is a normal situation for the labour market, and a 1 (not seen in this occupation) is a situation of excess supply.

Most provinces will experience normal labour market tightness for other engineers in the future, as can be seen from Table 14.7 below. The excess demand rankings in British Columbia, Manitoba and New Brunswick likely reflect upcoming major projects in these provinces, placing pressure on the demand for these workers. Given that it appears that the labour market for other engineers in these three provinces will be only slightly tight in a few years through the medium-term it may not be necessary to go outside the provinces to find them.

Table 14.7 Weighted Labour Market Tightness Rank (1-3) for Other Engineers (2015-2025)

	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
British Columbia	3	3	3	3	3	2	2	2	2	2	2
Alberta	2	2	2	2	2	2	2	2	2	2	2
Saskatchewan	2	2	2	2	2	2	2	2	2	2	2
Manitoba	3	3	3	2	2	2	2	2	2	2	2
Ontario	2	2	2	2	2	2	2	2	2	2	2
Quebec	2	2	2	2	2	2	2	2	2	2	2
New Brunswick	2	2	3	3	3	3	3	2	2	2	2
Nova Scotia	2	2	2	2	2	2	2	2	2	2	2
Prince Edward Island	-	-	-	-	-	-	-	-	-	-	-
Newfoundland & Labrador	2	2	2	2	2	2	2	2	2	2	2

The breakdown of in-migration into international and inter-provincial in-migration is shown in Table 14.8, below. As you can see in the table, international in-migration is considerably more important in British Columbia, Alberta and Ontario over the next five years.

Table 14.8 International and Inter-Provincial In-Migration of Other Engineers (2015-2025)

	Average 2015-19		Average 2020-25	
	International	Inter-Provincial	International	Inter-Provincial
British Columbia	31	10	22	5
Alberta	27	14	7	9
Saskatchewan	1	0	-2	0
Manitoba	3	-1	1	-1
Ontario	24	-3	22	-3
Quebec	5	-1	6	0
New Brunswick	1	0	2	0
Nova Scotia	0	0	0	0
Prince Edward Island	-	-	-	-
Newfoundland & Labrador	1	-3	0	0

15 ENGINEERING MANAGERS

The forecast is for the Canadian economy to produce about 1080 job openings for engineering managers annually over the next five years – over 70 per cent of these openings will be related to replacement demand. Total job openings will taper off to about 940 per year during the latter 5 year period as expansion demand from industry is diminished but replacement demand continues to rise.

Net other mobility in the occupation is very high as experienced engineers are promoted to the level of engineering manager. Net other mobility contributes 950 engineering managers annually or 90 per cent of total supply requirements. International in-migration is expected to average about 100 annually while inter-provincial migration is limited due to licensing requirements. New entrants are zero given the experience requirements of the occupation.

Occupation Characteristics

Industry Employment

Table 15.2 below shows a ranking of employment by industry and province for engineering managers over the forecast period. A large number of these engineers work in the Architectural, Engineering and Related Services industry in Ontario, Alberta, Quebec and British Columbia. The Transportation Equipment Manufacturing industry also employs a significant number of these engineers. In general Ontario employs the vast majority of the engineering managers.

Table 15.2 Top 25 Employment Estimates, Engineering Managers by Industry and Province (2015-2025)

Province	Industry	Average 2015-19	Average 2020-25
ONTARIO	Architectural, Engineering and Related Services	2076	2155
ALBERTA	Architectural, Engineering and Related Services	1370	1465
ONTARIO	Transportation equipment manufacturing	1122	1080
QUEBEC	Architectural, Engineering and Related Services	915	926
BRITISH COLUMBIA	Architectural, Engineering and Related Services	741	779
QUEBEC	Transportation equipment manufacturing	568	533
ONTARIO	Computer and electronic product manufacturing	534	561
ONTARIO	Computer Systems Design and Related Services	510	527
ONTARIO	Wholesale Trade	450	470
ONTARIO	Machinery manufacturing	422	440
ONTARIO	Utilities	387	396
ONTARIO	Other Professional, Scientific and Technical Services	338	352
ONTARIO	Chemical manufacturing	269	268
ALBERTA	Oil Sands	247	270
ALBERTA	Machinery manufacturing	233	236
ONTARIO	Fabricated metal product manufacturing	216	217
ONTARIO	Telecommunications	213	218
ONTARIO	Federal government public administration	201	210
ONTARIO	Management, Scientific and Technical Consulting Services	182	190
QUEBEC	Computer and electronic product manufacturing	181	170
ONTARIO	Trade contracting	163	164
ALBERTA	Other Transportation	159	168
ONTARIO	Local municipal and regional public administration	156	165
ONTARIO	Other Manufacturing	155	154
ONTARIO	Food manufacturing	149	148

Age Structure

The average age of engineering managers is somewhat higher in Saskatchewan, Manitoba, Ontario and Nova Scotia. The average age of engineering managers is generally expected to increase over the 10 year period.

Table 15.3 Average Age of Engineering Managers (2015-2025)

	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
British Columbia	48	49	49	49	49	49	49	49	49	50	50
Alberta	48	48	48	49	49	49	49	49	49	49	49
Saskatchewan	49	49	49	49	49	49	49	49	49	49	49
Manitoba	49	49	49	49	49	49	49	49	49	49	49
Ontario	49	49	49	49	49	49	50	50	50	50	50
Quebec	47	47	47	48	48	48	48	48	49	49	49
New Brunswick	47	47	48	48	48	49	49	49	49	49	50
Nova Scotia	49	49	49	49	49	49	49	50	50	50	50
Prince Edward Island	-	-	-	-	-	-	-	-	-	-	-
Newfoundland & Labrador	45	45	46	47	47	47	48	48	48	49	49

Median wage data for engineering managers by province is shown in Table 15.4, below. The data in the table represents thousands of dollars per year. Engineering managers in Alberta have median wages that are considerably higher than other provinces and are expected to be pushed even higher over the forecast. Engineering managers are paid relatively low in New Brunswick where employment is minimal.

Table 15.4 Median Annual Wage ($ 000s) 2015-2025

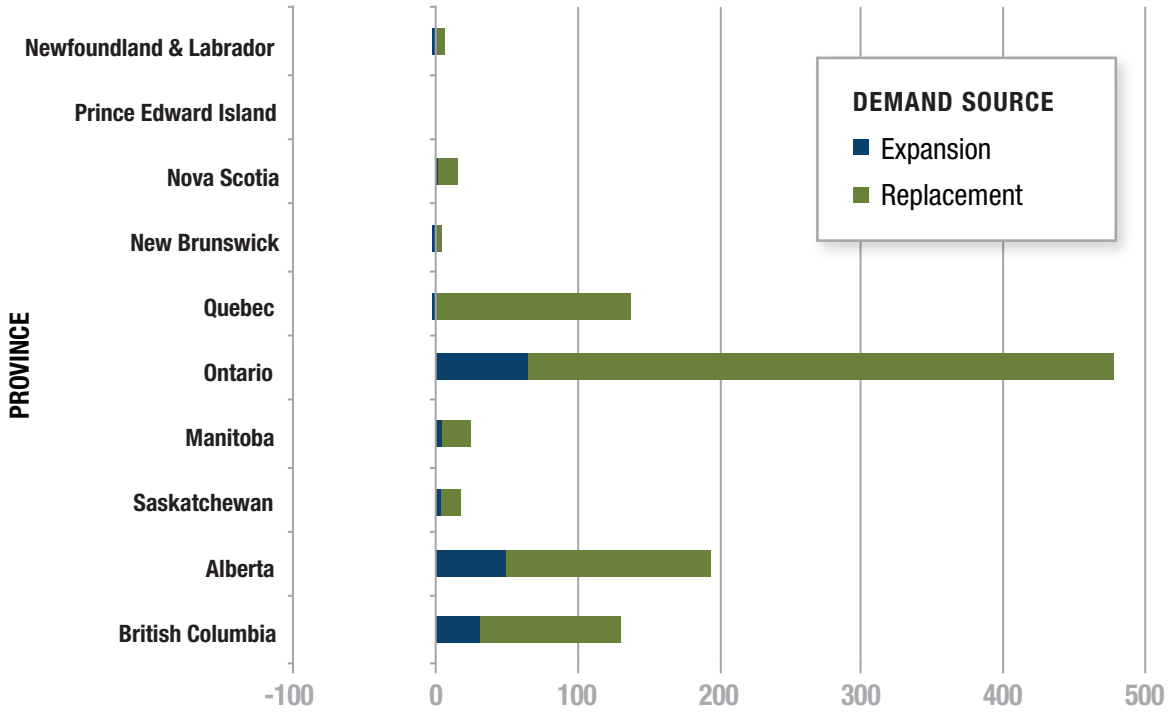
	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
British Columbia	118.0	121.5	125.9	131.3	137.1	142.8	148.3	153.4	158.4	163.2	168.0
Alberta	156.0	159.2	162.9	167.9	173.8	180.2	186.7	193.0	198.7	204.3	209.8
Saskatchewan	126.5	131.0	134.9	138.4	141.3	143.8	145.8	147.7	149.9	152.7	156.6
Manitoba	104.8	107.9	110.9	113.8	116.3	118.7	120.8	122.9	125.3	127.8	130.8
Ontario	120.2	123.8	127.5	131.5	135.1	138.5	141.8	145.2	148.8	152.8	157.4
Quebec	107.8	111.1	114.8	119.0	123.0	126.9	130.3	133.5	136.7	140.0	143.7
New Brunswick	97.1	99.0	102.0	105.6	109.5	113.8	117.9	121.9	125.9	130.0	134.3
Nova Scotia	102.4	105.8	109.7	114.0	118.2	122.5	126.7	131.0	135.4	140.0	145.1
Prince Edward Island	-	-	-	-	-	-	-	-	-	-	-
Newfoundland & Labrador	128.6	131.7	135.0	139.2	143.6	148.5	153.6	159.0	164.0	168.5	172.8

Sources of Demand

Expansion Demand and Replacement Demand

Total demand (total job openings) is composed of expansion demand and replacement demand (retirements and deaths). Figure 15.1 shows the importance of replacement to total demand change for engineering managers by province over the forecast period. Replacement demand for engineering managers is very high in Quebec, Ontario, Alberta and British Columbia.

Figure 15.1 Sources of Demand for Engineering Managers (Annual Average 2015-2025)



Average job openings for engineering managers are highest in Ontario at 483 over the next five years – see Table 15.5.[31] Replacement demand is expected to contribute 78 per cent of total job openings in Ontario over that period. The importance of replacement demand will increase to 93 per cent of total job openings in Ontario during the last five years. Job openings for engineering managers will also be significant in Alberta, British Columbia and Quebec over the next five years at 211, 160 and 154 respectively. These openings will taper off during the last five years with diminished expansion demand.

31 Due to random rounding, expansion demand plus replacement demand may not equal total job openings

Table 15.5 Sources of Demand for Engineering Managers (Annual Average 2015-19 and 2020-25)

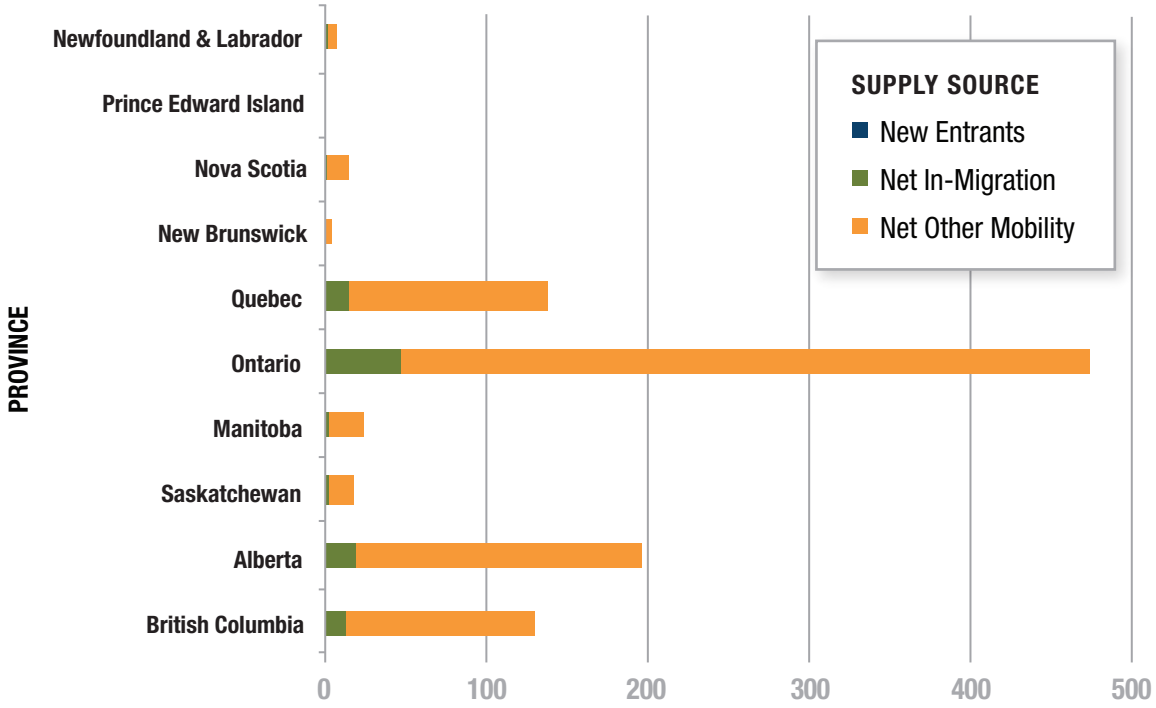
	Average 2015-19			Average 2020-25		
	Expansion	Replacement	Job Openings	Expansion	Replacement	Job Openings
British Columbia	69	91	160	2	106	108
Alberta	81	130	211	24	154	178
Saskatchewan	5	14	18	2	14	16
Manitoba	9	17	27	2	20	22
Ontario	105	379	483	34	437	471
Quebec	28	126	154	-25	147	122
New Brunswick	0	4	4	-1	5	4
Nova Scotia	5	13	19	-1	14	13
Prince Edward Island	0	0	0	0	0	0
Newfoundland & Labrador	-1	6	5	0	9	9

Sources of Supply

New Entrants, Migration and Other Mobility

Figure 15.2 below, shows the sources of supply for engineering managers. There are no new entrants to the occupation over the forecast period given experience requirements. There is a small amount of net in-migration in Quebec, Ontario, Alberta and British Columbia. Net other mobility contributes the most to the supply requirements of engineering managers.

Figure 15.2 Sources of Supply for Engineering Managers (Annual Average 2015-2025)



Total supply requirements and the components of supply of engineering managers are provided in Table 15.6 below. Over the next five years, Ontario's total supply requirements for engineering managers average 481 per year followed by Alberta with 211 and British Columbia with 149. New entrants do not contribute to supply requirements for engineering managers. Net in-migration also contributes very little to supply requirements. Net other mobility contributes about 90 per cent of total supply requirements in Ontario, Quebec, Alberta and British Columbia. The total supply requirement for engineering managers moves lower in the last five years.

Table 15.6 Sources of Supply for Engineering Managers (Annual Average 2015-19 and 2020-25)

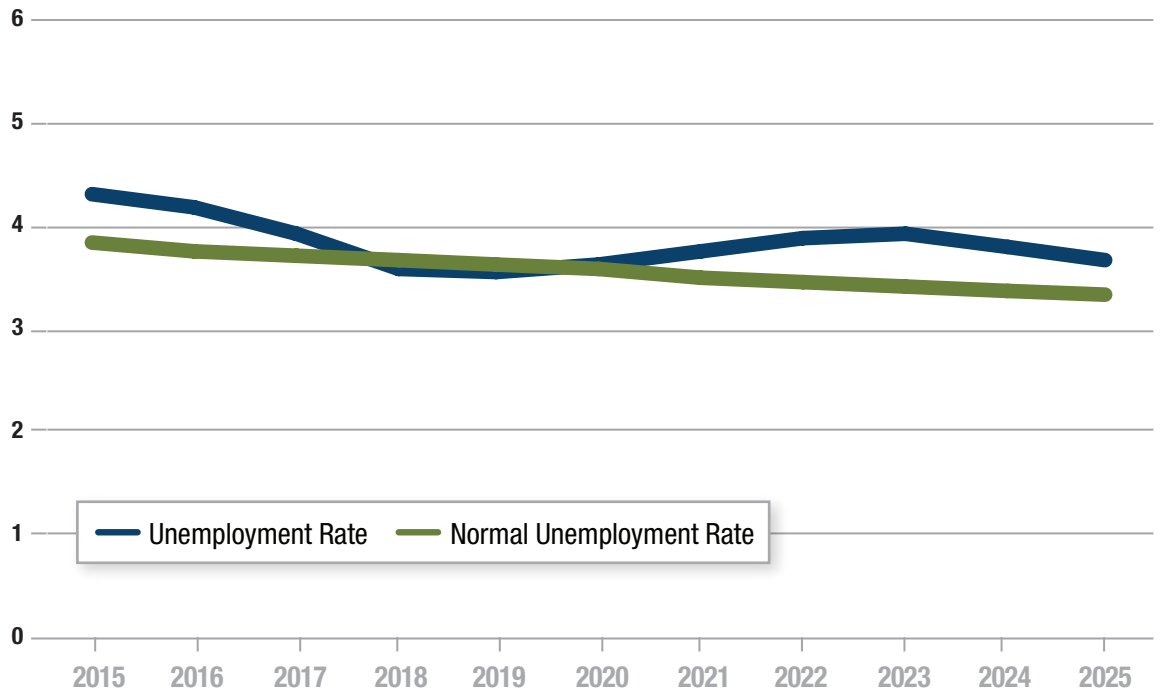
	Average 2015-19				Average 2020-25			
	New Entrants	Net In-Migration	Net Other Mobility	Total Supply	New Entrants	Net In-Migration	Net Other Mobility	Total Supply
British Columbia	0	15	134	149	0	11	103	114
Alberta	0	21	190	211	0	18	164	183
Saskatchewan	0	2	17	19	0	2	15	17
Manitoba	0	3	24	27	0	2	20	22
Ontario	0	48	433	481	0	47	420	467
Quebec	0	15	134	148	0	13	115	127
New Brunswick	0	0	3	3	0	0	4	4
Nova Scotia	0	2	15	17	0	1	12	13
Prince Edward Island	0	0	0	0	0	0	0	0
Newfoundland & Labrador	0	1	4	5	0	1	8	9

Labour Market Tightness

Actual vs. Normal Unemployment Rates and Gap

Figure 15.3 below shows the actual and the normal unemployment rate for engineering managers in Canada. Unemployment rates near the normal unemployment rate suggests a normal labour market, while unemployment rates noticeably above or below the normal rate suggests either a loose or tight market, respectively. The chart suggests a normal market situation. The actual unemployment rate drops below the normal rate during the medium-term of the forecast, but not by a significant amount.

Figure 15.3 Unemployment Rate for Engineering Managers (%), Canada (2015-2025)



Labour market tightness rankings for engineering manager across the provinces are shown in Table 15.7 below. Rankings of 3 are colour coded in red and represent excess demand, a rank of 2 is a normal situation for the labour market, and a 1 (not seen in this occupation) is a situation of excess supply.

Most provinces will experience normal labour market tightness for engineering managers in the future, as can be seen from Table 15.7 below. There is some amount of excess demand in British Columbia, Alberta, Saskatchewan and Nova Scotia.

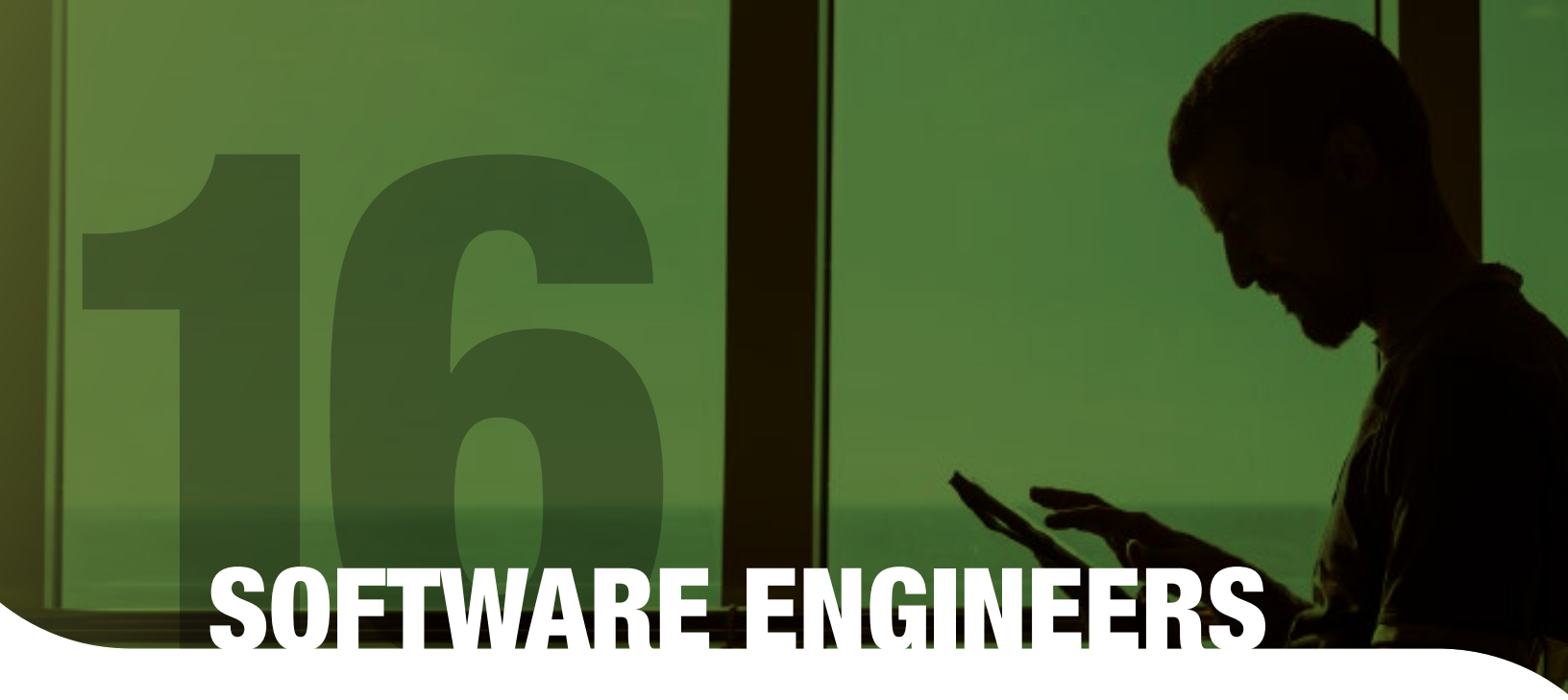
Table 15.7 Weighted Labour Market Tightness Rank (1-3) for Engineering Managers (2015-2025)

	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
British Columbia	2	2	2	3	3	2	2	2	2	2	2
Alberta	2	2	2	2	3	2	2	2	2	2	2
Saskatchewan	2	3	2	2	2	2	2	2	3	3	3
Manitoba	2	2	2	2	2	2	2	2	2	2	2
Ontario	2	2	2	2	2	2	2	2	2	2	2
Quebec	2	2	2	2	2	2	2	2	2	2	2
New Brunswick	2	2	2	2	2	2	2	2	2	2	2
Nova Scotia	2	3	3	3	2	2	2	2	2	2	2
Prince Edward Island	-	-	-	-	-	-	-	-	-	-	-
Newfoundland & Labrador	2	2	2	2	2	3	2	2	2	2	2

The breakdown of in-migration into international and inter-provincial in-migration is shown in Table 15.8 below.

Table 15.8 International and Inter-Provincial In-Migration of Engineering Managers (2015-2025)

	Average 2015-19		Average 2020-25	
	International	Inter-Provincial	International	Inter-Provincial
British Columbia	11	4	9	2
Alberta	14	7	9	10
Saskatchewan	2	0	7	-5
Manitoba	3	-1	4	-2
Ontario	54	-7	56	-9
Quebec	17	-2	14	-1
New Brunswick	0	0	0	0
Nova Scotia	4	-2	2	-1
Prince Edward Island	0	0	0	0
Newfoundland & Labrador	0	0	2	-1



16 SOFTWARE ENGINEERS

The forecast is for the Canadian economy to produce about 1250 job openings for software engineers annually over the next five years – half of those openings will be in Ontario. Job openings are expected to hold steady during the latter 5 year period despite reduced expansion demand from industry. Canadian universities are granting nearly 800 software engineering degrees and our projection is for new entrants to supply about 1000 workers annually to the occupation over the next 5 years. The projections suggest that no excess demand should be expected over the forecast.

Occupation Characteristics

Graduates

University degrees granted for software engineers by province are presented in Table 16.1 below. Ontario universities grant by far the largest number of software engineering degrees and the number has increased significantly since 2000. Universities in Alberta also grant a significant number of software engineering degrees. Quebec universities are granting far fewer degrees to software engineers than in 2010. The number of degrees granted to women in this category has increased sharply from 4 in 2001 to 43 in 2013. Visa students have earned about 6 percent of total degrees awarded in software engineering[32].

32 Source: Engineers Canada. Visa data in this report refers to undergraduates only.

Table 16.1 Degrees Granted, Software Engineers (2000-2013)

	Average 2000-04	Average 2005-09	2010	2011	2012	2013
British Columbia	0	2	13	12	13	28
Alberta	13	24	27	11	18	119
Saskatchewan	0	1	5	11	5	32
Manitoba	0	0	0	0	0	0
Ontario	89	206	147	154	179	323
Quebec	24	173	173	173	190	51
New Brunswick	0	3	2	5	8	22
Nova Scotia	0	0	0	0	0	147
Prince Edward Island	0	0	0	0	0	0
Newfoundland & Labrador	0	0	0	0	0	68

Source: Engineers Canada's 2014 Enrolment and Degrees Awarded Report

Industry Employment

A ranking of employment by industry and by province for software engineers is presented in Table 16.2, below. A large number of software engineers work in the Computer Systems Design and Related Services. The majority of these jobs are in Ontario but there are significant number in British Columbia and Alberta. Computer engineers also work in the Wholesale trade sector, Publishing and Finance.

Table 16.2 Top 25 Employment Estimates, Software Engineers by Industry and Province (2015-2025)

Province	Industry	Average 2015-19	Average 2020-25
ONTARIO	Computer Systems Design and Related Services	11407	11808
BRITISH COLUMBIA	Computer Systems Design and Related Services	4299	4471
QUEBEC	Computer Systems Design and Related Services	3831	3876
ONTARIO	Wholesale Trade	1936	2019
ONTARIO	Computer and electronic product manufacturing	1578	1659
ONTARIO	Other Professional, Scientific and Technical Services	1499	1559
ALBERTA	Computer Systems Design and Related Services	1481	1575
ONTARIO	Publishing industries	1466	1496
ONTARIO	Finance	1314	1350
BRITISH COLUMBIA	Publishing industries	1172	1285
ONTARIO	Architectural, Engineering and Related Services	657	682
ONTARIO	Telecommunications	567	580
BRITISH COLUMBIA	Wholesale Trade	455	474
QUEBEC	Other Professional, Scientific and Technical Services	438	441
ALBERTA	Wholesale Trade	405	430
NOVA SCOTIA	Computer Systems Design and Related Services	393	386
BRITISH COLUMBIA	Other Professional, Scientific and Technical Services	388	404
ONTARIO	Insurance carriers and related activities	365	377
QUEBEC	Publishing industries	363	364
QUEBEC	Computer and electronic product manufacturing	357	336
ONTARIO	Federal government public administration	354	369
ONTARIO	Management of Companies and Enterprises & Administrative and Support	350	357
BRITISH COLUMBIA	Computer and electronic product manufacturing	295	287
MANITOBA	Computer Systems Design and Related Services	274	283
QUEBEC	Wholesale Trade	264	262

Age Structure

The average age for software engineers by province is presented in Table 16.3 below. Software engineers in New Brunswick have an average age of 42 in 2015; slightly higher than that of the rest of Canada. Software engineers have significant variation in average age across provinces, the lowest being 33 in Newfoundland. The projections are for a small increase in the average age of software engineers over the forecast.

Table 16.3 Average Age of Software Engineers (2015-2025)

	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
British Columbia	40	40	40	41	41	41	41	42	42	42	42
Alberta	39	40	40	40	40	41	41	41	41	42	42
Saskatchewan	39	40	40	41	41	42	42	43	43	43	43
Manitoba	35	36	37	38	38	39	40	40	41	41	41
Ontario	41	41	41	41	42	42	42	42	42	42	42
Quebec	41	42	42	42	42	42	42	43	43	43	43
New Brunswick	42	42	42	42	42	41	41	42	42	41	41
Nova Scotia	40	40	41	41	41	41	42	41	42	42	42
Prince Edward Island	-	-	-	-	-	-	-	-	-	-	-
Newfoundland & Labrador	33	33	36	36	36	37	37	37	37	37	38

Median annual wage data for software engineers is shown in Table 16.4 below. The data in the table represents thousands of dollars. Alberta shows the highest wage paid for software engineers in Canada, followed closely by Ontario. The lowest annual wage is in Newfoundland, where there is very little demand for the occupation. Sizeable increases in annual wages are expected in all provinces over the forecast.

Table 16.4 Median Annual Wage ($ 000s) 2015-2025

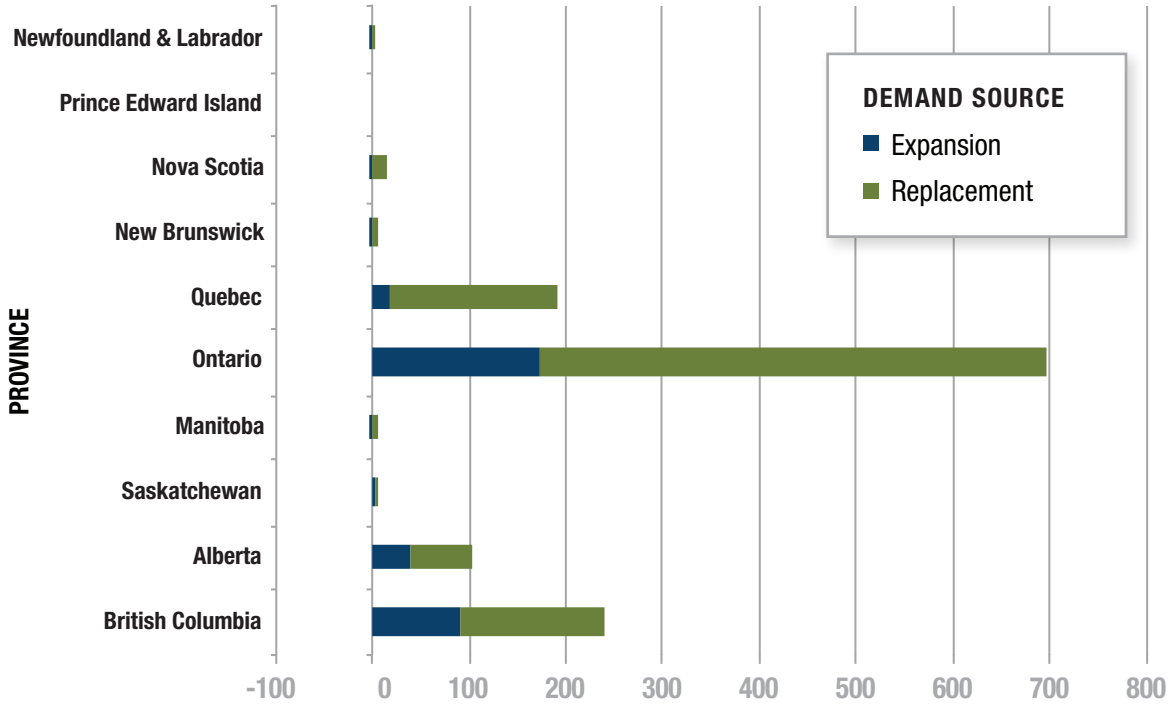
	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
British Columbia	87.4	89.7	92.8	96.6	100.9	105.1	109.2	113.1	116.9	120.5	124.1
Alberta	93.3	95.0	97.1	100.1	103.6	107.5	111.4	115.1	118.5	121.8	125.1
Saskatchewan	83.5	86.3	88.8	91.0	92.8	94.4	95.7	96.9	98.3	100.2	102.8
Manitoba	81.6	83.1	85.0	87.0	88.7	90.4	92.0	93.7	95.5	97.5	99.9
Ontario	91.2	93.9	96.6	99.6	102.3	105.0	107.6	110.2	112.9	116.1	119.6
Quebec	88.7	91.3	94.4	97.9	101.2	104.5	107.4	110.2	112.9	115.7	118.8
New Brunswick	74.4	75.9	78.1	80.9	83.9	87.1	90.2	93.3	96.4	99.5	102.8
Nova Scotia	75.7	78.2	81.0	84.1	87.2	90.3	93.4	96.5	99.8	103.2	106.9
Prince Edward Island	-	-	-	-	-	-	-	-	-	-	-
Newfoundland & Labrador	69.5	70.5	71.7	73.6	75.8	78.4	81.1	83.8	86.4	88.8	91.1

Sources of Demand

Expansion Demand and Replacement Demand

Total demand (total job openings) is composed of expansion demand and replacement demand (retirements and deaths). Figure 13.1 shows the importance of replacement to total demand change over the forecast period. Replacement demand is quite significant in Quebec, Ontario and British Columbia.

Figure 16.1 Sources of Demand for Software Engineers (Annual Average 2015-2025)



New job openings for software engineers will average 655 per year in Ontario over the next five years followed by British Columbia with 261. This level will be maintained over the last five years of the projection; however, replacement demand will become relatively more important. A breakdown of the components into the short to medium and long-term is further shown in Table 16.5 below.[33]

33 Due to random rounding, expansion demand plus replacement demand may not equal total job openings

Table 16.5 Sources of Demand for Software Engineers (Annual Average 2015-19 and 2020-25)

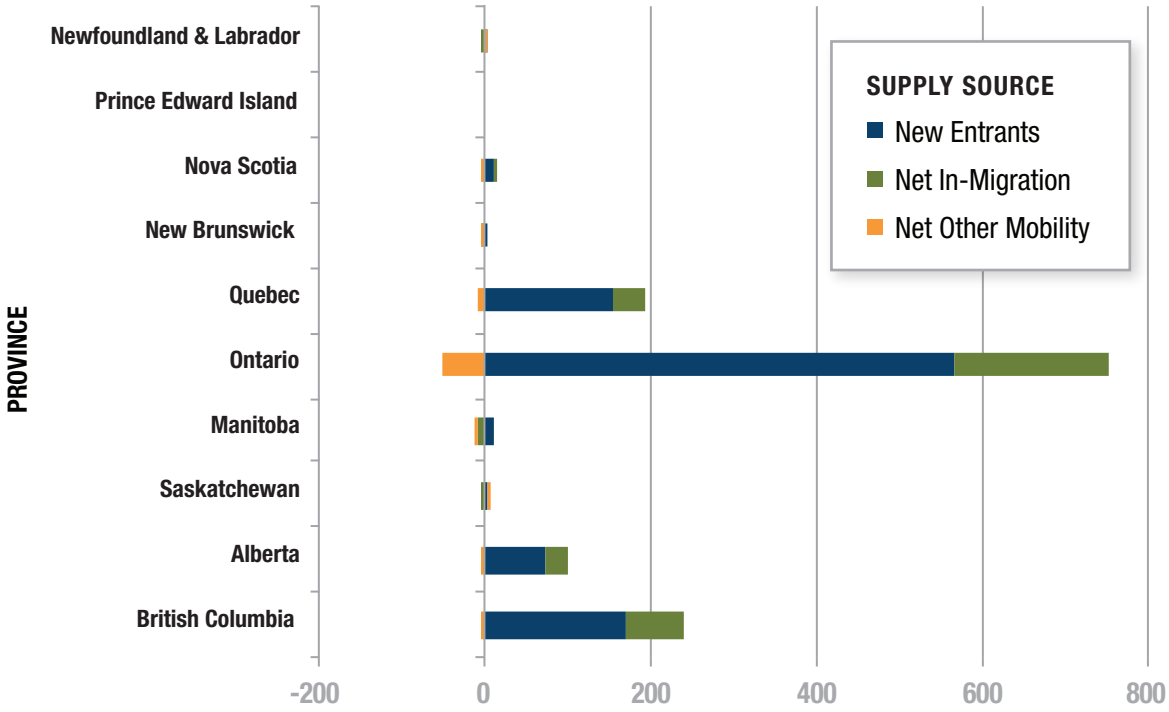
	Average 2015-19			Average 2020-25		
	Expansion	Replacement	Job Openings	Expansion	Replacement	Job Openings
British Columbia	141	121	261	47	173	221
Alberta	61	54	115	21	69	91
Saskatchewan	1	3	3	2	5	6
Manitoba	-7	3	-5	4	7	11
Ontario	198	457	655	150	584	734
Quebec	62	152	214	-19	191	172
New Brunswick	-1	5	3	-2	5	3
Nova Scotia	2	13	14	-4	16	12
Prince Edward Island	-	-	-	-	-	-
Newfoundland & Labrador	-6	1	-4	0	2	2

Sources of Supply

New Entrants, Migration and Other Mobility

Figure 16.2, below, shows the sources of supply for software engineers. Young people are being drawn into the occupation and this is reflected in high levels of new entrants. There a requirement for net in-migration for software engineers in Ontario.

Figure 16.2 Sources of Supply for Software Engineers (Annual Average 2015-2025)



New entrants form a very large proportion of total supply requirement for software engineers in all provinces, as shown in Table 16.6 below. Ontario, British Columbia and Quebec stand out as locations in which the level of new entrants to the occupation is high.

Table 16.6 Sources of Supply for Software Engineers (Annual Average 2015-19 and 2020-25)

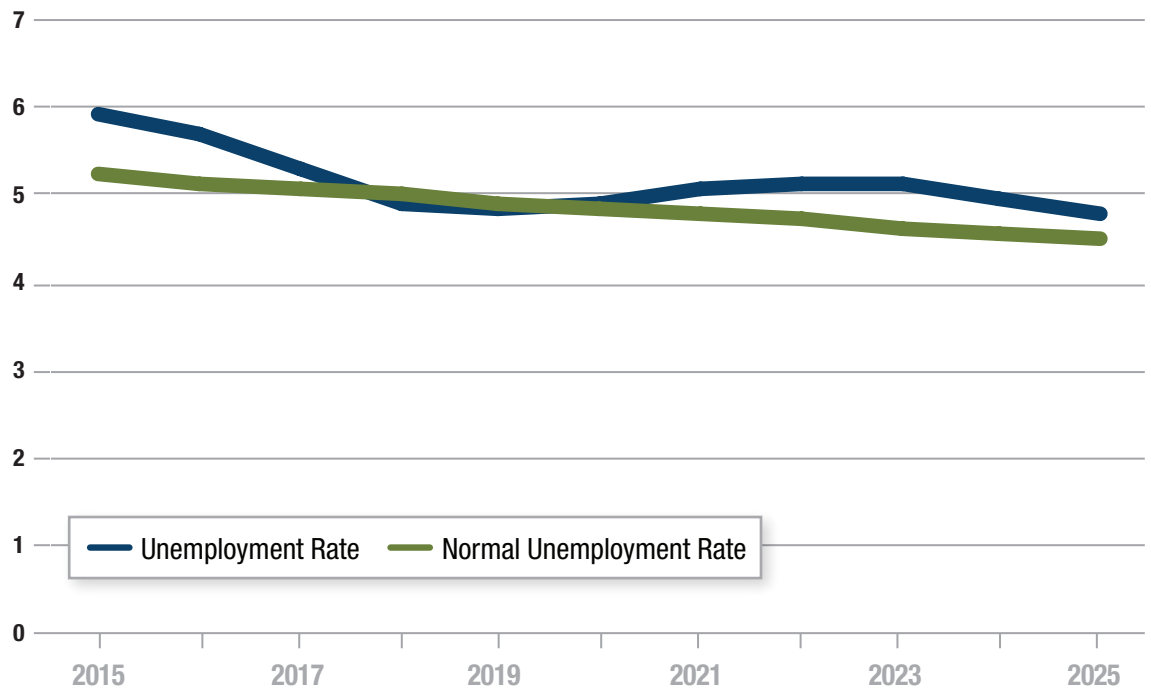
	Average 2015-19				Average 2020-25			
	New Entrants	Net In-Migration	Net Other Mobility	Total Supply	New Entrants	Net In-Migration	Net Other Mobility	Total Supply
British Columbia	171	57	8	236	169	81	-7	243
Alberta	74	37	2	112	79	20	-3	96
Saskatchewan	5	-1	0	4	5	-2	2	6
Manitoba	12	-13	0	-2	12	-2	0	10
Ontario	573	115	-5	684	563	247	-86	725
Quebec	154	31	10	195	158	43	-17	184
New Brunswick	3	-1	0	2	3	0	0	3
Nova Scotia	14	1	-1	14	13	2	-2	12
Prince Edward Island	-	-	-	-	-	-	-	-
Newfoundland & Labrador	2	-7	2	-3	2	0	0	2

Labour Market Tightness

Actual vs. Normal Unemployment Rates and Gap

Figure 16.3 below shows the actual and the normal unemployment rate for software engineers in Canada. Unemployment rates near the normal unemployment rate suggests a normal labour market, while unemployment rates noticeably above or below the normal rate suggests either a loose or tight market, respectively. The actual unemployment rate trends down towards the normal rate over the short-term, it briefly drops just below the normal rate before beginning a slow climb that once again begins to cycle downwards nearing the end of the forecast.

Figure 16.3 Unemployment Rate for Software Engineers (%), Canada (2015-2025)



All provinces will experience normal labour market tightness for software engineers in the future, as can be seen from Table 16.7.

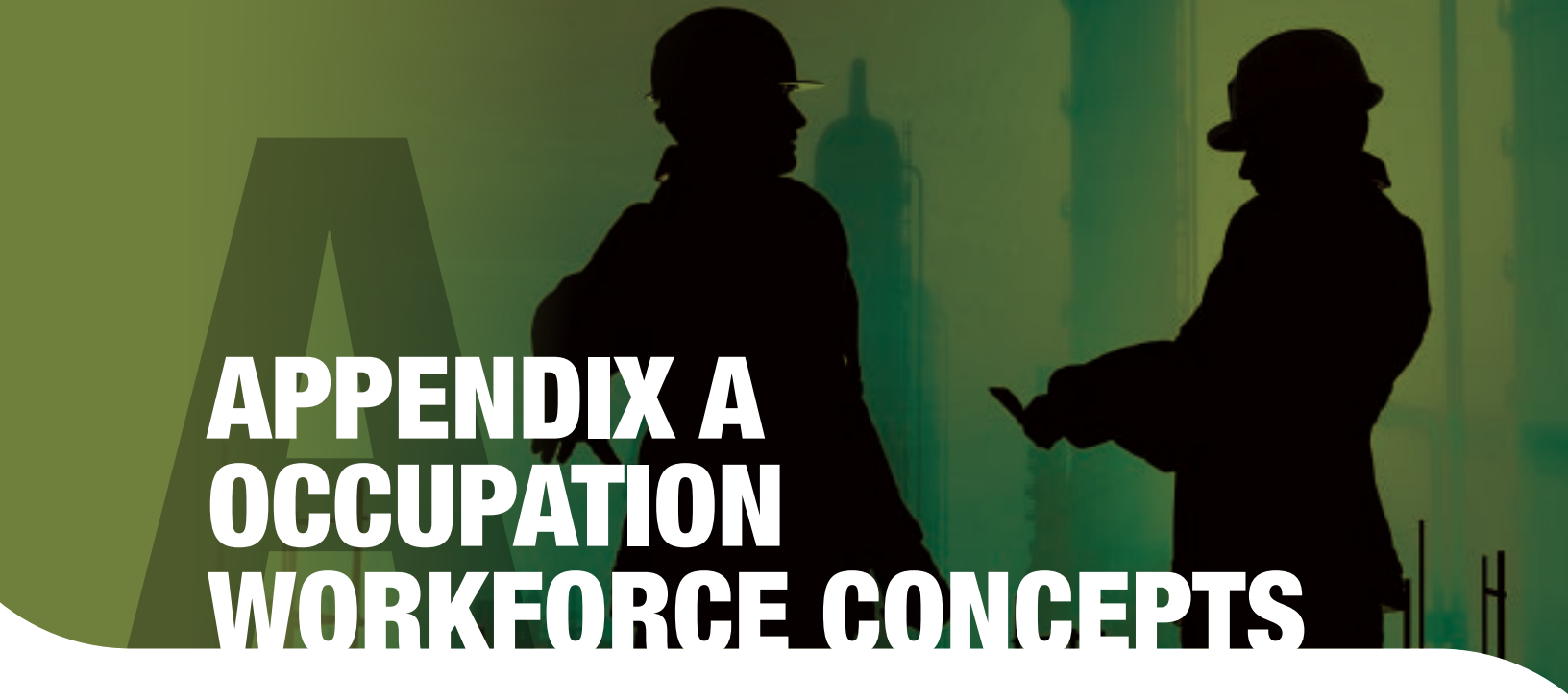
Table 16.7 Weighted Labour Market Tightness Rank (1-3) for Software Engineers (2015-2025)

	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
British Columbia	2	2	2	2	2	2	2	2	2	2	2
Alberta	2	2	2	2	2	2	2	2	2	2	2
Saskatchewan	2	2	2	2	2	2	2	2	2	2	2
Manitoba	2	2	2	2	2	2	2	2	2	2	2
Ontario	2	2	2	2	2	2	2	2	2	2	2
Quebec	2	2	2	2	2	2	2	2	2	2	2
New Brunswick	2	2	2	2	2	2	2	2	2	2	2
Nova Scotia	2	2	2	2	2	2	2	2	2	2	2
Prince Edward Island	-	-	-	-	-	-	-	-	-	-	-
Newfoundland & Labrador	2	2	2	2	2	2	2	2	2	2	2

The breakdown of in-migration is shown in Table 16.8, below. International in-migration is the larger source of migration in every province. International in-migration is particularly strong in Ontario where higher international migration is required to offset negative net inter-provincial migration.

Table 16.8 International and Inter-Provincial In-Migration of Software Engineers (2015-2025)

	Average 2015-19		Average 2020-25	
	International	Inter-Provincial	International	Inter-Provincial
British Columbia	41	17	67	14
Alberta	23	13	8	11
Saskatchewan	-1	0	-2	1
Manitoba	-17	4	-4	2
Ontario	135	-20	288	-41
Quebec	34	-2	46	-3
New Brunswick	-1	1	0	0
Nova Scotia	-1	2	3	-1
Prince Edward Island	-	-	-	-
Newfoundland & Labrador	2	-10	0	0



APPENDIX A OCCUPATION WORKFORCE CONCEPTS

This appendix provides a brief description of the concepts used in this report. These concepts include basic labour market information such as that used by Statistics Canada as well as those used in the outlooks and analyses described above.

Basic Labour Market Concepts

The workforce information is derived from labour market information produced by Statistics Canada. Statistics Canada conducted the 2011 National Household Survey to obtain detailed information about the labour market. Each month it publishes information in the Labour Force Survey about the labour force, employment, unemployment, the unemployment rate, source population, and the labour force participation rate for various locations across the country. The definition of these Statistics Canada labour market variables is as follows:

- **Employment**: number of people who are working at a particular point in time. This number includes both full and part time employees;
- **Labour force**: number of people working (employment) plus the number of people actively looking for work at a particular point in time;
- **Unemployment**: persons who are actively looking for work but are unable to find it at a particular point in time – calculated as labour force minus employment;
- **Unemployment Rate**: percentage of the labour force that is unemployed at a particular point in time – calculated as unemployment divided by labour force multiplied by 100;
- **Source Population**: number of persons in the population aged 15 years and over that is able to work. The source population excludes persons in institutions such as prisons and hospitals or those that are ill or disabled and unable to work; and
- **Labour Force Participation Rate**: the percentage of the source population that is in the labour force – labour force divided by source population multiplied by 100.

Occupation Analysis Concepts

The concepts for the occupation workforce outlook and analyses are as follow:

- **Labour force demand** – employment plus the normal level of unemployment for an occupation;
- **Normal unemployment** – unemployment normally observed for an occupation because of the nature of the work and the industries in which it is primarily employed;
- **Labour force supply** – the labour force as described above;
- **Excess labour force supply** – labour force supply minus labour force demand;
- **Normal unemployment rate** – the percentage of labour force supply that is normally unemployed; and
- **Market tightness rank** – a measure of the relative difficulty in acquiring the occupation in question – how serious is the gap?

Normal Unemployment

While it would be desirable for there to be no unemployment in the economy such a situation is not possible. Given the nature of the labour market it is necessary that there be some unemployment to facilitate its proper functioning. The latter unemployment is what is defined as normal unemployment.

There are a number of different types of unemployment:

- **Seasonal unemployment**: many activities in the economy such as construction have a seasonal component where fewer or more workers are required at different times during the year. For these occupations a higher level of the labour force in relation to employment is required to meet peak demand for workers;
- **Frictional unemployment**: there is always a number of people between jobs either as they search to improve their careers or move to a different geographic location;
- **Structural unemployment**: as the economy changes over time there will always be some mismatch between the skills required and those possessed by workers in the local economy; and
- **Cyclical unemployment**: is the unemployment that is associated with recessions and recoveries as the economy goes through economic cycles.

Normal unemployment refers to the first three types of unemployment. Normal unemployment rates differ across occupations reflecting differences in the seasonal and other aspects of a job. Managers, for example, have relatively low rates while those for construction related trades are relatively high as the work is seasonal and more labour force is required to meet peak levels of economic activity.

Estimates of the normal unemployment rates are derived from Statistics Canada's Labour Force Survey data on unemployment rates by occupation.

Labour force demand is the concept used to measure workforce demand in the outlooks and analyses. Labour force supply, as measured by the labour force, is the concept used to measure workforce supply. The "gap" between supply and demand is excess labour force supply.

Source Analysis

The following "change" concepts are used in examining the sources of demand and supply:

- **Expansion demand** – change in labour force demand which is the change in employment plus the change in normal unemployment;
- **Retirements** – the number of workers that leave the labour force permanently for the reason of retirement;
- **Deaths** – the number of workers that die from all causes not just on-the-job deaths;
- **Total demand change (Job Openings)** – sum of expansion demand, retirements, and deaths. This concept is also called net hiring requirements or job openings (if positive) or job closings (if negative);
- **New entrants** – the number of young people that enter the labour force after receiving an education;
- **Net in-mobility** – sum of net in-migrants and other net in-mobility;
- **Net in-migrants** – net in-migration of workers (those moving in minus those moving out) for a geographic area;
- **Other net in-mobility** – all other sources of change in labour force supply such as changing occupations, re-entering the labour force after illness, and changes in labour force participation rates caused by increased wage rates or social factors such as the increased desire on the part of women to enter the labour force; and
- **Total supply change** – sum of new entrants, net in-migrants and other net in-mobility.

Expansion Demand

Expansion demand refers to changes in labour force demand for an occupation. The sources of change in expansion demand are the change in employment and the change in normal unemployment. The change in normal unemployment is directly related to changes in employment through the normal unemployment rate. If the normal unemployment rate is 5 percent, for every 100 new employees required for an occupation, an additional 5 would be needed for the labour force to keep the unemployment rate at 5 percent. The 100 new jobs add 100 new persons to employment and 105 persons to the labour force.

Retirements

Retirements subtract from the labour force for an occupation. In occupation analysis, the concept of retirement is meant to refer to those persons who leave the economy's labour force – they no longer work. Often the concept of retirement is not interpreted in this manner by the public. Some people retire from their job and then take up work in another job either in the same occupation or another occupation. In this case the person has not left the economy's labour force. If they work in another occupation then they represent inter-occupation mobility – movement between occupations such as a person in the construction trades who retires from construction and works in a restaurant as a waiter on a part time basis.

One of the problems encountered in occupation analysis is that information on retirements for occupations is normally not provided on the basis required. For example, it has recently been stated in a story in the paper that the average age at retirement for teachers is 59. Does this mean that when teachers retire they are no longer in the labour force or that they are "officially" retired from teaching and remain in the labour force – some teachers qualifying for retirement may retire and then take supply teacher positions or a job in a different occupation? To the extent that the reported retirement ages refer to the latter situation, retirements from the overall labour force will be overestimated.

This problem does not affect the size of the overall labour force in the analyses since the sum of the individual occupation labour forces is required to add to that for the economy as a whole – the latter is an input to the occupation outlook and analyses. As a result, the overestimation or underestimation of retirements is allocated to net in-mobility – largely inter-occupation mobility – which is described below. The economy's total labour force is computed using labour force participation rates by age and sex. These rates implicitly show the percentage of people retiring from the labour force.

Deaths

Deaths refer to those occurring from all causes, not just on-the-job deaths. Deaths subtract from the labour force.

Total Demand Change (Job Openings)

Total demand change for an occupation is the sum of the above three concepts. It is the number of workers in an occupation that is required to fill new jobs and replace those workers that die or are retiring from the workforce.

Expansion demand represents net "new" jobs, while retirements and deaths represent "replacement" demand. It should be noted that all retirements and deaths for an occupation need not be replaced if expansion demand is negative. For example, suppose expansion demand is -1000 and retirements and deaths are 2000. The total demand change is 1000. In this case only 1000 persons of the 2000 who died or retired need to be replaced.

New Entrants

The number of new entrants to the labour force refers to persons entering the labour force from the population in the 15 to 30 age group. They represent additions to the labour force. Migrants or occupations such as managers or supervisors that require related labour market experience are not included in this category.

This concept is meant to refer to persons that enter the labour force either for the first time after completing their education, or, if previously working part time while receiving their education, as they complete their education and start to work in their chosen occupation. While related to the concept of school leavers that is often used in occupation analysis, it is not the same concept. It also does not include people completing their apprenticeship, as these people normally apprentice after entering the labour force.

An example of how new entrants differ from school leavers is a student who joins the labour force for 3 months in the summer while obtaining his or her education but does not work during the school year. This student would be counted as 0.25 persons – 3 divided by 12 months – in the labour force for the year as a whole. When they begin to work 12 months a year after completing their education they are counted as 1 person in the labour force – their annual participation rate in the labour force jumps from 25 percent to 100 percent. New entrants would capture this latter labour force increase of .75, not 1 implied by school leavers. The increase in the participation rate observed from ages 15 to 30 reflects this type of activity.

Net In-Mobility

Net in-mobility is defined as the sum of net in-migration and other net in-mobility. This component of labour force change measures the change in the existing labour force that is required because withdrawals from the labour force – deaths and retirements – are not equal to new entrants to the occupation's labour force.

Net In-Migration

Net in-migration refers to persons moving into or out of a geographic area to take or find a job. Positive net in-migration adds to the labour force while negative net in-migration subtracts from the labour force. Measures of both net international and net interprovincial migration are considered.

Other Net In-Mobility

Other net in-mobility refers to net additions to an occupation's labour force from such sources as persons changing occupations – inter-occupation mobility – and changes in labour force participation rates for social or cyclical reasons.

Total Supply Change

Total supply change is the sum of new entrants and net in-mobility. New entrants always add to the labour force while net in-mobility can add or subtract from the labour force. The components of net in-mobility can add to or subtract from the labour force. If net in-mobility is negative it is part of replacement demand, when it is positive it is part of supply. If people leave an occupation they may need to be replaced when the total demand change remains the same. Net in-mobility is usually negative in response to similar changes in expansion demand and vice versa.

Explaining Labour Force Supply Change

The change in labour force supply is comprised of the following parts:

Additions to Supply

- New Entrants
- In-Migration
- Other In-Mobility

Reductions in Supply

- Deaths
- Retirements
- Out-Migration
- Other Out-Mobility

In the modelling and analyses of the occupations, migration and mobility are expressed in net terms: net in-migration equals in-migration minus out-migration and net other in-mobility equals other in-mobility minus other out-mobility. Availability of data is an important reason for using this net approach.

Deriving the Total Demand and Supply Change Concepts

Over the long run it is generally expected that the level of labour force demand will be equated to labour force supply. In this case the change in demand will also be equal to the change in supply:

- Labour Force Demand Change equals Labour Force Supply Change.

Substituting the components of the change in labour force demand and supply as described above yields the following equation:

- Expansion Demand equals New Entrants minus Retirements and Deaths plus Net In-Mobility.

Rearranging the equation yields:

- Expansion Demand plus Retirements and Deaths equals New Entrants plus Net In-Mobility.

The components on the left hand side of this equation represent total demand change while those on the right hand side represent total supply change.

A Requirements Approach

Finally, it should be noted that the approach adopted by the demand and supply models is a "requirements" one. When it deals with supply it is focusing on the "required" supply given the "required" demand. It takes into account lags in achieving supply given demand, but does not make an estimate of supply independent of the demand for workforce.