

Calgary Next 20: Population, Employment and Housing Projections

Final Report

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Background

This Working Paper has been prepared to document the population and employment projections analysis completed in 2020 for the City of Calgary by Applications Management Consulting Ltd.. This paper is intended to provide an overview of the analysis. It is intended as information regarding the results of this analysis and the assumptions that have been incorporated in arriving at the results.

STUDY OBJECTIVES

The primary purpose of this analysis is:

- ▶ Prepare population, employment and household control totals for the Calgary Region for the period 2018 to 2076.
- ▶ The allocation of population, employment and household control totals for the Calgary Region to the transportation zone level for the period 2018 to 2076.

Each of the population and employment control totals have been broken down as follows:

Population Categories

- ▶ Age Cohorts: Transportation zone population totals are disaggregated by single year age cohort.
- ▶ Gender: Transportation zone population totals are disaggregated by male and female.

Employment Categories

- ▶ Industry: A total of 20 industries have been defined using the North American Industry Classification System (2 Digit NAICS).
- ▶ Work at Home: Estimates of the number of workers who work primarily at home versus those working outside the home have been provided.
- ▶ Occupation: A total of 10 occupation categories that have been identified using the National Occupation Classification System (1 Digit NOC).

Household Categories

- ▶ Households by type: Estimates of the number of households by household type by transportation zone.
- ▶ Dwelling units by type: Estimates of the number of dwelling units by dwelling unit type by transportation zone.
- ▶ Household Size: Estimates of the number of households by household size (1-5+) by transportation zone.
- ▶ Average Household Income: Estimates of the average household income by transportation zone.

STUDY AREA

For the purpose of this analysis, the geography of the study area is the Calgary Region¹. This includes a detailed analysis by transportation zone. The Calgary Region is comprised of 1918 transportation zones.

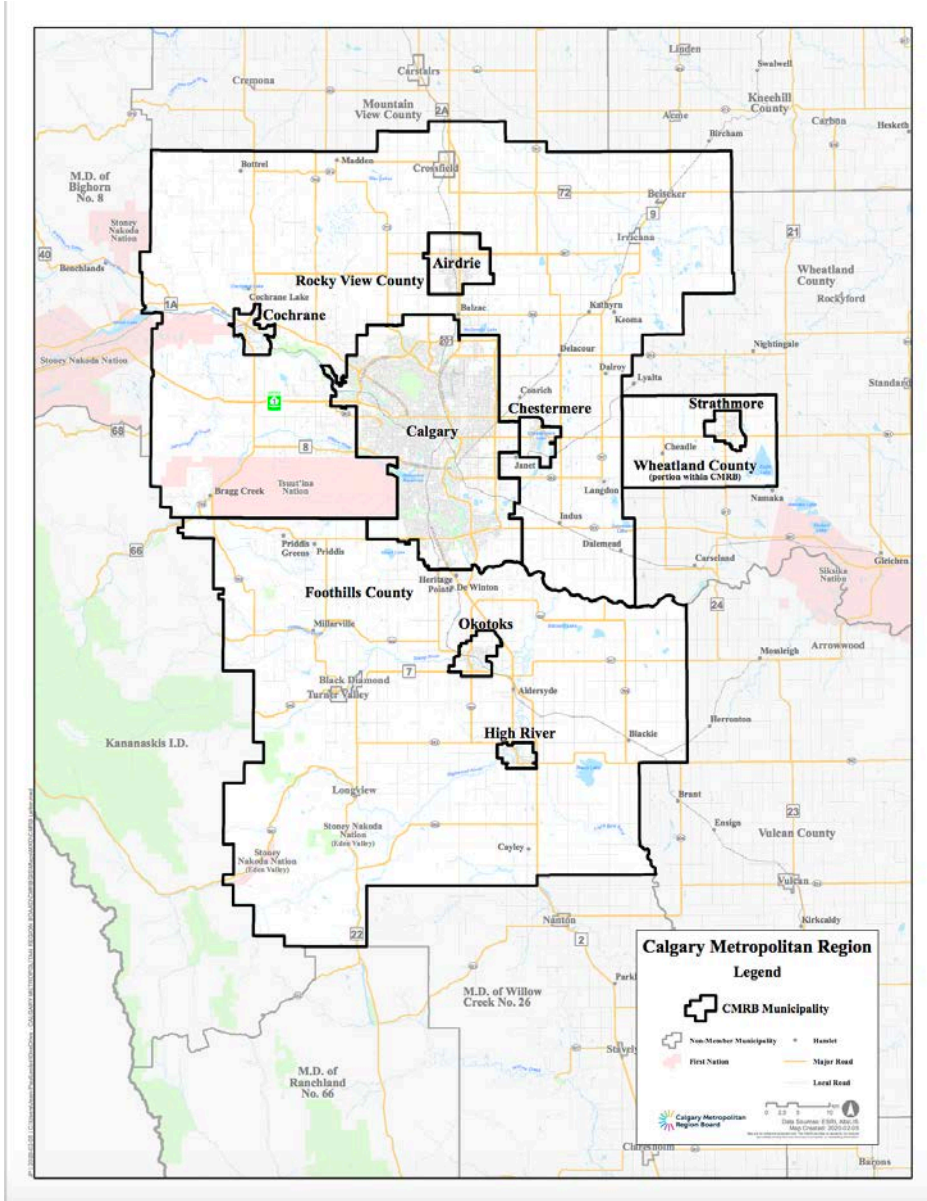
This study area includes the following municipalities:

- ▶ City of Airdrie
- ▶ City of Calgary
- ▶ City of Chestermere
- ▶ Town of Cochrane
- ▶ Foothills County
- ▶ Town of High River
- ▶ Town of Okotoks
- ▶ Rocky View County
- ▶ Town of Strathmore
- ▶ Wheatland County (10% portion included in the CMRB)
- ▶ Tsuu T'ina Nation I45²

¹ The Calgary Region is largely consistent with the Calgary Metropolitan Region (CMR).

² Tsuu T'ina Nation I45 is not a member of the CMR, but was included in the analysis.

Calgary Region Map³



^{3 3} The Calgary Region is largely consistent with the Calgary Metropolitan Region (CMR). This map is based on the Calgary Metropolitan Region.

Scenarios

This analysis proposed six unique Calgary Region employment scenarios for consideration through the 2018 to 2076 forecast period.

These scenarios include:

- ▶ **Baseline Scenario:** The Baseline scenario generally assumes that the Calgary Region economy will continue its reliance on the energy sector through the forecast period, with only minimal industry diversification achieved in the regional economy. This scenario also aligns with the intensification targets as set out in the City of Calgary's Municipal Development Plan (MDP)⁴ that aims for 50% of population growth to be accommodated within already developed areas of the City.
- ▶ **Baseline with Demographic Shift Scenario:** This scenario is similar to the Baseline scenario described above, but introduces changes to fertility and mortality rates in later forecast years - an important consideration given the significant length of the forecast covered in this analysis. The overall fertility rate is expected to stay relatively constant, however there are changes to the age-specific rates with assumptions of females having children later in life. The overall mortality rates are expected to decline in this scenario. This scenario also aligns with the 50% intensification target as set out in the MDP.
- ▶ **Industry Diversification Scenario:** The Industry Diversification scenario assumes that the Calgary region economy will gradually lessen its dependence on the energy sector through the forecast period. While the energy sector remains an important and growing part of the regional economy, industries such as specialized manufacturing, information-based industries, and research/innovation are expected to increase in relative prominence. This scenario also aligns with the 50% intensification target as set out in the MDP.
- ▶ **Technological Change Scenario:** The Technology Advancement scenario assumes that growth in the Calgary region economy will be driven by an especially high rate of technological advancement/adoption, leading to high potential growth in technology-sensitive industries such as oil and gas, manufacturing, utilities, and professional, scientific and technical services. This scenario also aligns with the 50% intensification target as set out in the MDP.
- ▶ **Climate Change Scenario:** There is a likelihood that climate change becomes an increasingly significant issue impacting the Calgary region economy through the forecast period. As temperature, precipitation, and extreme weather patterns continue to shift, the Calgary region's building stock, transportation infrastructure, water supply, and economic outlook across a number of industry groups will be at risk. This scenario also aligns with the 50% intensification target as set out in the MDP.

⁴ City of Calgary Municipal Development Plan, December 2018.

- ▶ **Development Dispersion Scenario:** The Development Dispersion scenario assumes that development in the Calgary region deviates from the developed area/greenfield targets outlined in the Municipal Development Plan, which currently aims for 50% of population growth to be accommodated within already developed areas of the city.

Scenarios differ from each other across six parameters: Economic Diversification, Technological Change, Trade Liberalization, Environmental Stewardship, Social Development, and Development Density. Projected employment impacts specific to the Climate Change scenario have also been developed. The detailed assumptions related to the scenarios is available in Appendix A: Scenarios

Population Projections Methodology

This section provides information on the methodology and assumptions used in generating the population projections. The methodology used in the model to project population includes an employment based method to project net migration along with the Standard Component Method. The Standard Component Method takes into consideration factors such as fertility, mortality and migration rates, which are key factors that can affect population change.

Population control totals were prepared for the Calgary Region for the forecast period 2018-2076 and then disaggregated to the transportation zones within the municipalities across the Region. These control totals provide direction on the amount of economic and population growth that will occur in the Region over the 57 year forecast period.

POPULATION CONTROL TOTALS

The initial step in developing detailed geographic allocations of population is by establishing population control totals. This was completed for the Calgary Region for the period 2018 to 2076 using the Population and Employment Forecasting Model. These population forecast control totals were prepared for the purposes of this study with direction and input from members of the client team⁵.

For the purposes of this analysis, 6 scenarios were developed. These scenarios reflect varying levels of economic activity in the Calgary Region. The population control totals are summarized in the table below.

Population Projections for the Calgary Region by Scenario⁶

Year	Baseline	Dispersed	Baseline + Demographic	Industry Diversification	Technological Change	Climate Change
2018	1,524,931	1,524,931	1,524,931	1,524,931	1,524,931	1,524,931
2024	1,702,677	1,705,779	1,703,141	1,720,917	1,717,491	1,705,446
2039	2,077,670	2,094,984	2,083,588	2,149,383	2,137,825	2,093,326
2049	2,376,586	2,392,785	2,389,589	2,480,322	2,466,059	2,400,949
2059	2,674,983	2,699,763	2,706,298	2,817,566	2,803,472	2,712,913
2069	2,907,265	2,943,573	2,955,221	3,091,761	3,077,076	2,957,946
2076	3,084,476	3,113,807	3,147,177	3,300,682	3,285,200	3,148,881

⁵ City of Calgary

⁶ Population control totals include institutional population,

- ▶ In the Baseline Scenario, the population is projected to increase from 1,524,931 in 2018 to 3,084,476 by 2076. This represents an average annual growth rate of 1.2% over the period 2018 to 2076.
- ▶ In the Dispersed Scenario, the population is projected to increase from 1,524,931 in 2018 to 3,113,807 by 2076. This represents an average annual growth rate of 1.2% over the period 2018 to 2076.
- ▶ In the Baseline + Demographic Shift Scenario, the population is projected to increase from 1,524,931 in 2018 to 1,622,246 by 2076. This represents an average annual growth rate of 1.3% over the period 2018 to 2076.
- ▶ In the Industry Diversification Scenario, the population is projected to increase from 1,524,931 in 2018 to 1,755,751 by 2076. This represents an average annual growth rate of 1.3% over the period 2018 to 2076.
- ▶ In the Technological Change Scenario, the population is projected to increase from 1,524,931 in 2018 to 1,760,269 by 2076. This represents an average annual growth rate of 1.3% over the period 2018 to 2076.
- ▶ In the Climate Change Scenario, the population is projected to increase from 1,524,931 in 2018 to 1,623,950 by 2076. This represents an average annual growth rate of 1.3% over the period 2018 to 2076.

The following section discusses the underlying principles and assumptions used in developing these forecasts, as well as the process that generated the information necessary to prepare the forecasts.

STANDARD COMPONENT METHOD

The Standard Component Method is one of the more common methods being relied upon for population projections. The Standard Component Method can yield a more reliable result since it takes into consideration fertility, mortality and migration rates, and projects the individual components of the population rather than the population as a whole.

The Standard Component Method includes:

- ▶ Natural Increase: Change in population related to births and deaths.
- ▶ Net Migration: Change in population related to inflow of migrants and outflow of migrants.

By incorporating a cohort survival approach, an estimate of age and gender can be provided for each forecast year which are internally consistent with the total population and employment projections.

Migration is more complex and is largely dependant upon local economic conditions, relative to those that exist elsewhere – in this case largely elsewhere in Canada. For example, a high rate of economic growth in Alberta relative to B.C. and Ontario can lead to a net inflow of migrants from these provinces to Alberta.

Net migration can also have an impact on the natural increase of the population. Where there is a net inflow of workers to a region, there is generally an increase in the population of child bearing years, since many of the incoming migrants fall within the younger adult cohorts. Since these cohorts have the highest fertility rates, new migrants can be expected to increase the number of births in the future, resulting in additions to the population through natural increase.

FERTILITY RATES

The model calculates the number of births and advances the age of the population in each of the forecast years. Surviving members in each age cohort or age group proceed into successive age groups in each year of the forecast. Further information regarding historical and projected fertility rates is providing in Appendix A.

MORTALITY RATES

In each year, the model calculates the number of deaths. Surviving members in each age cohort or age group proceed into successive age groups in each year of the forecast. Further information regarding historical and projected mortality rates is providing in Appendix A.

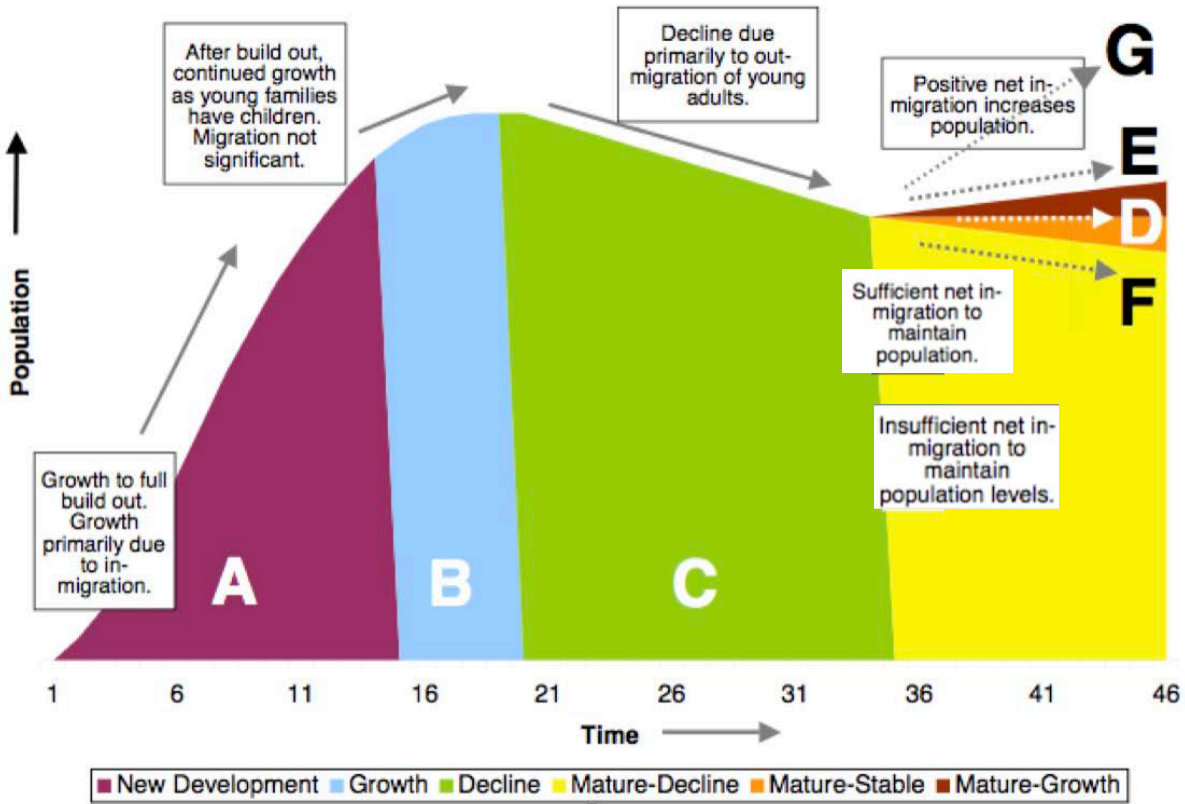
NET MIGRATION

In addition to cohort survival, the model uses net migration to migrate population into and out of traffic zones. In each forecast period, the cohort survival component of the model was run to determine a population total (without migration) and compared to the target population for the Traffic Zone. Where these numbers differed, the difference was resolved with net migration.

NEIGHBORHOOD CYCLE

The population and employment forecasting model uses a neighborhood cycle to identify growth targets by transportation zone. Each transportation zone has been assigned to be in a neighbourhood cycle status in 2018 and then passes through the cycle over the forecast period. The neighborhood cycle is presented in the diagram below.

Neighborhood Cycle Diagram



BASE YEAR POPULATION (2018)

The base year for the population projections is 2018. The 2018 population for the Calgary Region has been estimated to be 1,524,931. This includes a population of 1,267,344 within the City of Calgary⁷ and 257,587 within the rest of the Calgary Region.

The 2018 population was based on several data sources for all municipalities within the Calgary Region. Where a Municipal Census was available it was used. If a Municipal Census was not available, then Federal Census data was used to make a projection from 2016 to 2018.

⁷ Based on the 2018 City of Calgary Municipal Census.

DEVELOPMENT PLANS

The population and employment projections use approved plans as a platform to determine the type of development, density, and location of development in neighborhoods around the City of Calgary and regional municipalities. The information gathered from the Area Structure Plans (ASPs), and Area Redevelopment Plans (ARP) is used in the model to identify the location of residential/non-residential development, and capacity for development. While the plans provide this detail at a neighborhood geography, for the purposes of the population and employment model, the information is further disaggregated to a transportation zone level. A neighborhood typically contains numerous transportation zones, which we have mapped out using Google Maps to identify the neighborhood boundary as well as the internal transportation zone boundaries. Then using the plan zone type map, we identify the type of residential or non-residential development that will occur in each zone. Some zones will have a mix of single family, multi-family, and commercial. While other zones are strictly residential or non-residential. The template for plans is not exactly the same, however the information we try to collect from the plans includes the following:

- ▶ Gross developable area for residential development (single vs multi-family)
- ▶ Net developable area for residential development(excluding areas that cannot be developed on ie. transportation corridors etc.)
- ▶ Gross developable area for non-residential development (commercial, institutional, light-high industrial)
- ▶ Net developable area for non-residential development (excluding areas that cannot be developed on ie. transportation corridors etc.)
- ▶ Number of single family dwelling units, multi-family dwelling units or area designated area for this development.
- ▶ People per household factors
- ▶ Employment densities
- ▶ Overall capacities for development

Typically some or all of the above information is available through plans, and provides us with the necessary inputs to determine capacities for development. In individual transportation zones, capacities are used as targets for residential and non-residential growth. However, in some cases we use other available information to make modifications to capacity information.

As part of this analysis the number of plans reviewed within the Calgary Region was over 200, including approximately 70 plans within the City of Calgary.

For each of the plans reviewed, we estimated a population and employment capacity. Firstly, we used the land use map to identify the boundaries of the ASP and then divided that out into the transportation zones, to align with our model. Next, based on the land use map we estimated the type of dwelling units for each traffic zone (single family/multi-family) and the

resulting population capacity for each traffic zone. Special considerations would be identified, such as, areas not available for development (school sites, parks, transportation corridors etc.).

MAJOR RESIDENTIAL GROWTH ASSUMPTIONS

DISTRIBUTION OF RESIDENTIAL GROWTH

The City of Calgary Municipal Development Plan⁸ was used as a guide for assumptions related to the density and distribution of development within the City of Calgary.

In the Baseline Scenario, the share of Calgary Region population within the City of Calgary decreases from 83% in 2018 to 79% by 2076. In the Dispersed Scenario, the share of Calgary Region population within the City of Calgary decreases from 83% in 2018 to 75% by 2076.

In the Baseline Scenario it has been assumed that approximately half of residential growth⁹ within the City of Calgary would occur in developed areas, and half of residential growth would occur in developing areas. In the Dispersed Scenario, these targets are relaxed and it has been assumed that the distribution of future residential development would occur in a similar pattern to the status quo, with approximately 85% of residential growth occurring in developing areas and 15% occurring in developed areas within the City of Calgary.

Population in City of Calgary Developed vs. Developing Areas¹⁰

	Baseline Scenario Growth 06-76	% of Growth	Dispersed Scenario Growth 18-76	% of Growth
Developing Areas	740,670	51%	1,143,432	85%
Developed Areas	713,123	49%	203,093	15%
Total	1,453,793	100%	1,346,525	100%

COMPONENTS OF POPULATION GROWTH

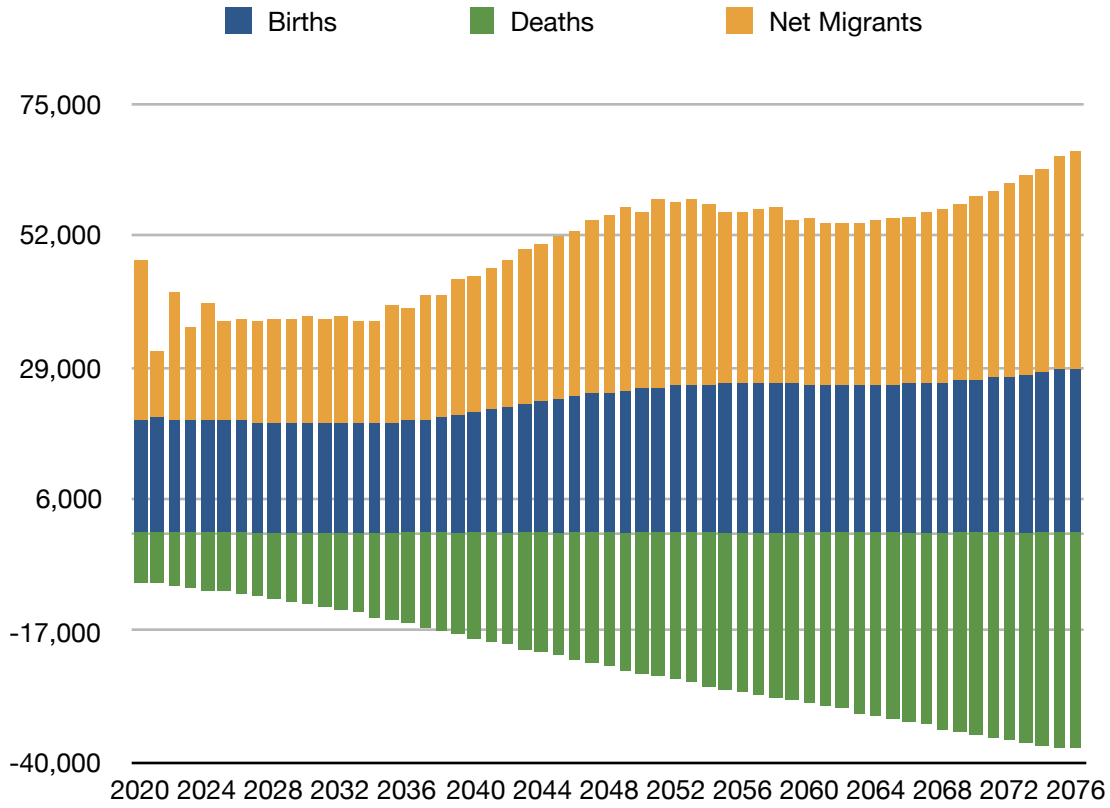
In the Baseline Scenario, the natural increase of the population is positive for the first 30 years of the forecast (2049). During this period, the estimated annual births are greater than the deaths. In the second half of the forecast, the annual number of deaths is greater than the annual number of births, resulting in a negative natural increase. This is the result of an aging population in the Calgary Region. Over the forecast period, the net migration ranges from 26,000 to 38,000 annual net migrants.

⁸ City of Calgary Municipal Development Plan, September 2009.

⁹ Growth from 2006 to 2076

¹⁰ Population totals include institutional population.

Components of Population Growth; 2018 to 2076



Employment Projections Methodology

As with population, projections of the number of jobs have also been prepared for the Calgary Region. In this study, the total number of jobs (i.e. employment) was estimated from the labour force. These employment totals were subsequently allocated geographically to transportation zones in the Calgary Region, and across 20 industry types. Estimates of the number of jobs associated with persons working at home and those not working at home have been determined by industry and sector. Employment control totals were prepared for the Calgary Region for the forecast period 2018-2076 and then disaggregated to the transportation zones within the Region.

EMPLOYMENT CONTROL TOTALS

The number of jobs in the Calgary Region is closely related to the total number of people who both live in the Calgary Region and are determined to be working.

Control totals for future employment within Calgary Region have been developed using the following considerations:

- The labour force is comprised of 15-64 and mature workers (65+) living in the Calgary Region.

The employment controls for the Calgary Region used in the development of this analysis are provided in the table below.

Employment Projections for the Calgary Region by Scenario

Year	Baseline	Dispersed	Baseline + Demographic	Industry Diversification	Technological Change	Climate Change
2018	871,361	871,361	871,361	871,361	871,361	871,361
2024	957,023	959,315	959,204	968,554	965,336	959,103
2039	1,169,465	1,179,860	1,177,982	1,214,374	1,203,960	1,176,943
2049	1,312,549	1,326,823	1,323,128	1,376,261	1,361,824	1,319,139
2059	1,451,587	1,473,859	1,471,733	1,541,069	1,521,852	1,464,584
2069	1,601,253	1,620,979	1,619,847	1,706,000	1,680,626	1,609,010
2076	1,696,378	1,723,602	1,722,778	1,819,882	1,794,755	1,708,314

- ▶ In the Baseline Scenario, the employment is projected to increase from 871,361 in 2018 to 1,696,378 by 2076. This represents an average annual growth rate of 1.2% over the period 2018 to 2076.
- ▶ In the Dispersed Scenario, the employment is projected to increase from 871,361 in 2018 to 1,723,602 by 2076. This represents an average annual growth rate of 1.2% over the period 2018 to 2076.
- ▶ In the Baseline + Demographic Shift Scenario, the employment is projected to increase from 871,361 in 2018 to 1,722,778 by 2076. This represents an average annual growth rate of 1.2% over the period 2018 to 2076.
- ▶ In the Industry Diversification Scenario, the employment is projected to increase from 871,361 in 2018 to 1,819,882 by 2076. This represents an average annual growth rate of 1.3% over the period 2018 to 2076.
- ▶ In the Technological Change Scenario, the employment is projected to increase from 871,361 in 2018 to 1,794,755 by 2076. This represents an average annual growth rate of 1.3% over the period 2018 to 2076.
- ▶ In the Climate Change Scenario, the employment is projected to increase from 871,361 in 2018 to 1,708,314 by 2076. This represents an average annual growth rate of 1.2% over the period 2018 to 2076.

BASE YEAR EMPLOYMENT (2018)

Initial base year employment estimates for the CMR were based on forecast data received from Calgary Corporate Economics. This forecast data included employment estimates covering the 2016 to 2077 period for the Calgary Economic Region (CER), allocated according to 16 industry categories.

To disaggregate Calgary Corporate Economics' 16 industry categories into the 20 2-digit NAICS categories used in analysis by Applications, the 2016 Corporate Economics estimate was compared to the 2016 Federal Census labour force profile for the CER.¹¹ Four of the industry categories provided by Corporate Economics were disaggregated according to the proportions estimated by the 2016 Federal Census. The CER Corporate Economics employment estimate for 2016, transformed into 2-digit NAICS categories, is shown in the table below.

Estimated Employment by 2 Digit NAICS, Calgary Economic Region, 2016

Industry	Employment
11 Agriculture, forestry, fishing and hunting	3,800
21 Mining, quarrying, and oil and gas extraction	56,500

¹¹ Statistics Canada, Census Profile, 2016 Census. <https://www12.statcan.gc.ca/census-recensement/2016/dp-pd/prof/index.cfm?Lang=E>

22 Utilities	9,000
23 Construction	88,500
31-33 Manufacturing	43,800
41 Wholesale trade	31,581
44-45 Retail trade	95,519
48-49 Transportation and warehousing	49,800
51 Information and cultural industries	16,331
52 Finance and insurance	29,749
53 Real estate and rental and leasing	16,751
54 Professional, scientific and technical services	100,300
55 Management of companies and enterprises	2,942
56 Administrative and support, waste management and remediation services	27,058
61 Educational services	53,200
62 Health care and social assistance	95,500
71 Arts, entertainment and recreation	19,369
72 Accommodation and food services	54,900
81 Other services (except public administration)	40,500
91 Public administration	24,300
Total	859,400

The CER data was then transformed to reflect employment in the CMR. Employment associated with municipalities not located in the CMR was subtracted, and those included in the CMR but not the CER were added. For a listing of municipalities added/subtracted and the 2016 employment associated with each, see Appendix A. Municipality-specific labour force profiles from the 2016 Federal Census were used as a proxy for employment. The table below shows the employment adjustments required to transform CER data to reflect the CMR, by 2-digit NAICS.

Calgary Economic Region to Calgary Metropolitan Region Employment Adjustments, by 2 Digit NAICS

2-digit NAICS	2016 CER employment	Employment added	Employment subtracted	Net % Adjustment
11 Agriculture, forestry, fishing and hunting	3,800	387	2,105	-45%

21 Mining, quarrying, and oil and gas extraction	56,500	436	1,665	-2%
22 Utilities	9,000	68	160	-1%
23 Construction	88,500	914	3,360	-3%
31-33 Manufacturing	43,800	484	1,395	-2%
41 Wholesale trade	31,581	248	715	-2%
44-45 Retail trade	95,519	926	2,595	-2%
48-49 Transportation and warehousing	49,800	489	1,475	-2%
51 Information and cultural industries	16,331	54	345	-2%
52 Finance and insurance	29,749	262	600	-1%
53 Real estate and rental and leasing	16,751	85	425	-2%
54 Professional, scientific and technical services	100,300	369	1,410	-1%
55 Management of companies and enterprises	2,942	12	50	-1%
56 Administrative and support, waste management and remediation services	27,058	270	885	-2%
61 Educational services	53,200	609	1,715	-2%
62 Health care and social assistance	95,500	785	2,515	-2%
71 Arts, entertainment and recreation	19,369	136	700	-3%
72 Accommodation and food services	54,900	592	1,465	-2%
81 Other services (except public administration)	40,500	349	1,440	-3%
91 Public administration	24,300	369	1,280	-4%
Total	859,400	7,844	26,300	-

The CER-to-CMR industry-specific employment adjustments for 2016 were then applied to a 2018 employment estimate for the CER provided by Calgary Corporate Economics (the 16 industry categories for 2018 were transformed into the 20 2-digit NAICS categories using the same methodology as described above for the 2016 data). Applying the industry-specific

percentage adjustments to the Calgary Corporate Economics CER data yields 2018 CMR employment results shown in the table below.

Estimated Employment by 2-Digit NAICS, Calgary Economic Region and CMR, 2016

2-digit NAICS	2018 CER employment	2018 CMR employment
11 Agriculture, forestry, fishing and hunting	7,200	3,945
21 Mining, quarrying, and oil and gas extraction	53,500	52,336
22 Utilities	10,700	10,591
23 Construction	84,700	82,359
31-33 Manufacturing	48,100	47,099
41 Wholesale trade	32,276	31,799
44-45 Retail trade	97,624	95,917
48-49 Transportation and warehousing	60,100	58,909
51 Information and cultural industries	17,933	17,613
52 Finance and insurance	27,510	27,197
53 Real estate and rental and leasing	15,490	15,176
54 Professional, scientific and technical services	96,200	95,201
55 Management of companies and enterprises	3,462	3,417
56 Administrative and support, waste management and remediation services	31,838	31,115
61 Educational services	52,600	51,506
62 Health care and social assistance	101,900	100,054
71 Arts, entertainment and recreation	21,267	20,648
72 Accommodation and food services	60,600	59,636
81 Other services (except public administration)	40,500	39,409
91 Public administration	28,600	27,528
Total	892,100	871,455

The above 2018 CMR employment total of 871,455 was used as a “control total” for the base year of the analysis. However, some spatial and industry specific manual adjustments were made on a Transportation Zone (TZ) basis, using the following data sources provided by the City of Calgary:

- 2015 employment estimates by transportation zone

- ▶ 2016 Place of Work (Federal Census) employment estimates by transportation zone
- ▶ 2018 employment estimates by transportation zone

Note that the 2018 employment estimate (by transportation zone) listed above does not align with the industry-specific 2018 employment estimate provided by Corporate Economics (described above).

For each transportation zone, the above three total employment estimates were compared to each other. In cases where a significant difference across the three employment estimates was reported for a zone, the zone was manually investigated using Google Earth mapping to better understand potential employment levels in the zone. Typically, the estimate believed to best represent total employment in the zone was selected (in some cases, a hybrid or average of the estimates was used). These manual adjustments resulted in a net subtraction of approximately 15,000 jobs relative to the City of Calgary's 2018 employment estimate by zone. The adjusted employment estimates by municipality were then generally aligned to the control total of 871,455 discussed earlier in this report. These aligned 2018 employment estimates are shown in the table below.

Municipality	Final employment (2018)
City of Airdrie	17,362
City of Calgary	780,512
City of Chestermere	3,460
Town of Cochrane	9,616
Town of High River	5,961
Foothills County	12,753
Rocky View County	24,224
Town of Okotoks	9,775
Town of Strathmore	5,716
Tsuu T'ina Nation 145	453
Wheatland County	1,622
Total	871,455

MAJOR NON-RESIDENTIAL GROWTH ASSUMPTIONS

In this analysis, non-residential growth was distributed to employment areas across the Calgary Region. These employment areas consist of intensification of existing employment centres and future areas based on plans.

Employment Areas within the City of Calgary:

- ▶ *City of Calgary Airport:* The City of Calgary International Airport is considered a major employment area across all scenarios within this analysis. This includes passenger and commercial activity at the terminal, industrial aviation activity around the airport, and other business and industrial activity to the north and south of the existing airport.
- ▶ *Downtown Core and Peripheral Area:* The Calgary Downtown Core is the centre of business activity in Calgary. This area is bounded by 11 street on the west, 4th ave SW on the north, McLeod Trail on the east and 9th ave SW on the south.. The Calgary Downtown Periphery includes the area north and east of the Calgary Downtown Core to the river.
- ▶ *Post-Secondary:* Post-secondary institutions within the Calgary Region have strategic importance and are projected to continue to be major employment areas. Employment has been added to the major post-secondary institutions to keep up with the post-secondary aged population growth.
- ▶ *K-12 Education:* The forecast assumes new K-9 and 10-12 school sites throughout the City of Calgary and Region. These school sites are a proxy for potential school locations based on plans and higher levels of student population. Education employment has been added to the schools to keep up with the school aged population growth.
- ▶ *Hospitals:* The analysis includes assumptions around continued employment at hospitals across the Region. There has been high density residential and commercial development assumed at the South Health Campus site. It also assumes a new hospital site located north of Stoney Trail and East of Centre Street.
- ▶ *Industrial Areas:* Several industrial areas within the City of Calgary are expected to grow and continue to grow including: Nose Creek, Stoney Industrial, Aurora Business Park, and the existing southeast, southwest and northeast industrial areas.
- ▶ *Transit Oriented Development:* There has been residential and non-residential growth projected along the Green, Red and Blue Line stations of the City of Calgary LRT. The Green Line stations that have non-residential development include: 26 Avenue SE, Highfield, South Hill, Quarry Park, Douglas Glen, Shephard, Auburn Bay/Mahaogany, Hospital, Seton. The Red Line stations that have included non-residential intensification include: Heritage, Brentwood, University, SunnySide, Anderson and Chinook. The Blue Line stations that include intensification include: Westbrook.
- ▶ *Commercial Development:* Commercial development has been projected within growth neighbourhoods and existing commercial developments to support the local population.

Employment Areas in the rest of the Calgary Region:

- ▶ *Industrial Development* There have been several developments in the Calgary Region that have been considered to have major business and industrial

development. This includes: Conrich/Omni, West Highway 1, Highway 2A (Okotoks/High River), Balzac and within City of Airdrie.

- ▶ *Commercial Development:* In the Calgary Region, commercial development has been projected within all municipalities to support the local population. In addition, other larger commercial developments include Balzac, Omni, and potential for highway commercial along key highway corridors in the Region.

Household Projections Methodology

This section provides information on the methodology and assumptions used in generating the household and dwelling unit projections. Housing need is based on how the population changes over the years.

HOUSEHOLD FORMATION

This analysis includes a projection of the total households by type over the forecast period. The model uses headship rates¹², defined as the likelihood that a person will head a household and live in a specific dwelling type, to project housing requirements over the forecast period. The methodology that the model uses is as follows:

- ▶ Apply headship rates to the change in permanent population by age cohort and gender each year to determine the change in number of people who are heads of a household.
- ▶ Projected household types include:
 - ▶ Lone parent with children
 - ▶ Couple with children
 - ▶ Couple without children
 - ▶ Multi-Census family
 - ▶ One person household
 - ▶ Two persons or more household

DWELLING UNITS

This analysis includes a projection of the total dwelling units by type over the forecast period. The change in the number of dwelling units by type that the permanent population demands is calculated by the model by using the number of households created by household type and applying a dwelling unit profile¹³ to distribute them among the different dwelling types. The model includes a projection of the following dwelling unit types:

- ▶ Single Detached
- ▶ Semi-Detached
- ▶ Row House
- ▶ Apartment or flat in a duplex
- ▶ Other Single Attached
- ▶ Apartment less than 5 stories

¹² Headship rates used for this analysis have been based on Calgary Region 2016 Federal Census data from Statistics Canada.

¹³ Dwelling unit profiles used for this analysis have been based on Calgary Region 2016 Federal Census data from Statistics Canada, Calgary Municipal Development Plan, other regional planning documents and discussion with the client team.

- ▶ Apartment 5+ stories
- ▶ Movable dwelling



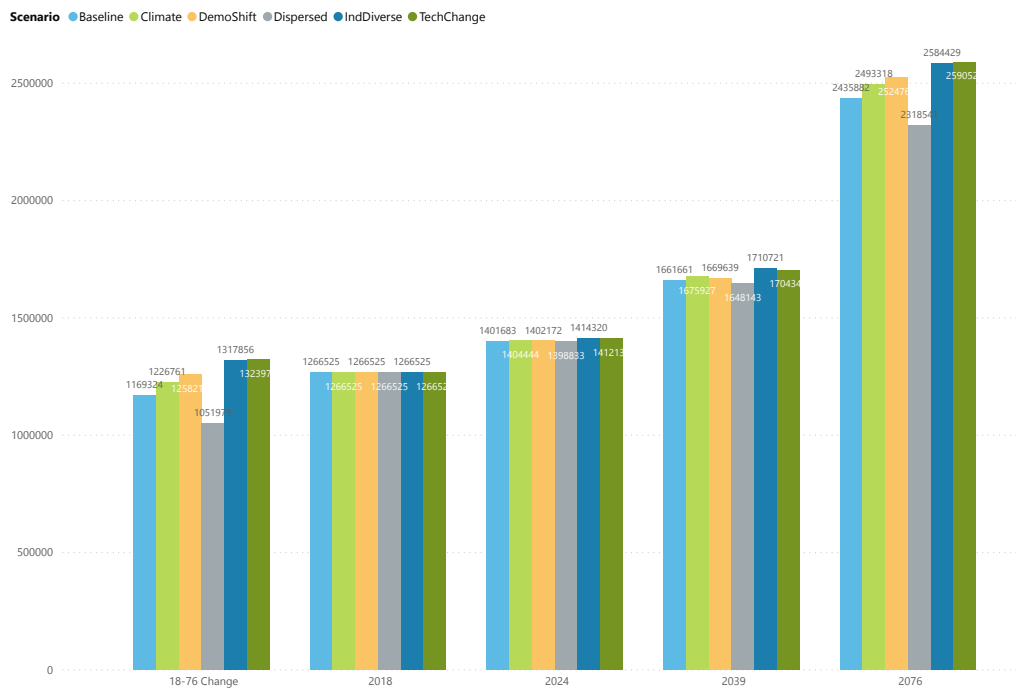
Projection Results

The following section provides the projection results for each data item. The results are presented by data item, including the results for each of the 6 scenarios.

TOTAL POPULATION¹⁴

In the Baseline Scenario, the total population within the City of Calgary is projected to increase from 1,266,525 in 2018 to 2,435,882 in 2076. This represents an average annual growth rate of 1.1%. The alternate scenarios are described below:

- ▶ In the Dispersed Scenario, the population is projected to increase from 1,266,525 in 2018 to 2,318,541 by 2076. This represents an average annual growth rate of 1.0% over the period 2018 to 2076.
- ▶ In the Baseline + Demographic Shift Scenario, the population is projected to increase from 1,266,525 in 2018 to 2,524,768 by 2076. This represents an average annual growth rate of 1.2% over the period 2018 to 2076.
- ▶ In the Industry Diversification Scenario, the population is projected to increase from 1,266,525 in 2018 to 2,584,429 by 2076. This represents an average annual growth rate of 1.2% over the period 2018 to 2076.
- ▶ In the Technological Change Scenario, the population is projected to increase from 1,266,525 in 2018 to 2,590,522 by 2076. This represents an average annual growth rate of 1.2% over the period 2018 to 2076.
- ▶ In the Climate Change Scenario, the population is projected to increase from 1,266,525 in 2018 to 2,493,318 by 2076. This represents an average annual growth rate of 1.2% over the period 2018 to 2076.

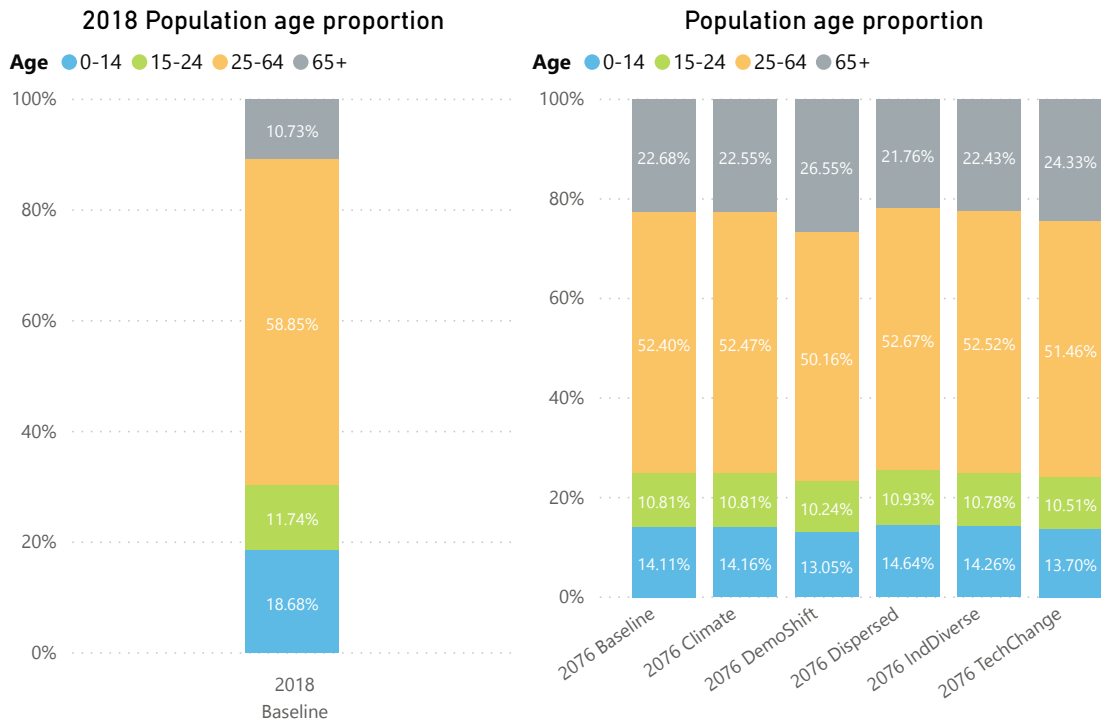


¹⁴ Population totals include institutional population.

POPULATION BY AGE

In 2018 the population within the City of Calgary is approximately 19% children (0-14 years of age), 12% youth (15-24 years of age), 59% adults (25-64 years of age) and 11% seniors (65+).

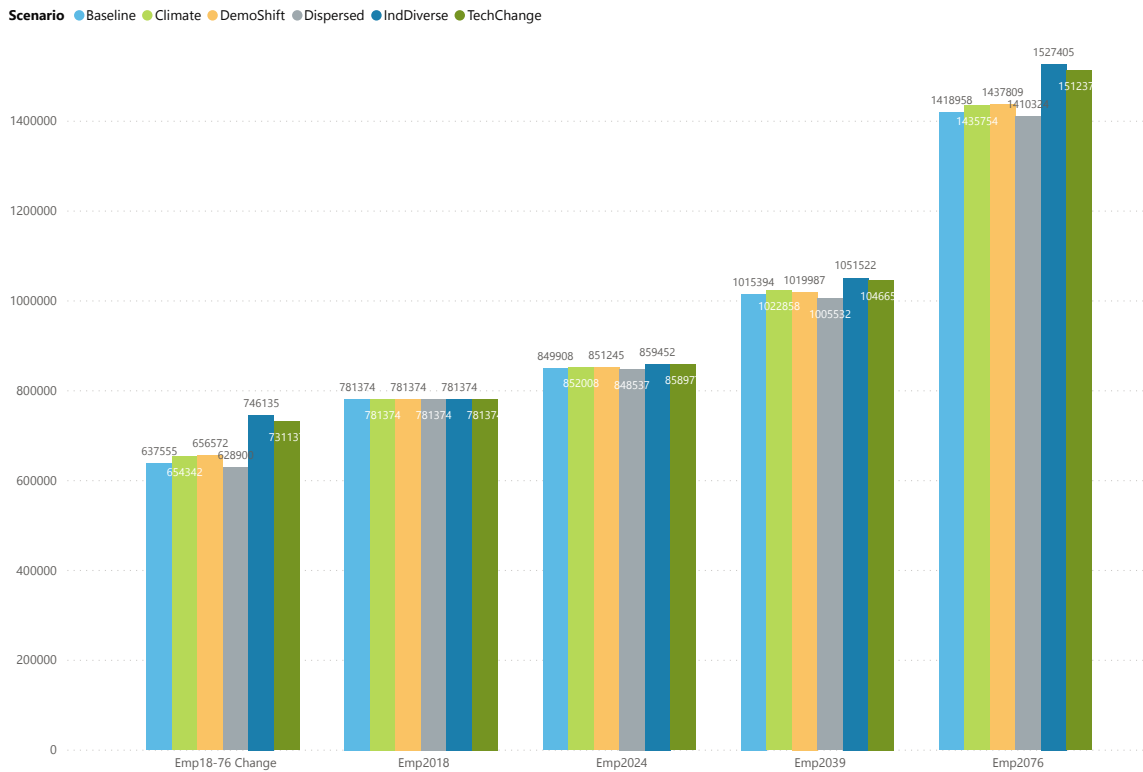
- ▶ In the Baseline Scenario by 2076, the age profile shifts to a greater proportion of seniors (23%). Children are 14% of the population, youth are 11% and adults are 52%.
- ▶ In the Dispersed Scenario by 2076, the age profile shifts to a greater proportion of seniors (22%). Children are 15% of the population, youth are 11% and adults are 53%.
- ▶ In the Baseline+Demographic Shift Scenario by 2076, the age profile also shifts to a greater proportion of seniors (27%). Children are 13% of the population, youth are 10% and adults are 50%.
- ▶ In the Industry Diversification Scenario by 2076, the age profile also shifts to a greater proportion of seniors (22%). Children are 14% of the population, youth are 11% and adults are 53%.
- ▶ In the Technological Change Scenario by 2076, the age profile also shifts to a greater proportion of seniors (24%). Children are 14% of the population, youth are 11% and adults are 52%.
- ▶ In the Climate Change Scenario by 2076, the age profile also shifts to a greater proportion of seniors (23%). Children are 14% of the population, youth are 11% and adults are 52%.



TOTAL EMPLOYMENT

In the Baseline Scenario, the employment for the City of Calgary is projected to increase from 781,374 in 2018 to 1,418,958 by 2076. This represents an average annual growth rate of 1.0% over the period 2018 to 2076. The alternate scenarios are described below:

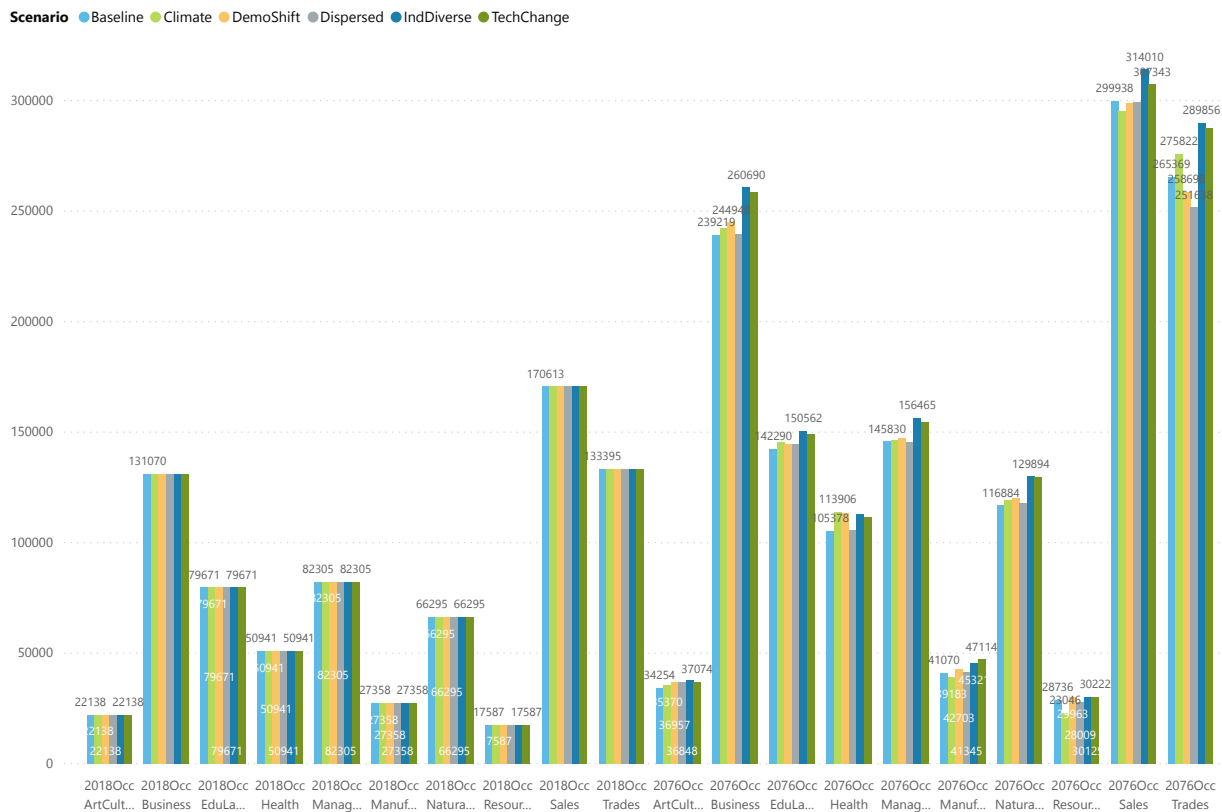
- ▶ In the Dispersed Scenario, the employment is projected to increase from 781,374 in 2018 to 1,410,324 by 2076. This represents an average annual growth rate of 1.0% over the period 2018 to 2076.
- ▶ In the Baseline + Demographic Shift Scenario, the employment is projected to increase from 781,374 in 2018 to 1,437,809 by 2076. This represents an average annual growth rate of 1.1% over the period 2018 to 2076.
- ▶ In the Industry Diversification Scenario, the employment is projected to increase from 781,374 in 2018 to 1,527,405 by 2076. This represents an average annual growth rate of 1.2% over the period 2018 to 2076.
- ▶ In the Technological Change Scenario, the employment is projected to increase from 781,374 in 2018 to 1,512,373 by 2076. This represents an average annual growth rate of 1.1% over the period 2018 to 2076.
- ▶ In the Climate Change Scenario, the employment is projected to increase from 781,374 in 2018 to 1,435,754 by 2076. This represents an average annual growth rate of 1.1% over the period 2018 to 2076.



OCCUPATION

In 2018 the labour force within the City of Calgary is comprised of the following occupation profile: 22% Sales, 17% Trades, 17% Business, 11% Management, 10% Ed/Law/Social, 8.5% Natural Sciences, 6.5% Health, 3.5% Manufacturing, 2.8% Arts, Culture and Recreation and 2.3% Resources and Agriculture.

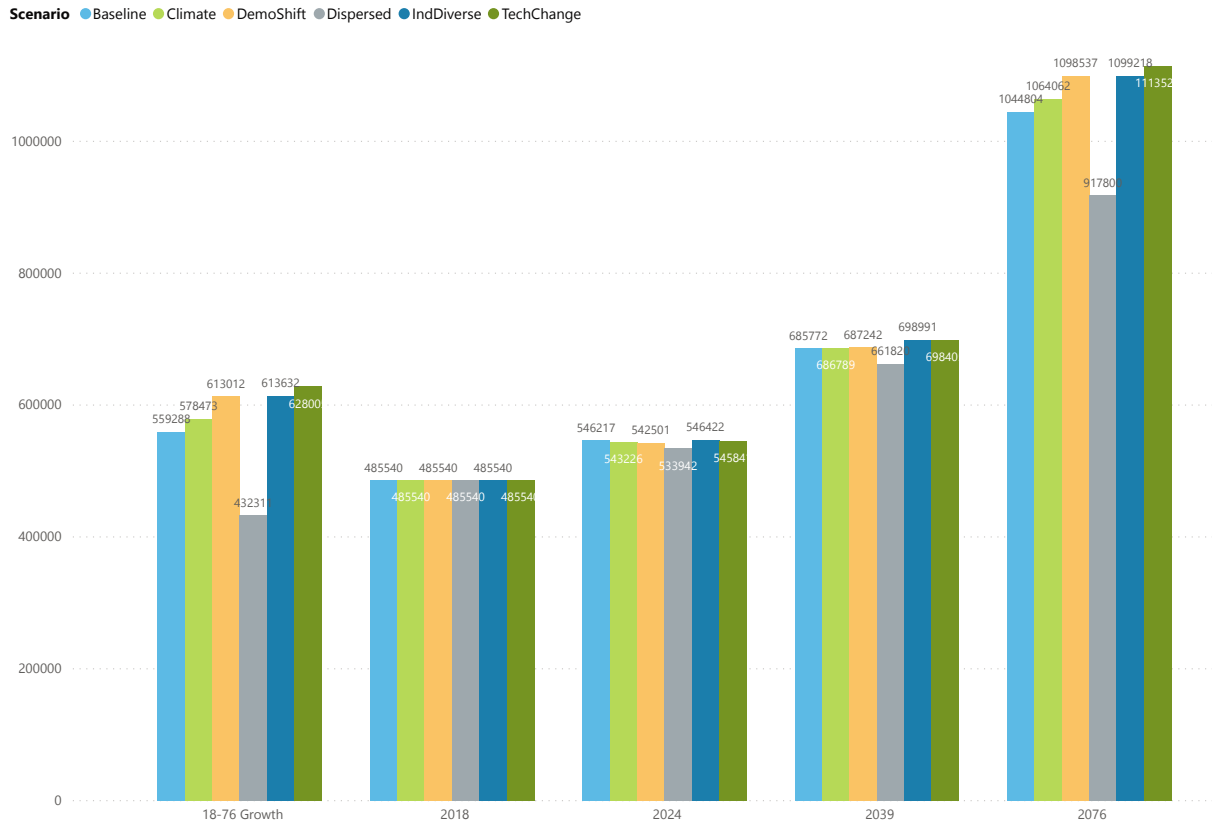
- ▶ In the Baseline Scenario by 2076, the most notable changes in the occupation profile: Health increases to 7.4%, Trades increases to 18.7%, Resources & Ag decreases to 2.0%.
- ▶ In the Dispersed Scenario by 2076, the most notable changes in the occupation profile: Health increases to 7.4%, Trades increases to 18.7%, Resources & Ag decreases to 2.0%.
- ▶ In the Baseline + Demographic Shift Scenario by 2076, the most notable changes in the occupation profile: Health increases to 8%, Trades increases to 18.2%, Resources & Ag decreases to 2.1%.
- ▶ In the Industry Diversification Scenario by 2076, the most notable changes in the occupation profile: Business increases to 18.4%, Health increases to 8%, Natural Sciences increases to 9.2%. Resources & Ag decreases to 2.1%.
- ▶ In the Technological Change Scenario by 2076, the most notable changes in the occupation profile: Business increases to 18.2%, Health increases to 7.9%, Management increases to 10.9%.
- ▶ In the Climate Change Scenario by 2076, the most notable changes in the occupation profile: Health increases to 8%, Resources & Agriculture declines to 1.6%.



TOTAL HOUSEHOLDS

In the Baseline Scenario, the total number of households for the City of Calgary is projected to increase from 485,540 to 1,044,804 by 2076. This represents 559,264 additional households, and an annual average growth rate of 1.3%.

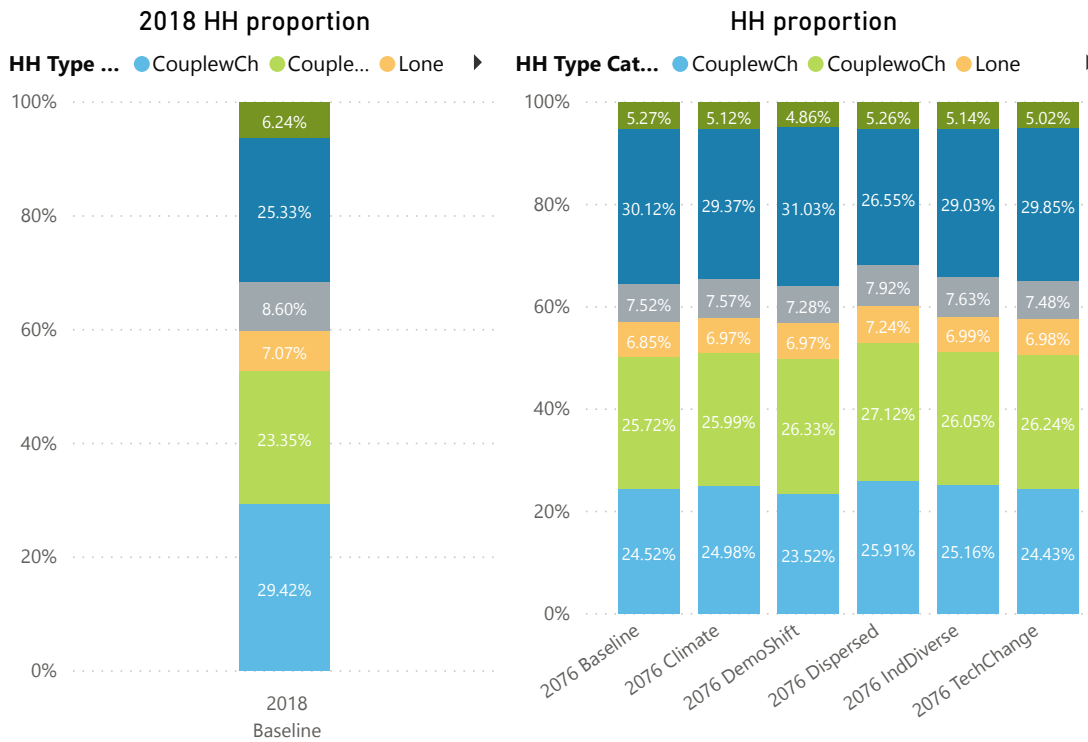
- ▶ In the Dispersed Scenario, the number of households is projected to increase from 485,540 in 2018 to 917,800 by 2076. This represents an average annual growth rate of 1.1% over the period 2018 to 2076.
- ▶ In the Baseline + Demographic Shift Scenario, the number of households is projected to increase from 485,540 in 2018 to 1,098,537 by 2076. This represents an average annual growth rate of 1.4% over the period 2018 to 2076.
- ▶ In the Industry Diversification Scenario, the number of households is projected to increase from 485,540 in 2018 to 1,099,218 by 2076. This represents an average annual growth rate of 1.4% over the period 2018 to 2076.
- ▶ In the Technological Change Scenario, the number of households is projected to increase from 485,540 in 2018 to 1,113,521 by 2076. This represents an average annual growth rate of 1.4% over the period 2018 to 2076.
- ▶ In the Climate Change Scenario, the number of households is projected to increase from 485,540 in 2018 to 1,064,062 by 2076. This represents an average annual growth rate of 1.4% over the period 2018 to 2076.



HOUSEHOLDS BY TYPE

In 2018 the total number of households within the City of Calgary is 485,540. These households comprise of: Couple with children (29.4%), One Person households (25.3%), Couple without children (23.4%), Multi-Census families (8.6%), Lone-parent (7.1%), and Two or more person households (6.2%).

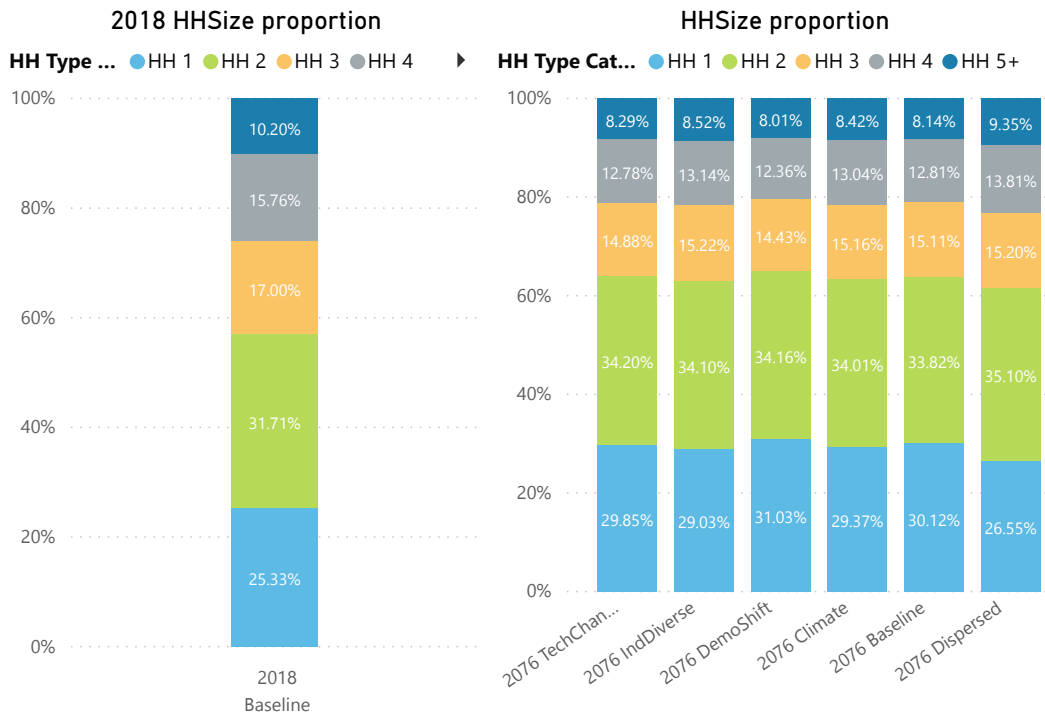
- ▶ In the Baseline Scenario by 2076, household profile is projected to be: Couple with children (24.5%), One Person households (30.1%), Couple without children (25.7%), Multi-Census families (7.5%), Lone-parent (6.8%), and Two or more person households (5.3%).
- ▶ In the Dispersed Scenario by 2076, household profile is projected to be: Couple with children (25.9%), One Person households (26.6%), Couple without children (27.1%), Multi-Census families (7.9%), Lone-parent (7.2%), and Two or more person households (5.3%).
- ▶ In the Baseline + Demographic Shift Scenario by 2076, household profile is projected to be: Couple with children (23.5%), One Person households (31%), Couple without children (26.33%), Multi-Census families (7.3%), Lone-parent (7.0%), and Two or more person households (4.9%).
- ▶ In the Technological Change Scenario by 2076, household profile is projected to be: Couple with children (24.4%), One Person households (29.9%), Couple without children (26.2%), Multi-Census families (7.5%), Lone-parent (7.0%), and Two or more person households (5.0%).
- ▶ In the Climate Change Scenario by 2076, household profile is projected to be: Couple with children (24.9%), One Person households (29.4%), Couple without children (26%), Multi-Census families (7.6%), Lone-parent (7.0%), and Two or more person households (5.1%).



HOUSEHOLDS BY SIZE

In 2018 the average household size in the City of Calgary is approximately 2.61 people per household. In the Baseline Scenario by 2076, it is estimated the average household size will decrease to 2.33 people per household. The one and two person households are increasing from 57% of total households in 2018 to 64% of total households in 2076.

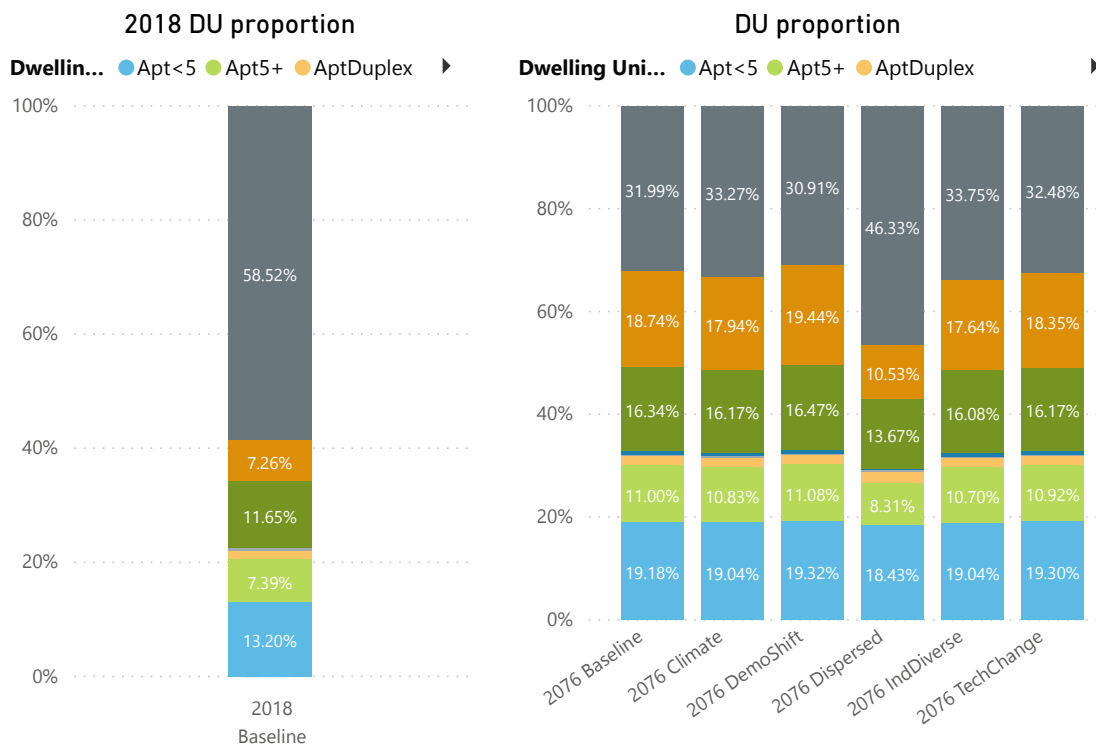
- ▶ In the Dispersed Scenario by 2076, the average household size is projected to decrease to 2.53 people per household. The one and two person households are increasing in 2076 to 62% of total households in 2076.
- ▶ In the Baseline + Demographic Shift Scenario by 2076, the average household size is projected to decrease to 2.30 people per household. The one and two person households are increasing in 2076 to 65% of total households in 2076.
- ▶ In the Technological Change Scenario by 2076, the average household size is projected to decrease to 2.33 people per household. The one and two person households are increasing in 2076 to 64% of total households in 2076.
- ▶ In the Climate Change Scenario by 2076, the average household size is projected to decrease to 2.34 people per household. The one and two person households are increasing in 2076 to 63% of total households in 2076.



DWELLING UNITS

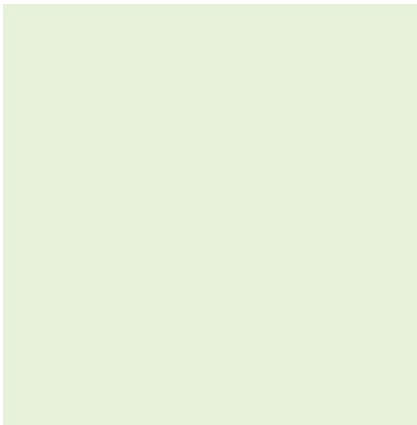
In 2018 the total number of dwelling units in the City of Calgary is 485,562. In the Baseline Scenario, the total number of dwelling units is projected to increase to 1,044,819. In 2018, the dwelling unit mix is comprised of: Single Detached (58.5%), Semi-Detached (7.3%), Row (11.7%), Apartment or flat in a duplex (1.5%), Apartment less than 5 stories (13.2%), Apartment more than 5 stories (7.4%), and Movable (0.5%)

- ▶ In the Baseline Scenario by 2076, the dwelling unit mix is comprised of: Single Detached (32%), Semi-Detached (18.7%), Row (16.3%), Apartment or flat in a duplex (1.7%), Apartment less than 5 stories (19.2%), Apartment more than 5 stories (11%), and Movable (0.2%)
- ▶ In the Dispersed Scenario by 2076, the dwelling unit mix is comprised of: Single Detached (46.3%), Semi-Detached (10.5%), Row (13.7%), Apartment or flat in a duplex (2.2%), Apartment less than 5 stories (18.4%), Apartment more than 5 stories (8.3%), and Movable (0.2%)
- ▶ In the Baseline + Demographic Shift Scenario by 2076, the dwelling unit mix is comprised of: Single Detached (30.9%), Semi-Detached (19.4%), Row (16.5%), Apartment or flat in a duplex (1.7%), Apartment less than 5 stories (19.3%), Apartment more than 5 stories (11%), and Movable (%)
- ▶ In the Technological Change Scenario by 2076, the dwelling unit mix is comprised of: Single Detached (32.5%), Semi-Detached (18.4%), Row (16.2%), Apartment or flat in a duplex (1.8%), Apartment less than 5 stories (19.3%), Apartment more than 5 stories (10.9%), and Movable (0.2%)
- ▶ In the Climate Change Scenario by 2076, the dwelling unit mix is comprised of: Single Detached (33.3%), Semi-Detached (17.9%), Row (16.2%), Apartment or flat in a duplex (1.8%), Apartment less than 5 stories (19.0%), Apartment more than 5 stories, (10.8%) and Movable (0.2%)



Appendix A: Alternate Scenarios Working Paper





Next 20 Alternate Scenarios

Scenario Details

DRAFT

WORKING PAPER

March 24, 2020



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Overview

This analysis proposed six unique Calgary-region employment scenarios for consideration through the 2019 to 2076 forecast period. These scenarios include: Baseline, Baseline with Dynamic Demographic Change, Industry Diversification, Technology Advancement, Climate Change, and Development Dispersion. Scenarios differ from each other across six parameters: Economic Diversification, Technological Change, Trade Liberalization, Environmental Stewardship, Social Development, and Development Density. Projected employment impacts specific to the Climate Change and Baseline with Dynamic Demographic Change scenarios have also been developed.

In some cases, fertility and mortality assumptions also differ across scenarios. These differences are outlined in the Fertility and Mortality Assumptions section of this report.

Each scenario description is preceded with a diagram illustrating the assumed magnitude of each forecast parameter, as well as a brief synopsis of any other assumptions that went into the development of the scenario. For more detail on the parameters used in this analysis, see Appendix B.

Also contained in each scenario description section is a brief summary as to how each 2-digit NAICS industry group is expected to perform in that scenario. Where applicable, examples of notable sub-industries in each industry group are also discussed.

The table below displays forecasts of average annual employment growth (2019 to 2076) for each 2-digit NAICS (North American Industry Classification System) group, in each scenario. For more detail on this industry classification system, see Appendix A.

Scenario Employment Forecasts by 2-Digit NAICS

NAICS	AVERAGE ANNUAL EMPLOYMENT GROWTH (2019-76)					
	BL	BL + DEMO	IND. DIV.	TECH	CLIMATE	DISPERSION
Agriculture, Forestry, Fishing and Hunting	0.0%	-0.0%	0.1%	0.1%	-0.4%	-0.3%
Mining and Oil and Gas Extraction	1.1%	1.1%	1.1%	1.3%	0.6%	1.1%
Utilities	1.1%	1.1%	1.6%	1.6%	1.0%	1.1%
Construction	1.4%	1.5%	1.5%	1.5%	1.6%	1.5%
Manufacturing	0.9%	1.0%	1.4%	1.4%	0.8%	0.9%
Wholesale Trade	1.0%	1.0%	1.2%	1.2%	1.0%	1.0%
Retail Trade	1.1%	1.1%	1.1%	1.1%	1.0%	1.1%
Transportation and Warehousing	1.5%	1.5%	1.7%	1.5%	1.4%	1.6%
Information and Cultural Industries	0.8%	0.8%	1.1%	1.0%	0.8%	0.8%
Finance and Insurance	1.1%	1.2%	1.3%	1.2%	0.9%	1.1%
Real Estate and Rental and Leasing	1.0%	1.1%	1.1%	1.1%	0.9%	1.0%
Professional, Scientific and Technical Services	1.2%	1.2%	1.4%	1.4%	1.4%	1.2%
Management of Companies and Enterprises	1.2%	1.2%	1.4%	1.4%	1.2%	1.2%
Administrative and Support, Waste Management and Remediation Services	1.3%	1.3%	1.3%	1.3%	1.4%	1.3%
Educational Services	0.8%	0.4%	0.8%	0.8%	0.8%	0.8%
Health Care and Social Assistance	1.4%	1.5%	1.5%	1.4%	1.4%	1.4%
Arts, Entertainment and Recreation	0.8%	0.8%	0.9%	0.9%	0.8%	0.8%
Accommodation and Food Services	0.7%	0.7%	0.8%	0.7%	0.3%	0.8%
Other Services (except Public Administration)	1.4%	1.4%	1.5%	1.5%	1.5%	1.4%
Public Administration	0.8%	0.9%	0.8%	0.8%	1.1%	1.0%
Total	1.2%	1.2%	1.3%	1.3%	1.1%	1.2%

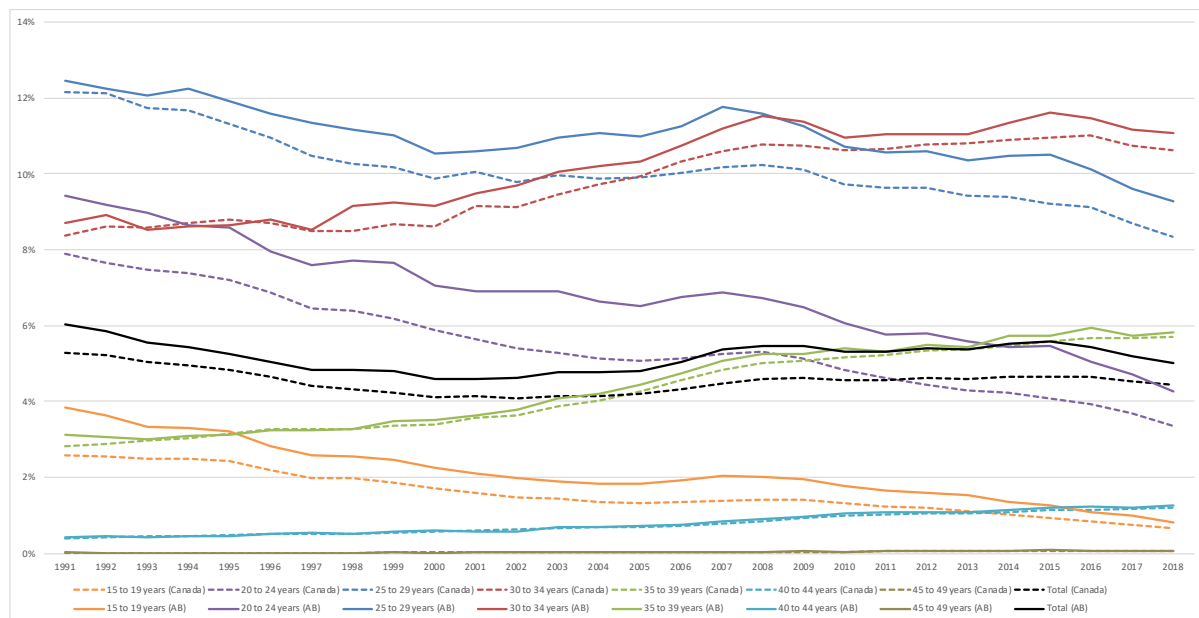
Fertility and Mortality Assumptions

The rate at which births and deaths occur across age groups are critical assumptions in a population forecast. Along with migration, fertility and mortality rates can significantly influence long-term demographic trends such as the rate of population growth and the age composition of the population. This section of the report provides an overview of fertility and mortality trends, and how these trends are used in each forecast scenario of this analysis.

Over the past few decades, the overall birth rate (as measured by the number of live births as a proportion of the female population aged 15 to 49) has declined from 5.3% in 1991 to 4.4% in 2018 in Canada, and from 6.0% to 5.0% in Alberta over the same period.¹⁵ However, age-specific fertility rates have exhibited disparate trends over time. At both the national and provincial levels, fertility rates across age groups below 30 years have dropped precipitously, while rates in the relatively older age groups have increased. In each age category, fertility rates remain greater in Alberta compared to the national average. The chart below shows how age-specific fertility rates have changed in Canada (broken lines) and Alberta (solid lines) from 1991 to 2018.

For more detail on historical and projected fertility and mortality rates used in each scenario, see Appendix C.

Historical Age-Specific Fertility Rates, Canada and Alberta, 1991 to 2018



¹⁵ Statistics Canada, Table 17-10-0008-01, Estimates of the components of demographic growth, annual. <https://www150.statcan.gc.ca/t1/tbl/en/tvaction?pid=171000801>

In Canada, mortality rates for both males and females declined across all age groups between 1991 and 2018. The trend of declining mortality rates was similar in Alberta, with the exception of females aged 20 to 29 where mortality rates increased slightly (though rates remain very low at around 0.06% annually, and the increase was largely attributable to a bump in 2018 rates). Generally, mortality rates in Alberta are similar to that of the national average. Charts displaying historical provincial and national mortality rates specific to age and gender can be found in Appendix C.

Comparable historical data regarding age-specific fertility rates in the Calgary region are unavailable. However, estimated rates for Calgary's census division (CD 6) are available for recent years.¹⁶ Fertility rates among Calgary's 15 to 29 age groups are lower relative to the provincial average, and higher for age groups 30 and above. This is unsurprising given Calgary's status as an urban centre, where fertility rates tend to skew relatively older (and lower overall, in general). The age-specific fertility rates used in the base year (2018) of this analysis are shown in the table below in the column labelled 'CD 6'. Also shown is the estimated total fertility rate (TFR) for each geography, which represents the average number of children a female is expected to have in her lifetime (equal to the sum of all single-year age-specific fertility rates). Note that the rates shown represent a five-year average (2014 to 2018), which are used to account for potential year-to-year volatility in the data.

Assumed Base Year (2018) Age-Specific Fertility Rates, Census Division 6 (Calgary), Alberta and Canada

AGE GROUP	CD 6 (CALGARY)	ALBERTA	CANADA
15 to 19	0.6%	0.8%	0.7%
20 to 24	3.1%	4.3%	3.4%
25 to 29	8.3%	9.3%	8.3%
30 to 34	11.8%	11.1%	10.6%
35 to 39	6.6%	5.8%	5.7%
40 to 44	1.4%	1.3%	1.2%
45 to 49	0.1%	0.1%	0.1%
Total (TFR)	1.5898	1.6166	1.4988

Comparable historical data regarding age-specific mortality rates in the Calgary region is similarly unavailable, but is shown in the table below for Calgary's census division (CD 6) for the base year of the analysis. Again, the base year rates represent a five-year average (2014 to 2018). Generally, age and gender-specific mortality rates in the Calgary region closely follow the provincial and national averages.

¹⁶ Alberta Treasury Board and Finance, Fertility Rates - Alberta and Census Divisions, September 30, 2019. <https://open.alberta.ca/dataset/fertility-rates-alberta-and-census-divisions>

Base Year (2018) Age and Gender-Specific Mortality Rates, Census Division 6 (Calgary), Alberta and Canada

AGE GROUP	MALE			FEMALE		
	CD 6 (CALGARY)	ALBERTA	CANADA	CD 6 (CALGARY)	ALBERTA	CANADA
<1	0.50%	0.51%	0.48%	0.47%	0.46%	0.42%
1 to 4	0.02%	0.02%	0.02%	0.02%	0.02%	0.02%
5 to 9	0.01%	0.01%	0.01%	0.01%	0.01%	0.01%
10 to 14	0.01%	0.01%	0.01%	0.01%	0.01%	0.01%
15 to 19	0.06%	0.07%	0.04%	0.03%	0.03%	0.02%
20 to 24	0.10%	0.10%	0.07%	0.04%	0.05%	0.03%
25 to 29	0.11%	0.12%	0.09%	0.05%	0.05%	0.04%
30 to 34	0.12%	0.13%	0.10%	0.05%	0.06%	0.05%
35 to 39	0.13%	0.14%	0.12%	0.07%	0.07%	0.06%
40 to 44	0.17%	0.17%	0.15%	0.11%	0.11%	0.09%
45 to 49	0.25%	0.26%	0.23%	0.16%	0.15%	0.15%
50 to 54	0.37%	0.38%	0.36%	0.27%	0.26%	0.23%
55 to 59	0.58%	0.59%	0.57%	0.38%	0.38%	0.37%
60 to 64	0.91%	0.89%	0.90%	0.56%	0.55%	0.58%
65 to 69	1.38%	1.37%	1.37%	0.92%	0.90%	0.88%
70 to 74	2.25%	2.22%	2.16%	1.48%	1.42%	1.43%
75 to 79	3.68%	3.64%	3.54%	2.40%	2.39%	2.37%
80 to 84	6.37%	6.26%	6.17%	4.23%	4.17%	4.28%
85 and over	14.10%	14.50%	14.20%	12.04%	11.95%	11.94%

FERTILITY ASSUMPTIONS

It is evident that since 1991, Alberta's age-specific fertility rates have declined in the 15 to 29 age groups with an offsetting increase among females 30 and over. Further, that Alberta's aggregate birth rate has declined significantly in recent years.

Even with a discernible pattern observed in the historical data, it is unclear as to how fertility trends will evolve in the Calgary region in the years ahead. It is unlikely that the marked shift in a greater number of females choosing to have children in their 30s (rather than their teens or 20s) will reverse. However, it may be true that fertility rates among females under 30 have reached a floor, and could decline only minimally in the future. Similarly, fertility rates among females 30 and over may be resistant to further increase. This assumption that age-specific

fertility rates will remain unchanged from base year levels is used in the Baseline scenario, as well as the Development Dispersion scenario (for comparison purposes).

Another possibility is that the aggregate birth rate and age-specific fertility rates in the Calgary region follow a trajectory similar to that which is observed in the historical data. That is, further fertility rate reductions are exhibited by females under 30, with corresponding increases for the 30 and over age categories. As well, that the aggregate birth rate will continue to decline in line with the historical trend. This assumption that the future will mirror the past is used in the Baseline with Demographic Change scenario.

Yet another possibility is that fertility rates among females under 30 are nearing their floor and could continue to decline, but at a fraction of the magnitude observed during the 1991 to 2018 period. Similarly, that rates associated with the 30 and over age categories will continue to increase, but at a slower pace relative to historical trends. This assumption is used for the Industry Diversification and Technology Advancement scenarios. It is also noted that, unlike the Baseline with Demographic Change scenario, the constraint of a lower aggregate birth rate is not imposed in these scenarios.

The fertility assumptions applied in the Climate Change scenario are unique. In this scenario, fertility rates associated with the under 30 age groups are assumed to decline at a fraction of the observed historical pace. However, health, environmental, social and economic factors along with a prevailing mood of pessimism are assumed to contribute to stagnation in fertility rates among females in the over 30 age categories.

MORTALITY ASSUMPTIONS

Similarly, mortality rates in Alberta exhibited a general trend of decline across age groups during the 1991 to 2018 period, but future developments will not necessarily be identical.

The trend of declining mortality rates could stall at current levels due to floor rates being reached, with only minimal progress achieved in future years. This assumption implies that future advances in medical technology are limited, and/or factors such as poverty, disease or social preference offset any improvements in life expectancy. The assumption that age-specific mortality rates are static at current levels is used in the Baseline scenario, as well as the Development Dispersion scenario (for comparison purposes).

There is also the possibility that age-specific mortality continues to decline at rates similar to that of the 1991 to 2018 period. This assumption would likely require technology to advance at a faster pace relative to current levels, but is not an excessive target given the number of health-related innovations on the horizon. This assumption is used in the Industry Diversification scenario.

With substantial medical and technological advances, mortality rates may decline at pace even faster than observed during the 1991 to 2018 period. Given the exponential nature of

technological growth, this assumption is not entirely implausible. This assumption is used in the Baseline with Demographic Change and Technology Advancement scenarios.

In the Climate Change scenario, it is assumed that negative health-related impacts are a result of increased weather severity and environmental degradation. Such impacts could include a rise in respiratory ailments, heat concerns, and allergens.¹⁷ In the Climate Change scenario, it is assumed that the reductions in age-specific mortality realized during the 1991 to 2018 period are undone.

¹⁷ Martinich, J and Crimmins A. Climate damages and adaptation potential across diverse sectors of the United States. Nature Climate Change, April 2019.

Scenario-Specific Fertility and Mortality Forecast Assumptions

SCENARIO	FERTILITY	MORTALITY
Baseline	Age-specific rates are unchanged from the base year (2018).	Age-specific rates are unchanged from the base year (2018).
Baseline w/ Demographic Change	Age-specific fertility rates continue to change at rates similar to historical trends from 1991 to 2018; and the aggregate birth rate declines (though at a slower pace relative to historical change).	Age-specific mortality rates continue to decline at a faster average annual pace relative to the 1991 to 2018 period.
Industry Diversification	Age-specific fertility rates continue to change, though at a fraction of the rates observed from 1991 to 2018.	Age-specific mortality rates continue to decline at an average annual pace similar to historical trends from 1991 to 2018.
Technology Advancement	Age-specific fertility rates continue to change, though at a fraction of the rates observed from 1991 to 2018.	Age-specific mortality rates continue to decline at a faster average annual pace relative to the 1991 to 2018 period.
Climate Change	Fertility rates continue to decline across females in the 15 to 29 age groups according to historical trends, but at a fraction of the magnitude. Fertility rates across females in the 30+ age groups are unchanged from the base year (2018).	Age-specific mortality rates increase through the forecast period, generally reversing the declines observed during the 1991 to 2018 period.
Development Dispersion	Age-specific rates are unchanged from the base year (2018).	Age-specific rates are unchanged from the base year (2018).

Charts displaying historical and projected age-specific fertility and mortality rates can be found in Appendix C.

Scenario I: Baseline



DESCRIPTION

The Baseline scenario generally assumes that the Calgary region economy will continue its reliance on the energy sector through the forecast period, with only minimal industry diversification achieved in the regional economy. As well, this scenario assumes only slight gains realized across economic dimensions including technology advancement/adoption, liberalization of domestic and global trade conditions, environmental sustainability efforts, social progress / income equality, and development density.

Overall employment growth in the Baseline scenario is projected at an average annual rate of 1.2% from 2019 to 2076.

GDP PROJECTIONS

In the Baseline Scenario, real GDP (as measured in chained 2012 dollars) in the Calgary Region is projected to increase from \$140 billion in 2018 to about \$273 billion by 2076 – an average annual growth rate of approximately 1.2%.

As has been observed in recent trends, this scenario projects that economic growth in the Calgary Region continues to be led by the oil and gas industry, with inter-related industries such as construction and transportation and warehousing experiencing similarly high rates of output growth through the forecast period.

Baseline Scenario GDP¹⁸ (Chained 2012\$)

NAICS	2018	2076	AAG
Agriculture, Forestry, Fishing and Hunting	413	421	0.0%
Mining and Oil and Gas Extraction	39,921	74,498	1.1%
Utilities	2,199	3,557	0.8%
Construction	8,988	21,794	1.5%
Manufacturing	8,394	14,415	0.9%
Wholesale Trade	5,290	10,086	1.1%
Retail Trade	5,370	10,469	1.2%
Transportation and Warehousing	9,824	28,723	1.9%
Information and Cultural Industries	4,293	6,371	0.7%
Finance and Insurance	5,467	9,114	0.9%
Real Estate and Rental and Leasing	13,489	23,430	1.0%
Professional, Scientific and Technical Services	9,965	19,737	1.2%
Management of Companies and Enterprises	1,278	2,540	1.2%
Administrative and Support, Waste Management and Remediation Services	3,109	6,276	1.2%
Educational Services	4,572	7,217	0.8%
Health Care and Social Assistance	7,952	17,856	1.4%
Arts, Entertainment and Recreation	898	1,141	0.4%
Accommodation and Food Services	2,657	4,414	0.9%
Other Services (except Public Administration)	2,289	5,194	1.4%
Public Administration	3,631	5,783	0.8%
Total	140,000	273,037	1.2%

¹⁸ Measured in millions of chained 2012 dollars

INDUSTRY ASSUMPTIONS

A brief description of the anticipated performance (in terms of job growth) for each 2-digit NAICS through the forecast period is provided below. Where applicable, examples of notable 4-digit NAICS within the industry group are also discussed.

11 AGRICULTURE, FORESTRY, FISHING AND HUNTING

Across all major industry categories in the Calgary region economy, agriculture is projected to record the lowest rate of job growth through the 2019 to 2076 forecast period. As farming continues to trend toward larger-scale, more efficient and capital-intensive operations, employment growth in this industry is expected to remain stagnant through the forecast period.

21 MINING AND OIL AND GAS EXTRACTION

The oil and gas sector is projected to remain an integral part of the Calgary region economy through the forecast period, though growth will continue to be subject to global price and domestic regulatory constraints. Employment in this industry is expected to grow at an average annual rate of 1.1%.

- ▶ **2111 Oil and gas extraction:** This sub-sector is of obvious importance in the Calgary region, representing nearly 70% of employment in the industry group. Advances in technology and trade liberalization both hold the potential to contribute significantly to job growth in this sub-sector, as even the slight gains assumed in this scenario add a meaningful number of new positions through the forecast period. Conversely, heightened environmental stewardship efforts has the effect of subtracting jobs in this sub-sector due to alternative forms of energy becoming more attractive to consumers, along with additional environmental regulations potentially being placed on domestic producers. The respective job growth impacts associated with social progress / income equality and densification were found to be neutral.

22 UTILITIES

While the methods used to generate power may shift during the forecast period, employment in the utilities industry is generally expected to grow at a rate similar to that of regional population trends at an average annual rate of approximately 1.1%.

- ▶ **2211 Electric power generation, transmission and distribution:** This sub-sector includes employment associated with hydro-electric, fossil-fuel, nuclear, and other forms of electric power generation. Employment in this sub-sector represents more than 70% of regional employment in the industry group. Improvements in the dimensions of economic diversification, technology advancement, and environmental stewardship are estimated to contribute to new jobs in the sub-sector. Shifts toward trade liberalization and social progress / income equality also add relatively small numbers of new positions in this sub-sector, respectively.

23 CONSTRUCTION

The majority of sub-sectors in the construction industry group are estimated to benefit substantially from any improvements in trade conditions. Employment impacts related to advances in technology adoption, environmental sustainability efforts, and social equality are generally positive, but relatively small. Overall, construction is projected to record employment growth at an average annual rate of 1.4% - above the all-industry average.

31-33 MANUFACTURING

While traditional and large-scale manufacturing operations in the Calgary region economy could endure some contraction due to international competition, manufacturers focused on local and/or specialized markets exhibit an opportunity for growth. Overall, manufacturing is projected to record employment growth at an average annual rate of 0.9% - slightly below the all-industry average.

- ▶ **3122 Tobacco manufacturing:** The majority of job growth in this sub-sector is related to the expected growth in cannabis product manufacturing in the Calgary region. It is anticipated that moderate, sustained job growth will be realized in this sector once market and regulatory issues have been fully resolved. This manufacturing sub-industry will soon have its own 4-digit NAICS code (3123 Cannabis product manufacturing).

41 WHOLESALE TRADE

The wholesale trade industry group typically follows the performance of the retail trade industry group (see next section), which closely follows consumer demand and population trends. Overall, wholesale is projected to record employment growth at an average annual rate of about 1.0%.

- ▶ **4132 Beverage merchant wholesalers:** As local and specialized food and beverage production in the Calgary region picks up, wholesalers should, in tandem, experience an increase in hiring. This sub-sector also contains sellers of alcoholic beverages, and should enjoy a boost in demand from the growing number of craft breweries in the Calgary area. While beverage wholesalers currently represent just 700 positions in the region (or about 2% of total wholesale employment), average annual job growth is projected at 1.6% through the forecast period - among the highest rate across wholesale sub-sectors.

44-45 RETAIL TRADE

The performance of the retail trade industry group is strongly correlated with population, demographic, and consumer spending and confidence trends. While employment in the Calgary region's retail industry is generally projected to follow that of aggregate population (at an average annual rate of about 1.1%), disparate rates of job growth are anticipated within retail sub-sectors. Spending habits have shifted away from traditional, "brick-and-mortar" retailers, with a growing number of consumers choosing to use online options. It is not anticipated that traditional retail is phased out entirely by the end of the forecast period, but

the prominence of online options will continue to rise. Overall, retail is projected to record employment growth at an average annual rate of about 1.1%.

- ▶ **4541 Electronic shopping and mail-order houses:** This retail sub-sector represented just 0.7% of total retail employment in the Calgary region in 2018 (about 650 jobs), but is expected to record significant growth through the forecast period. Employment related to online retail is projected to increase at an average annual rate of 1.8%. Further, online retail is expected to receive boosts from anticipated improvements in trade conditions, technology adoption, and income equality.
- ▶ **4521 Department stores:** Canadian department stores have suffered due to heightened competition from specialist and online retailers (among other reasons). This trend is expected to continue, with department store employment projected to stagnate at 0.1% average annual growth through the forecast period.

48-49 TRANSPORTATION AND WAREHOUSING

The Calgary region is expected to remain a major transportation hub through the duration of the forecast period. While the advent of driver-less trucking may lead to future job losses in driving occupations, the growth of online retailers such as Amazon should result in strong job growth in the logistics and warehousing sub-sectors. Overall, employment growth in the transportation and warehousing industry is expected to record the highest average annual rates across all major industry groups at approximately 1.5%.

- ▶ **4931 Warehousing and storage:** Firms in this sub-sector should continue to benefit from opportunities related to Calgary's positioning as the primary transportation hub in Alberta. Firms in this sub-sector may also provide logistics services such as labelling, light assembly, price marking, and order entry and fulfillment. The warehousing sub-sector is estimated to benefit significantly from any improvement in trade conditions. The robust job growth observed in this sub-sector since 2001 (from 2,300 jobs in 2001 to an estimated 5,800 in 2018) is expected to continue, with average annual employment growth of 2.1% projected to set the pace for the transportation industry group.

51 INFORMATION AND CULTURAL INDUSTRIES

This industry group contains a variety of industry types, which range from newspapers and periodicals to software, motion pictures, and telecommunications. Given the spectrum of different industry types, projected job growth rates and parameter-related impacts vary throughout the industry group. Overall, Calgary's information and cultural industries are projected to record employment growth at an average annual rate of about 0.8% - among the lowest across major industry groups.

- ▶ **5111 Newspaper, periodical, book and directory publishers:** While innovation is possible in any industry, it seems unlikely that newspapers will exist in their current form by the end of the forecast period covered in this analysis. The transition to online publication has been broadly implemented, but consistent downsizing and consolidation in the industry suggests that the job growth outlook is dim. This forecast projects that employment in Calgary's

newspaper, periodical, book and directory publishing industry will contract at an average annual rate of 3.1% in the Baseline scenario, with the sub-sector representing just 300 jobs by the end of the forecast (compared to 2,100 in 2018).

52 FINANCE AND INSURANCE

Calgary's concentration of corporate head offices and abundance of capital provides its financial sector with an inherent advantage. Access to high quality workers, tax competitiveness, and integration with global markets are also attractive to firms in the financial sector considering Calgary as a place to locate their operations. While the rise in online banking and the reduced need to has led to job losses across some occupations in the financial sector; it is likely that new positions related to information technology and data analysis will offset technology-related losses. Overall, the finance and insurance industry group is projected to record employment growth at an average annual rate of about 1.1%.

- **5223 Activities related to credit intermediation:** This financial sub-sector primarily contains activities related the brokering of mortgages and other loans, as well as cheque cashing and electronic financial payment services. Improvements in trade liberalization and social income equity are expected to contribute meaningfully to job growth in this sub-sector. Further, technological advances in the industry are more likely to lead to new growth opportunities (such as new customers accessing loan services through mobile apps), with automation not a significant concern. This sub-sector is projected to record job growth at an average annual rate of 1.7% through the forecast period.

53 REAL ESTATE AND RENTAL AND LEASING

Calgary's real estate and rental and leasing industry group typically recorded relatively steady employment growth through the 2001 to 2018 period, and this trend is expected to continue through the forecast period. Gains in trade conditions, social income equity, and technology adoption could contribute to future job growth in this sector; but outsized job gains (or losses) are unlikely. While Calgary's real estate market will surely continue to cycle up and down, these market fluctuations tend to have only a slight impact on overall hiring trends in this industry group. Overall, this industry group is projected to record employment growth at an average annual rate of about 1.0%.

54 PROFESSIONAL, SCIENTIFIC AND TECHNICAL SERVICES

This industry group contains a variety of professional services, including legal, accounting, architectural, engineering, computer systems, and other knowledge-based fields. Generally, these firms are dependent on human capital and are resistant to automation. Much of the demand for Calgary's professional, scientific and technical services is driven by the energy sector, which is projected to continue its pace of relatively strong overall growth through the forecast period. Overall, this industry group is projected to record employment growth at an average annual rate of about 1.2%.

- ▶ **5415 Computer systems design and related services:** This knowledge-based sub-sector (which includes services such as website development, software testing, hardware/software integration, and advising on information technology) is projected to record strong job growth through the forecast period, particularly as advanced technology gives rise to innovation and efficiency improvements. Given the ubiquitous nature of computing in business and the rapidly expanding means consumers possess to access information, hiring in this sub-sector will be strained to keep up with the demands of the economy. Average annual employment growth in computer systems design is projected at 1.4% through the forecast period.

55 MANAGEMENT OF COMPANIES AND ENTERPRISES

Firms in this industry group are generally responsible for holding the securities or financial assets of companies. Employment in this industry group is relatively low, with 3,400 positions estimated in the Calgary region as of 2018. Potential employment gains related to trade, technology, and social income equity are positive, but small. Overall, this industry group is projected to record employment growth at an average annual rate of about 1.2%.

56 ADMINISTRATIVE AND SUPPORT, WASTE MANAGEMENT AND REMEDIATION SERVICES

This industry group contains a variety of business-oriented services including employment placement agencies, security, office admin, and waste collection. Overall, this industry group is projected to record employment growth at an average annual rate of about 1.3%.

- ▶ **5615 Travel arrangement and reservation services:** While Calgary could experience a boost to tourism, many of the services that travel agencies provide have already been replaced by internet technology that allows consumers to arrange their own travel. Calgary region employment in this sub-sector has contracted consistently to an estimated 1,300 positions as of 2018 (from 2,000 in 2001). Unless these establishments are able to diversify and offer additional, specialized services not easily found online, further contraction is likely. Employment in this sub-sector is projected to continue its decline at an average annual rate of 1.4%, reaching a low of about 500 positions by 2076.

61 EDUCATIONAL SERVICES

Employment related to post-secondary represented approximately 22,000 jobs in 2018 (or about 40% of Calgary's education industry group). Regardless of economic conditions or local population growth, student enrolment in Calgary's post-secondary institutions has continued to climb (on a full-time equivalent basis) since 2001. Employment associated with Calgary's post-secondary institutions is projected to continue on its path of moderate increase, reaching about 33,000 positions by 2076 (an average annual growth rate of 0.7%).

Conversely, employment related to elementary and secondary schools (NAICS 6111, representing about 30,000 jobs in 2018) is highly correlated to the population (and proportion) of youth in the Calgary region. Assuming that fertility and mortality rates remain static at 2018 levels through the forecast, the population of individuals under 18 years of age is

projected to increase from about 344,000 in 2018 to 576,000 by 2076. However, youth as proportion of the total Calgary region population is expected to decline markedly from about 22.5% in 2018 to 18.7% in 2076. This result suggests that education employment associated with elementary and secondary schools will continue to increase, but will represent a lesser proportion of total employment in the future. Employment in this education sub-sector is projected to reach 47,000 positions by 2076, representing an average annual employment growth rate of 0.8%.

Overall, the education industry group is projected to record employment growth at an average annual rate of about 0.8%.

62 HEALTH CARE AND SOCIAL ASSISTANCE

Driven by rising levels of demand for health services, consistent job growth is projected across each sub-sector within the Calgary region's health care and social assistance industry group. Higher demand for health services will be driven by a higher proportion of seniors in the projected regional population, as well as increased specialization and technology-driven innovation in the industry, broadening consumer demand. Overall, the health and social services industry group is projected to record employment growth at an average annual rate of about 1.4%.

- ▶ **6213 Offices of other health practitioners:** Employment in this health sub-sector, which includes chiropractors, optometrists, mental health professionals, and other types of therapists, has climbed steadily from 2,600 jobs in 2001 to nearly 10,000 estimated as of 2018. As societal preferences continue to shift toward supplemental forms of treatment (particularly mental health), job growth is expected to continue through the forecast period with average annual employment growth projected at 1.5% - the highest rate across all health sub-sectors. Technology advances may also provide new high-skilled occupations, as well as innovations in treatment methods.

71 ARTS, ENTERTAINMENT AND RECREATION

Even if Calgary is successful in attracting a greater number of tourists to the region, employment growth in the arts, entertainment and recreation industry group is likely to remain at moderate levels. Improvements in parameters such as trade conditions, advanced technology adoption, social income equity efforts, and environmental sustainability measures are unlikely to generate any significant spinoff benefits across sub-sectors within this industry group. Overall, this industry group is projected to record employment growth at an average annual rate of about 0.8%.

- ▶ **7132 Gambling industries and 7139; Other amusement and recreation industries:** Possible exceptions to the weak employment growth projected in this industry group are the gambling and other amusement (golf courses, ski facilities, fitness centres) sub-sectors. Together accounting for approximately 13,400 jobs in 2018, another projected 10,000 positions could be added through the forecast period - dependent on the development

potential for new large-scale recreation projects such as golf courses, consumer attitudes towards gambling, and the success Calgary finds in its pursuit of increased tourism.

72 ACCOMMODATION AND FOOD SERVICES

Due in part to its high degree of reliance on Calgary's energy sector, the accommodation and food services industry group (which is primarily composed of restaurants, bars and lodging establishments) is projected for relatively weak employment growth through the forecast period. On a net basis, the Calgary region experienced only minimal employment growth between 2001 and 2018 across its restaurant and hotel sectors. While increased tourism and improvements to trade conditions possess significant job growth potential - particularly for restaurants - the industry group is also susceptible to technology-driven automation. An English study¹⁹ (2017) found that restaurant servers was the most at-risk occupation for automation across all occupations, with a 63% probability of long-term automation. The automation outlook in the accommodation sub-sector is similarly dismal, with a 60% probability of long-term automation. Overall, this industry group is projected to record employment growth at an average annual rate of about 0.7%.

81 OTHER SERVICES (EXCEPT PUBLIC ADMINISTRATION)

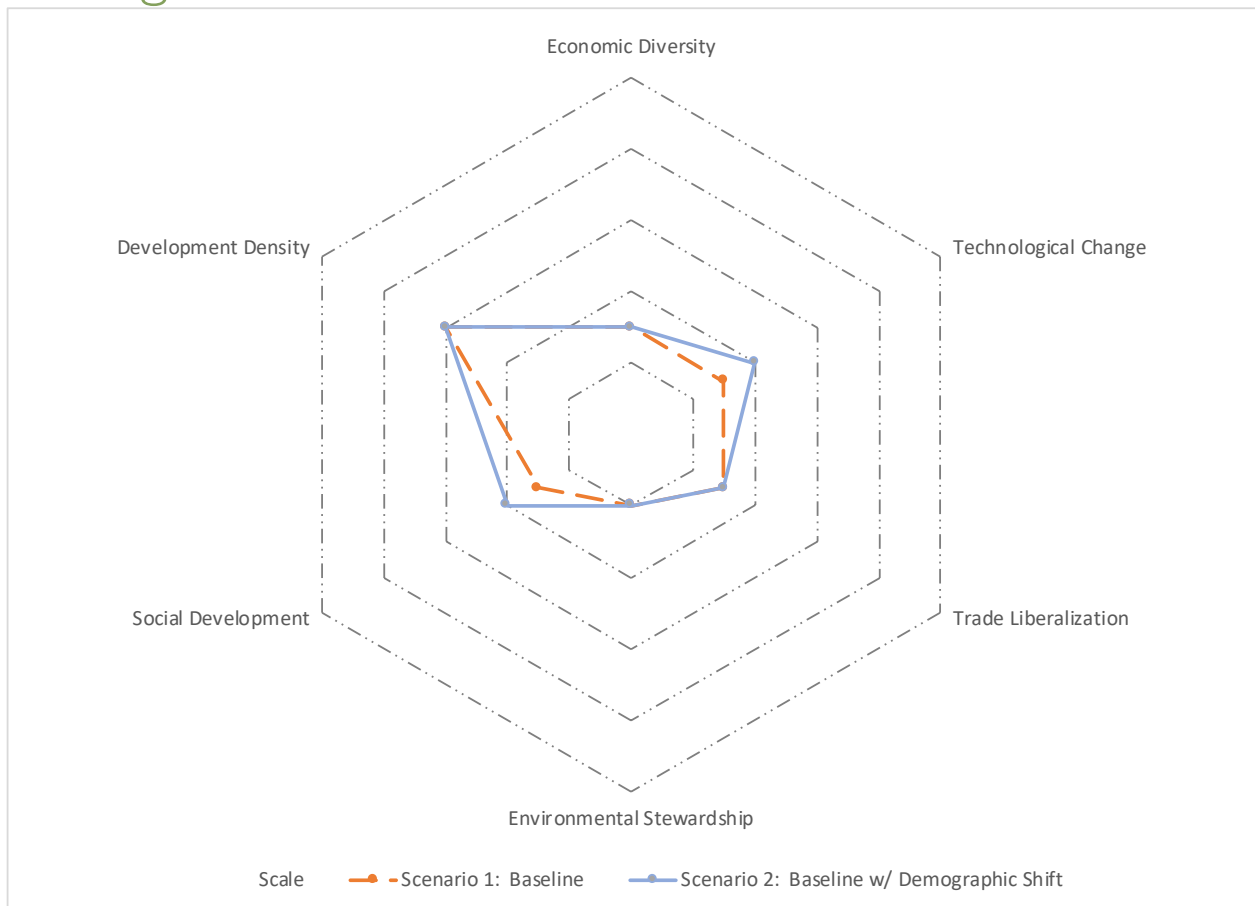
Overall, this industry group is projected to record employment growth at an average annual rate of about 1.4%.

91 PUBLIC ADMINISTRATION

Overall, this industry group is projected to record employment growth at an average annual rate of about 0.8%.

¹⁹ <https://www.ons.gov.uk/employmentandlabourmarket/peopleinwork/employmentandemployeetypes/datasets/probabilityofautomationinengland>

Scenario 2: Baseline with Dynamic Demographic Change



DESCRIPTION

This scenario is similar to the Baseline scenario described above, but introduces changes to fertility and mortality rates - an important consideration given the significant length of the forecast covered in this analysis. In the prior Baseline scenario, fertility and mortality rates were held constant at the 5-year historical averages observed in Calgary's census division.

Birth rates have declined considerably across some age groups in Alberta over the past thirty years, while rates have increased in other age groups. Historical data analysis was performed to better understand these trends, and applied to assumptions in this scenario. These time-sensitive fertility rates are used in the analysis to determine the impact of fewer births per female on the age composition of the long-term Calgary region population.

Due to a number of factors, life expectancy has consistently trended higher across genders and age cohorts in Alberta. Further incremental reductions to mortality rates across time may

allow for a more realistic assessment of what the long-term structure of the Calgary region population would look like (if historical trends are to continue into the future).

While the combined effect of fewer births and longer life expectancy possesses an ambiguous impact on aggregate population (relative to the static fertility and mortality rates used in the Baseline), this scenario will result in a relatively older long-term Calgary region population. The trend of longer average life expectancies (along with lower birth rates reducing the proportion of younger people in the population) would also likely raise labour force participation rates among seniors relative to the Baseline scenario. Given the growing size of the senior population projected in this scenario, even a slight increase in labour force participation in this age group possesses a significant impact on the need for employment-related migration. The aging population assumed in this scenario should also impact job growth in some Calgary region industries, with both positive and negative consequences in terms of job growth.

As well, this scenario assumes that the changing fertility and mortality rates are, in part, motivated by an increase in the technological change and social development parameters.

Overall employment growth in the Baseline with Demographic Shift scenario is projected at an average annual rate of 1.2% from 2019 to 2076.

GDP PROJECTIONS

The results of the Baseline with Demographic Shift Scenario are very similar to the Baseline, with real GDP increasing only slightly to \$279 billion by 2076.

Real output growth across most industries is greater relative to the Baseline Scenario, due primarily to gradually declining mortality rates providing a boost to health care demand, as well as moderate technology-related efficiency gains not assumed in the Baseline Scenario.

However, growth in this scenario is offset by gradually declining birth rates resulting in a reduced level of output growth in the education sector. As well, some contraction in output/productivity is projected in industries such as retail trade, financial services, and real estate due to anticipated changes in consumer spending patterns as the population ages.

Baseline with Demographic Shift Scenario GDP²⁰ (Chained 2012\$)

NAICS	2018	2076	AAG
Agriculture, Forestry, Fishing and Hunting	413	418	0.0%
Mining and Oil and Gas Extraction	39,921	76,485	1.1%
Utilities	2,199	3,674	0.9%

²⁰ Measured in millions of chained 2012 dollars

NAICS	2018	2076	AAG
Construction	8,988	22,165	1.6%
Manufacturing	8,394	14,760	1.0%
Wholesale Trade	5,290	10,107	1.1%
Retail Trade	5,370	10,330	1.1%
Transportation and Warehousing	9,824	28,877	1.9%
Information and Cultural Industries	4,293	6,416	0.7%
Finance and Insurance	5,467	9,461	0.9%
Real Estate and Rental and Leasing	13,489	24,274	1.0%
Professional, Scientific and Technical Services	9,965	20,057	1.2%
Management of Companies and Enterprises	1,278	2,565	1.2%
Administrative and Support, Waste Management and Remediation Services	3,109	6,383	1.2%
Educational Services	4,572	6,718	0.7%
Health Care and Social Assistance	7,952	19,565	1.6%
Arts, Entertainment and Recreation	898	1,145	0.4%
Accommodation and Food Services	2,657	4,430	0.9%
Other Services (except Public Administration)	2,289	5,222	1.4%
Public Administration	3,631	6,022	0.9%
Total	140,000	279,074	1.2%

INDUSTRY ASSUMPTIONS

A brief description of the anticipated performance (in terms of job growth) for each 2-digit NAICS through the forecast period is provided below. Where applicable, examples of notable 4-digit NAICS within the industry group are also discussed.

11 AGRICULTURE, FORESTRY, FISHING AND HUNTING

Same as Baseline scenario.

21 MINING AND OIL AND GAS EXTRACTION

Same as Baseline scenario.

22 UTILITIES

Same as Baseline scenario.

23 CONSTRUCTION

A slight increase in the construction of new units could lead to higher job growth in the construction industry group, with growth estimated at 1.5% (from 1.4% in the Baseline scenario).

31-33 MANUFACTURING

Same as Baseline scenario.

41 WHOLESALE TRADE

As the economic performance of the wholesale trade industry group tends to follow that of retail (see next section), it is likely that a slight decline will be observed in wholesale-related employment (relative to the Baseline scenario). Average annual employment growth in the wholesale trade industry group is projected to decline to about 1.0%.

44-45 RETAIL TRADE

Raising a child from birth through age 18 cost the average Canadian household \$253,954 (in 2015)²¹, with many components of these costs related to retail expenditure. As such, fewer children would likely result in a reduced level of aggregate retail spending (in the absence of child-related costs, a portion of this amount would likely be saved). Lower retail spending would likely result in lower output and hiring requirements in this industry group. Average

²¹ "How much does it cost to raise a kid in Canada?", Global News, January 12, 2017. <https://globalnews.ca/news/3172459/how-much-does-it-cost-to-raise-a-kid-in-canada/>

annual employment growth in the retail trade industry group is projected to decline slightly to about 1.1%.

48-49 TRANSPORTATION AND WAREHOUSING

Same as Baseline scenario.

51 INFORMATION AND CULTURAL INDUSTRIES

Same as Baseline scenario.

52 FINANCE AND INSURANCE

Longer average life expectancies would likely result in rising labour force participation rates among seniors through the forecast period. Longer average durations spent in the work force (along with reduced propensities to allocate these earnings towards child raising costs) could potentially result in a greater likelihood for workers to use this disposable income for saving and personal investing. While the impact may be relatively small, the demand for financial professionals could be provided a boost relative to the prior Baseline scenario. Average annual employment growth in the finance and insurance industry group is projected to increase to about 1.2% (from 1.1% in the original Baseline scenario).

53 REAL ESTATE AND RENTAL AND LEASING

Same as Baseline scenario.

54 PROFESSIONAL, SCIENTIFIC AND TECHNICAL SERVICES

Same as Baseline scenario.

55 MANAGEMENT OF COMPANIES AND ENTERPRISES

Same as Baseline scenario.

56 ADMINISTRATIVE AND SUPPORT, WASTE MANAGEMENT AND REMEDIATION SERVICES

Same as Baseline scenario.

61 EDUCATIONAL SERVICES

With lower fertility rates resulting in fewer children in the Calgary region (as a proportion of total population), there would be a reduced need for workers in the educational services industry group. While shifts in societal priorities could act to limit this decline in demand (i.e. smaller classroom sizes, increased teaching specialization in schools, an increased emphasis on adult education), it is highly probable that education employment in this scenario would increase at a rate less than that of the Baseline. Average annual employment growth in the

educational services industry group is projected to decline to about 0.4% (from 0.8% in the original Baseline scenario).

62 HEALTH CARE AND SOCIAL ASSISTANCE

Compared to the average Canadian, a relatively higher proportion of health care services are utilized by seniors, who collectively represent 60% of all hospital days in Canada.²² While the average life expectancy of Albertans has continued to trend upward, there is no guarantee that the onset of many of the health-related issues associated with aging will follow a similar upward pattern. It is likely that the rising proportion of seniors in the population will necessitate a revamp and expansion of the health care system - resulting in greater levels of expenditure and health professionals required. Average annual employment growth in the health care and social assistance industry group is projected to increase to about 1.5% (from 1.4% in the original Baseline scenario).

71 ARTS, ENTERTAINMENT AND RECREATION

Same as Baseline scenario.

72 ACCOMMODATION AND FOOD SERVICES

Same as Baseline scenario.

81 OTHER SERVICES (EXCEPT PUBLIC ADMINISTRATION)

Same as Baseline scenario.

91 PUBLIC ADMINISTRATION

Same as Baseline scenario.

²² Aravind Ganesh, "It's time to rethink how our health-care system treats seniors", Calgary Herald, June 13, 2016. <https://calgaryherald.com/health/seniors/ganesh-its-time-to-rethink-how-our-health-care-systems-treats-seniors>

Scenario 3: Industry Diversification



DESCRIPTION

The Industry Diversification scenario assumes that the Calgary region economy will gradually lessen its dependence on the energy sector through the forecast period. While the energy sector remains an important and growing part of the regional economy, industries such as specialized manufacturing, information-based industries, and research/innovation are expected to increase in relative prominence. As well as the high degree of economic diversification, this scenario also assumes a higher rate of technological advancement/adoption (relative to the Baseline scenario) and slightly more liberalized trade conditions, environmental protection efforts, social progress / income equality, and densification.

Overall employment growth in Industry Diversification scenario is projected at an average annual rate of 1.3% from 2019 to 2076.

GDP PROJECTIONS

Real GDP is expected to grow at an average annual rate of about 1.3% in the Industry Diversification Scenario, reaching \$297 billion by 2076.

As would be expected, the growth outlook for Calgary's oil and gas industry is diminished as the region attempts to gradually reduce its reliance on the energy sector. However, output growth is greater across all other major industries in this scenario relative to the Baseline. Productivity improvements resulting from increased technology adoption and specialization (relative to the Baseline) more than compensate for oil-related losses. In fact, productivity is enhanced to the extent that real output in the oil and gas sector declines only marginally relative to the Baseline Scenario. Output growth is also notably higher in industries such as utilities, construction, transportation and warehousing.

Industry Diversification Scenario GDP²³ (Chained 2012\$)

NAICS	2018	2076	AAG
Agriculture, Forestry, Fishing and Hunting	413	462	0.2%
Mining and Oil and Gas Extraction	39,921	73,417	1.1%
Utilities	2,199	4,893	1.4%
Construction	8,988	23,437	1.7%
Manufacturing	8,394	19,195	1.4%
Wholesale Trade	5,290	11,519	1.4%
Retail Trade	5,370	10,943	1.2%
Transportation and Warehousing	9,824	35,427	2.2%
Information and Cultural Industries	4,293	7,274	0.9%
Finance and Insurance	5,467	10,100	1.1%
Real Estate and Rental and Leasing	13,489	24,483	1.0%
Professional, Scientific and Technical Services	9,965	22,413	1.4%
Management of Companies and Enterprises	1,278	3,075	1.5%
Administrative and Support, Waste Management and Remediation Services	3,109	6,966	1.4%
Educational Services	4,572	7,468	0.8%
Health Care and Social Assistance	7,952	19,076	1.5%
Arts, Entertainment and Recreation	898	1,246	0.6%
Accommodation and Food Services	2,657	4,809	1.0%
Other Services (except Public Administration)	2,289	5,576	1.5%
Public Administration	3,631	5,795	0.8%
Total	140,000	297,574	1.3%

INDUSTRY ASSUMPTIONS

A brief description of the anticipated performance (in terms of job growth) for each 2-digit NAICS through the forecast period is provided below. Where applicable, examples of notable 4-digit NAICS within the industry group are also discussed.

²³ Measured in millions of chained 2012 dollars

11 AGRICULTURE, FORESTRY, FISHING AND HUNTING

While slightly liberalized trade conditions (relative to the Baseline scenario) provide a modest increase in job growth related to farming, employment growth in the agriculture industry group is generally unchanged, with diversification adding only few agriculture jobs to the outlook. Employment growth through the forecast period is expected to increase at an average annual rate of 0.1%.

21 MINING AND OIL AND GAS EXTRACTION

The boost to job growth in this industry group provided by improved trade conditions and advances in technology adoption outweighs the negative impact of heightened environmental concerns and regulations. Diversification efforts do not contribute to growth in this industry group. Employment in this industry is expected to increase at an average annual rate of 1.1%.

22 UTILITIES

Gains in the areas of economic diversification, technology adoption, and environmental stewardship should provide a significant increase in utilities job growth, with annual employment growth averaging 1.6% (from 1.1% in the Baseline scenario).

- **2211 Electric power generation, transmission and distribution:** Within the utilities industry group, job growth benefits related to diversification are most extensive in this sub-sector. Associated improvements in technology and environmental sustainability measures should contribute to growth as new opportunities arise in alternative forms of energy.

23 CONSTRUCTION

Calgary's construction industry is expected to benefit most notably from the liberalization of trade conditions in this scenario, with only slight job gains realized from technology adoption and environmental sustainability-related improvements. Enhanced trading arrangements should allow Calgary's construction industry lower prices on imported inputs, as well as better access to operate in external markets. Diversification efforts are not expected to contribute to job growth in this industry group. Overall, average annual employment growth is projected at about 1.5% (only slightly above the Baseline scenario), with additional job growth impacts spread relatively evenly throughout each of the industry sub-sectors.

31-33 MANUFACTURING

Advances in economic diversification, trade liberalization, technology adoption, social progress / income equality, and environmental sustainability efforts through the forecast period should each contribute meaningfully to job creation. Diversification efforts could be particularly important in adding jobs in specific sub-sectors related to specialized, value-added manufacturing such as food/beverage products and technology/medical devices. Progress in the areas of trade liberalization and technology adoption should also contribute to job gains

throughout the manufacturing industry group as a whole. Employment in this industry is expected to increase at an average annual rate of 1.4% (from 0.9% in the Baseline scenario).

- ▶ **3116 Meat product manufacturing:** Calgary's proximity to high value agricultural land and its access to distribution channels and could provide growth opportunities in agribusiness sub-sectors related to food and beverage processing.
- ▶ **3345 Navigational, measuring, medical and control instruments manufacturing:** Manufacturing sub-sectors related to technology and innovation could also benefit from improved diversification efforts. Calgary's access to a highly skilled local labour force would support growth across many of these innovation-based industries.

41 WHOLESALE TRADE

While progress in technology adoption and trade liberalization could benefit the wholesale trade industry as a whole, these gains are expected to be minimal relative to the Baseline scenario. Further, job growth resulting from diversification efforts would be restricted to those few sub-sectors related to agribusiness and food/beverage manufacturing. Employment in this industry is expected to increase at an average annual rate of 1.2% (from 1.0% in the Baseline scenario).

- ▶ **4111 Farm product merchant wholesalers; 4131 Food merchant wholesalers; 4132 Beverage merchant wholesalers:** Related to the diversification-driven benefits described above in specialized, value-added food and beverage product manufacturing, wholesale sub-sectors involved in the sale of these products would receive a similar boost in job creation. Average annual employment growth rates in these sub-sectors are projected to be slightly higher than those of the Baseline scenario.
- ▶ Largely due to the pharmaceutical component, this is one of the wholesale sub-sectors projected to record the fastest rate of employment growth over the forecast period. This sub-sector comprised just 3.4% of wholesale-related employment in 2018, but is expected to more than double this share by the end of the forecast period.
- ▶ **4145 Pharmaceuticals, toiletries, cosmetics and sundries merchant wholesalers:** Largely due to the pharmaceutical component, this is one of the wholesale sub-sectors projected to record the fastest rate of employment growth over the forecast period. This sub-sector comprised just 3.4% of wholesale-related employment in 2018, but is expected to more than double this share by the end of the forecast period.

44-45 RETAIL TRADE

Employment growth impacts in the retail trade industry are similar to those of the wholesale trade industry group described above. Advances in trade and technology could contribute to minimal increases in job creation through the industry group as a whole, but diversification-related gains would likely be limited to just a few sub-sectors. Along with online retailers, the sub-sectors best positioned to realize diversification-related growth are those involved in the selling of specialized consumer goods. Employment in this industry is expected to increase at an average annual rate of 1.1% (just above that of the Baseline scenario).

- ▶ **4452 Specialty food stores; 4461 Health and personal care stores:** As consumer preferences continue to shift toward specific, lifestyle-oriented products often related to health and diet, significant growth potential exists for retailers who cater to these specialty markets. As the Calgary region economy intensifies its diversification efforts and moves away from traditional retail, it is anticipated that these sub-sectors will realize significantly higher rates of employment growth through the forecast period, relative to the rest of the industry group (with the exception of online retailers).

48-49 TRANSPORTATION AND WAREHOUSING

Overall employment growth in this industry group is projected at an annual average of 1.7%.

51 INFORMATION AND CULTURAL INDUSTRIES

Positive job impacts associated with diversification are expected to be most acute in technology-related sub-sectors including software and video game design, as well as data processing and analysis services. Overall employment growth in this industry group is projected at an annual average of 1.1%.

- ▶ **5112 Software publishers:** As consumer connectivity and mobile computing devices become ubiquitous, demand for software developers has increased substantially. As evidenced by recent Calgary region hiring initiatives on the part of technology firms,²⁴ job growth is already occurring in this sub-sector. Further, an increasing focus on computer science in education systems along with the internet allowing for greater accessibility to computer programming learning resources has enhanced the skills of the labour force.
- ▶ **5182 Data processing, hosting, and related services; 5191 Other information services:** Businesses increasingly rely on advanced data analysis in informing their decisions, with fields such as data science, data mining and big data continuing to grow in prominence. There exists a high potential for employment growth in these sub-sectors, particularly in the Calgary region where corporate demand for such services is high and a technically proficient pool of labour already exists. Average annual employment growth in these sub-sectors is projected at significantly higher rates relative to the Baseline scenario.

52 FINANCE AND INSURANCE

While improvements in technology adoption ("Fintech"²⁵) and trade conditions could contribute to job growth in the finance and insurance industry group, new positions related to economic diversification would likely be minimal, with Calgary already positioned as a financial hub. Average annual employment growth in this industry group is projected at 1.3%.

²⁴ Amanda Stephenson, "Calgary tech companies banding together to host major hiring fair Saturday," Calgary Herald, December 4, 2019. <https://calgaryherald.com/business/local-business/calgary-tech-companies-banding-together-to-host-major-hiring-fair-saturday>

²⁵ Fintech refers to financial technology, and includes innovations such as crowdfunding, small business lending, payment technology, and debt collection.

53 REAL ESTATE AND RENTAL AND LEASING

The real estate and rental and leasing industry group is unlikely to realize any significant increase in employment relative to the Baseline scenario, with average annual growth projected at about 1.1%.

54 PROFESSIONAL, SCIENTIFIC AND TECHNICAL SERVICES

Employment gains associated with economic diversification are likely to be greatest in the professional, scientific and technical services industry group. Calgary's knowledge-based sub-sectors that provide services in fields such as architecture, engineering, specialized design, and computer systems possess significant growth potential, and are supported by a strong local corporate and post-secondary presence. Employment in this industry is expected to increase at an average annual rate of 1.4% (from 1.2% in the Baseline scenario).

- ▶ **5412 Architectural, engineering and related services; 5415 Computer systems design and related services; 5416 Management, scientific and technical consulting services:** Each of these sub-sectors exhibits a particularly high potential for job growth, with opportunities stemming from progress in diversification, technology, environmental sustainability efforts, and even trade liberalization (which allows firms in these sub-sectors better access to external markets).

55 MANAGEMENT OF COMPANIES AND ENTERPRISES

The management of companies and enterprises industry group is likely to realize gains related to trade and technology growth, with average annual growth projected at about 1.2%.

56 ADMINISTRATIVE AND SUPPORT, WASTE MANAGEMENT AND REMEDIATION SERVICES

Overall job growth in the administrative and support, waste management and remediation services industry group is not expected to be significantly above that of the Baseline scenario at an average annual rate of about 1.3%. However, sub-sectors involved in waste management may realize slight gains related to heightened diversification and environmental sustainability efforts.

- ▶ **5622 Waste treatment and disposal; 5629 Remediation and other waste management services:** Job growth in these waste-related sub-sectors could be encouraged through technology-related efficiency gains and mounting social support for environmental sustainability. However, these sub-sectors represent just 7% of employment in the industry group with shares expected to rise only slightly through the forecast period. Job growth may be more likely to occur in support industries, such as scientific/environmental research and policy.

61 EDUCATIONAL SERVICES

Growth in education employment is unlikely to significantly exceed that of the Baseline scenario at an average annual rate of 0.8%. Technological advances may create some positions in the industry group as new tools and approaches to learning are introduced, but these gains could be offset by an increased tendency toward “massive online courses” and distance learning, which reduce the demand for educators. Diversification attempts are unlikely to generate new jobs in this industry group. Employment in this industry is expected to increase at an average annual rate of 0.8%.

62 HEALTH CARE AND SOCIAL ASSISTANCE

Developments in technology could create new high-skill occupations in the health care field as new medical devices, treatments and procedures are introduced. However, technology could also generate efficiency gains in patient treatment, reducing the demand for other medical professionals. Average annual growth in health and social services employment is at 1.5%. With a few possible exceptions, diversification attempts are unlikely to generate new jobs in this industry group.

- ▶ **6215 Medical and diagnostic laboratories:** Sub-sectors that are associated with research and innovation may record job growth not realized elsewhere in the health industry. Advances in technology as well as diversification efforts have the potential to generate higher returns for establishments engaged in providing analytic or diagnostic services, but the sub-sector is expected to remain a relatively small proportion of the industry as a whole.

71 ARTS, ENTERTAINMENT AND RECREATION

The arts, entertainment and recreation industry group is unlikely to realize any significant increase in employment relative to the Baseline scenario, with average annual growth projected at about 0.9%.

72 ACCOMMODATION AND FOOD SERVICES

While efforts to further diversify the Calgary region economy are unlikely to yield any significant employment gains in this industry group, associated improvements in trade liberalization could lead to job growth in some sub-sectors. Overall, average annual employment growth in the accommodation and food services industry is projected at 0.8%.

- ▶ **7225 Full-service restaurants and limited-service eating places:** Improved trade conditions allow restaurants to purchase food at relatively cheaper prices, which could generate new employment opportunities - particularly with profit margins in the sub-sector being unusually thin relative to the all-industry average. Average annual employment growth in this sub-sector is expected to be slightly above that of the Baseline scenario.

81 OTHER SERVICES (EXCEPT PUBLIC ADMINISTRATION)

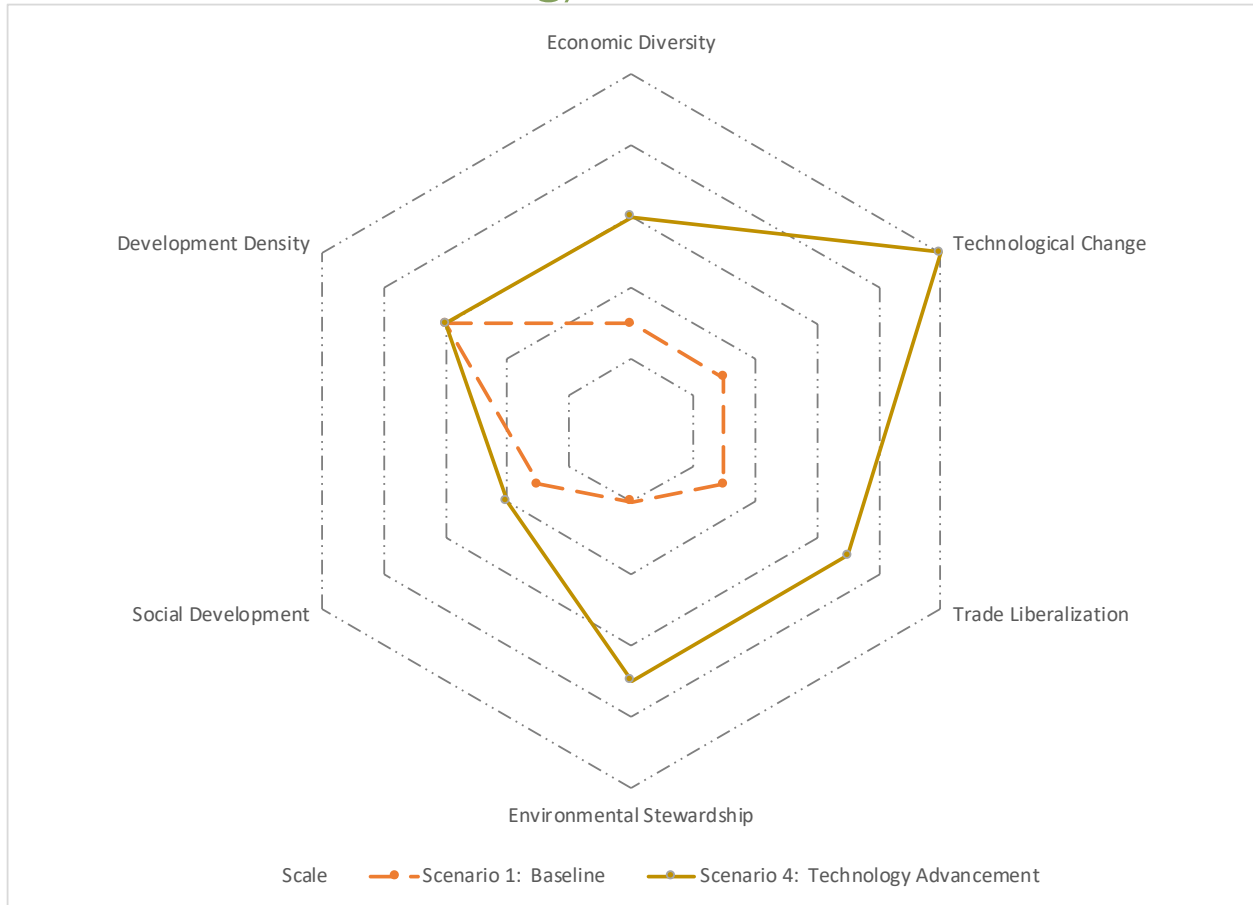
This industry group includes a variety of services including automotive repair, personal care, and civic and social organizations, among others. None of the sub-sectors contained in the industry are likely to benefit from diversification efforts, but associated gains in other dimensions such as trade liberalization and social progress / income equality could generate a higher rates of employment growth in those sub-sectors more closely related to consumer spending.

- ▶ **8111 Automotive repair and maintenance:** The relatively cheaper import prices and higher consumer spending associated with trade liberalization and income equality, respectively, have the potential to drive employment growth in this sub-sector. Further, technological advances and additional environmental regulations could give rise to demand in emerging areas such as electric cars.

91 PUBLIC ADMINISTRATION

The public administration industry group is unlikely to realize any significant increase in employment relative to the Baseline scenario, with average annual growth projected at about 0.8%.

Scenario 4: Technology Advancement



DESCRIPTION

The Technology Advancement scenario assumes that growth in the Calgary region economy will be driven by an especially high rate of technological advancement/adoption, leading to high potential growth in technology-sensitive industries such as oil and gas, manufacturing, utilities, and professional, scientific and technical services. Some industries may experience job losses as technology-enhanced capital replaces workers. Along with the high degree of technology advancement, this scenario assumes a higher rate of economic diversification (relative to the Baseline scenario), trade liberalization, environmental sustainability efforts, and densification. Social progress / income equality efforts are assumed to be minimal in this scenario.

Overall employment growth in Technology Advancement scenario is projected at an average annual rate of 1.3% from 2019 to 2076.

GDP PROJECTIONS

While this study finds that employment growth is greatest in the Industry Diversification Scenario, real GDP growth is faster in the Technology Advancement Scenario. Advances in technology are often the best source of efficiency gains – demonstrated by real output growth in this scenario being greater than the Baseline Scenario across all major industries. Real GDP is projected to increase at an average annual rate of 1.3%, reaching \$303 billion by 2076. In this sense, this scenario projects that fewer workers can generate a similar (or higher) level of real GDP, relative to other scenarios. By 2076, the average worker in the Calgary Region creates a projected \$170,000 in output per year – the highest rate across all scenarios. Efficiency improvements are expected to be particularly strong in the agriculture, manufacturing, and transportation and warehousing industries.

Technology Advancement Scenario GDP²⁶ (Chained 2012\$)

NAICS	2018	2076	AAG
Agriculture, Forestry, Fishing and Hunting	413	455	0.2%
Mining and Oil and Gas Extraction	39,921	81,769	1.2%
Utilities	2,199	4,986	1.4%
Construction	8,988	23,280	1.7%
Manufacturing	8,394	19,326	1.4%
Wholesale Trade	5,290	11,387	1.3%
Retail Trade	5,370	10,806	1.2%
Transportation and Warehousing	9,824	34,413	2.2%
Information and Cultural Industries	4,293	7,120	0.9%
Finance and Insurance	5,467	9,937	1.0%
Real Estate and Rental and Leasing	13,489	24,556	1.0%
Professional, Scientific and Technical Services	9,965	21,756	1.4%
Management of Companies and Enterprises	1,278	2,735	1.3%
Administrative and Support, Waste Management and Remediation Services	3,109	6,920	1.4%
Educational Services	4,572	7,406	0.8%
Health Care and Social Assistance	7,952	19,058	1.5%

²⁶ Measured in millions of chained 2012 dollars

NAICS	2018	2076	AAG
Arts, Entertainment and Recreation	898	1,209	0.5%
Accommodation and Food Services	2,657	4,672	1.0%
Other Services (except Public Administration)	2,289	5,533	1.5%
Public Administration	3,631	5,808	0.8%
Total	140,000	303,130	1.3%

INDUSTRY ASSUMPTIONS

A brief description of the anticipated performance (in terms of job growth) for each 2-digit NAICS through the forecast period is provided below. Where applicable, examples of notable 4-digit NAICS within the industry group are also discussed.

11 AGRICULTURE, FORESTRY, FISHING AND HUNTING

Advances in technological change and adoption are likely to hold implications for the agriculture industry group in terms of emerging farming practices and techniques. However, the job growth associated with these developments will likely be found in other industry groups more closely related to scientific research. Average annual employment growth is projected at 0.1% - just slightly above the Baseline scenario.

21 MINING AND OIL AND GAS EXTRACTION

New developments in extraction methods could lead to technology-driven job growth in the mining and oil and gas extraction industry group. During the 2011 to 2014 period when the price of oil often averaged more than \$100 per barrel, oil companies invested heavily in research and development and are now benefitting from new, more efficient approaches in directional drilling and injection.²⁷ Further technological advances could allow for the recovery of oil reserves that were not previously considered to be economically viable. Annual employment growth in the mining and oil and gas extraction industry group is expected to average 1.3% through the forecast period (from 1.1% in the Baseline scenario).

22 UTILITIES

Advances in technology related to alternative forms of energy could drive future job growth in the utilities industry group. As alternative / renewable energy sources become increasingly viable, job creation is projected in the electric power generation, transmission and distribution sub-sector, which comprises nearly 80% of utilities employment in the Calgary region. Average annual employment growth in this industry is projected at 1.6% through the forecast period

²⁷ Chris Baraniuk, "Future energy: The technology allowing more oil extraction", BBC News, July 13 2017, <https://www.bbc.com/news/business-40580058>

(from 1.1% in the Baseline scenario). Note that this scenario does not assume that fossil fuels will be phased out, so this job growth does not come at the assumed expense of other industries.

23 CONSTRUCTION

Job growth is projected to be higher in the technological change scenario (compared to the Baseline), but this is primarily a result of the assumed relative improvement in trade liberalization rather than a technology-driven impact. Innovations to the tools, machinery, modifications, and software used in construction are not estimated to yield significant job growth - with advances in automated and semi-automated equipment perhaps more likely to reduce the demand for labour in this industry group. However, the incremental improvement in trading conditions associated with this scenario suggests significant potential for cost savings and growth opportunities. Overall, average annual employment growth is projected at about 1.5% (from 1.4% in the Baseline scenario), with incremental job growth impacts spread relatively evenly throughout each of the industry sub-sectors.

31-33 MANUFACTURING

Similar to the case for the construction industry group discussed above, potential gains in trade liberalization are estimated to possess significantly greater job creation impacts relative to advances in technology. Exceptions include those manufacturing sub-sectors related to the production of tech-related goods, as well as petroleum product manufacturing. Overall, this industry group is projected to record average annual employment growth at a rate of about 1.4% (from 0.9% in the Baseline scenario).

- ▶ **3241 Petroleum and coal product manufacturing:** While there are no oil refineries located in the Calgary region, this sub-sector also includes the producers of asphalt, lubrication oils, and related products. Technological advancements related to refining processes could generate significant efficiency gains in this sub-sector. Further, new types of petroleum-related products could be introduced through technological progress.
- ▶ **3345 Navigational, measuring, medical and control instruments manufacturing:** Manufacturers involved in the production of tech-related goods can benefit from technology advances in two ways. First, the production process can be enhanced through the introduction of new manufacturing technology, allowing for efficiency gains in labour and capital. Second, opportunities can emerge for manufacturers to produce new goods (or components) as they are innovated.

41 WHOLESALE TRADE

Overall, this industry group is projected to record average annual employment growth at a rate of about 1.2% (from 1.0% in the Baseline scenario).

44-45 RETAIL TRADE

Overall, this industry group is projected to record average annual employment growth at a rate of about 1.1%.

48-49 TRANSPORTATION AND WAREHOUSING

Overall, this industry group is projected to record average annual employment growth at a rate of about 1.5%.

51 INFORMATION AND CULTURAL INDUSTRIES

Advances in technology do not significantly impact estimated job growth in this industry group, and the associated increase in trade liberalization provides only minimal benefit to each sub-sector. Overall employment growth in this industry group is projected at an average annual rate of 1.0% (from 0.6% in the Baseline scenario).

52 FINANCE AND INSURANCE

Progress in the development and implementation of financial technology ("Fintech") can provide new investment opportunities for startup firms in this industry group, and also expands the size of available markets (with apps allowing consumers greater accessibility to perform financial transactions without the need of a broker). The assumed increase in trade liberalization can also encourage job growth in certain sub-sectors by allowing better access to new national and international markets. Overall employment growth in this industry group is projected at an average annual rate of 1.02% (from 1.1% in the Baseline scenario).

- ▶ **5221 Depository credit intermediation:** The banking sub-sector has already experienced fintech-related disruption through channels such as automated tellers and online banking, and this trend is expected to continue. Further technological advances will likely lead to shifts in the occupations that comprise the sub-sector, with positions related to data analysis and cybersecurity growing in importance.
- ▶ **5242 Agencies, brokerages and other insurance related activities:** While advances in fintech may reduce the demand for some occupations in this sub-sector (such as brokers), the expansion in market size resulting from technology and trade liberalization is expected to generate additional employment growth on a net basis.

53 REAL ESTATE AND RENTAL AND LEASING

The real estate and rental and leasing industry group is unlikely to realize any significant increase in employment relative to the Baseline scenario, with average annual growth projected at about 1.1%.

54 PROFESSIONAL, SCIENTIFIC AND TECHNICAL SERVICES

Overall, this industry group is projected to record average annual employment growth at a rate of about 1.4% (from 1.2% in the Baseline scenario).

55 MANAGEMENT OF COMPANIES AND ENTERPRISES

The management of companies and enterprises industry group is unlikely to realize any significant increase in employment relative to the Baseline scenario, with average annual growth projected at about 1.4%.

56 ADMINISTRATIVE AND SUPPORT, WASTE MANAGEMENT AND REMEDIATION SERVICES

Overall, this industry group is projected to record average annual employment growth at a rate of about 1.3%.

61 EDUCATIONAL SERVICES

While advances in the field of educational technology could lead to further changes in the ways in which learning is facilitated and delivered, it is unlikely to significantly impact the demand for educators (and may lead to some job loss in this occupation group). However, the increase in the use of high-tech tools such as virtual classrooms will drive up the demand for skills and occupations involved in IT and computer hardware/software, along with education administrators. Overall employment growth through the forecast period in this industry group is projected at about 0.8% (net unchanged from the Baseline scenario).

62 HEALTH CARE AND SOCIAL ASSISTANCE

Continued breakthroughs and innovations in medical technology are certain to greatly impact the health profession through the forecast period. However, while many of the diagnostic and treatment methods will change, the job impact may be minimal on the demand for physicians directly involved in patient care. Overall employment growth through the forecast period in this industry group is projected at about 1.4% (net unchanged from the Baseline scenario).

71 ARTS, ENTERTAINMENT AND RECREATION

The arts, entertainment and recreation industry group is unlikely to realize any significant increase in employment relative to the Baseline scenario, with average annual growth projected at about 0.9%.

72 ACCOMMODATION AND FOOD SERVICES

While the relative liberalization in trade conditions assumed in this scenario could provide additional job growth in the restaurants sub-sector, technological advances are unlikely to

impact this industry group meaningfully. Trade-related job growth is projected to push average annual employment growth in this industry group to 0.7%.

81 OTHER SERVICES (EXCEPT PUBLIC ADMINISTRATION)

The relatively higher rate of technological progress and adoption is expected to significantly impact job growth in only a few sub-sectors of this industry group. Overall employment growth through the forecast period in this industry group is projected at about 1.5%.

- ▶ **8111 Automotive repair and maintenance; 8112 Electronic and precision equipment repair and maintenance; 8113 Commercial and industrial machinery and equipment repair and maintenance:** Technological advances could result in new and more efficient tools and methods for auto and equipment repair. Additional demand could also arise from new types of autos, electronic goods, equipment, etc.

91 PUBLIC ADMINISTRATION

The public administration industry group is unlikely to realize any significant increase in employment relative to the Baseline scenario, with average annual growth projected at about 0.8%.

Scenario 5: Climate Change



DESCRIPTION

There is a likelihood that climate change becomes an increasingly significant issue impacting the Calgary region economy through the forecast period. As temperature, precipitation, and extreme weather patterns continue to shift, the Calgary region’s building stock, transportation infrastructure, water supply, and economic outlook across a number of industry groups will be at risk. Primary concerns include the colder winter and warmer summer months disrupting the water supply; as well as potential damage resulting from extreme weather events.²⁸ Climate change may also provide an opportunity for growth across some other industries.

Overall employment growth in Climate Change scenario is projected at an average annual rate of 1.1% from 2019 to 2076.

²⁸ Lueschen, Kyra. Climate Change and the Law, Environmental Law Centre (Alberta) Society, April 2019. <http://elc.ab.ca/wp-content/uploads/2019/04/Climate-Change-Guide-Part-2-Adaptation-FINAL-04.03.2019.pdf>

GDP PROJECTIONS

In the Climate Change Scenario, real GDP is projected to increase from \$140 billion in 2018 to \$253 billion by 2076 – an average annual growth rate of just 1.0%. The Climate Change Scenario leads to the lowest rate of real output growth across all scenarios examined in this study.

Output growth is expected to be particularly weak in this scenario due in part to heightened environmental concerns resulting in much slower job growth in the oil and gas industry. Further, a decline in tourism globally would reduce output in Calgary's accommodation and food services and real estate industries. A shortage of land suitable for growing in the Calgary Region could also lead to stagnation in agricultural output – with minimal gains due only to slight productivity improvements related to technology advances. Significant productivity losses are also expected in industries such as utilities and transportation and warehousing due to infrastructure becoming more costly to build and maintain.

Some of the decline in the Climate Change Scenario is offset by an increased demand for weather-related repairs and maintenance from the construction industry; increased environmental research efforts generating higher output in professional, scientific, and technical services; and potentially worsening climate conditions inducing higher demand for health services as heat- and respiratory illnesses become more common.

Technology Advancement Scenario GDP²⁹ (Chained 2012\$)

NAICS	2018	2076	AAG
Agriculture, Forestry, Fishing and Hunting	413	365	-0.2%
Mining and Oil and Gas Extraction	39,921	56,138	0.6%
Utilities	2,199	3,473	0.8%
Construction	8,988	24,203	1.7%
Manufacturing	8,394	11,847	0.6%
Wholesale Trade	5,290	9,406	1.0%
Retail Trade	5,370	9,852	1.1%
Transportation and Warehousing	9,824	26,985	1.8%
Information and Cultural Industries	4,293	6,394	0.7%
Finance and Insurance	5,467	8,679	0.8%
Real Estate and Rental and Leasing	13,489	22,051	0.9%

²⁹ Measured in millions of chained 2012 dollars

NAICS	2018	2076	AAG
Professional, Scientific and Technical Services	9,965	21,954	1.4%
Management of Companies and Enterprises	1,278	2,943	1.4%
Administrative and Support, Waste Management and Remediation Services	3,109	6,603	1.3%
Educational Services	4,572	6,585	0.6%
Health Care and Social Assistance	7,952	19,047	1.5%
Arts, Entertainment and Recreation	898	1,102	0.4%
Accommodation and Food Services	2,657	3,593	0.5%
Other Services (except Public Administration)	2,289	5,408	1.5%
Public Administration	3,631	6,637	1.0%
Total	140,000	253,266	1.0%

INDUSTRY ASSUMPTIONS

A brief description of the anticipated performance (in terms of job growth) for each 2-digit NAICS through the forecast period is provided below. Where applicable, examples of notable 4-digit NAICS within the industry group are also discussed.

1 | AGRICULTURE, FORESTRY, FISHING AND HUNTING

Climate change could prompt a number of new challenges posed to the Calgary region's agriculture industry group. An already high degree of water instability exists in Alberta, with more than 80% of the province's water supply resources located in Northern Alberta coupled with 80% of demand originating in the South. Southern Alberta is particularly vulnerable to drought, and the industry would experience further increases in the costs of irrigation. As well, warmer weather is predicted to result in a greater frequency and severity of pests and invasive species, which pose a threat to the quality of crop harvests and forests.

While warmer summers may result in agricultural benefits related to longer growing seasons, higher yields across some types of crops, and an increase in the amount of land suitable for agriculture in Southern Alberta, the negative consequences described above are likely to dominate. Overall, average annual employment growth in this industry group is projected at -0.4% (from 0.0% in the Baseline scenario).

21 MINING AND OIL AND GAS EXTRACTION

Alberta's oil sector would be significantly affected by the rising price and disrupted supply of water, as the sub-sector is highly water-intensive (particularly in oil sands mining operations). Further, many remotely located oil sands sites would become more costly to access and maintain due to the increased severity of winter conditions and the degradation of winter roads. The infrastructure of some oil sands sites and mines would be jeopardized by increased precipitation levels and extreme weather events, further increasing maintenance costs. New oil sands and mining sites would likely have to plan for these hazards in the engineering phase, raising the costs of design and construction.

While disruptions to the global supply and production of oil could drive prices higher, demand for oil could also be diminished due to a shift in social preferences for alternative energy. Overall, average annual employment growth in this industry group is projected at 0.6% (from 1.1% in the Baseline scenario).

22 UTILITIES

Each sub-sector of the Calgary region's utilities industry group would be potentially impacted by climate change. Overall, average annual employment growth in this industry group is projected at 1.0% (from 1.1% in the Baseline scenario).

- ▶ **2211 Electric power generation, transmission and distribution:** While an increased level of demand for electricity used for cooling in the warmer summer months will benefit energy producers, this effect is likely to be outweighed by the negative consequences brought on by climate change. Rising levels of interest in alternative forms of energy is likely to be offset by downside risks related to the effects of climate change. Hydro-electric power generation is at particular risk due to changing precipitation patterns causing water overflows in the winter and spring, and shortages during the summer and fall. Damage to equipment involved in wind power generation would be a greater risk due to extreme winds; and solar power generation would be less efficient due to increased cloud cover.
- ▶ **2212 Natural gas distribution:** Warmer winters would likely result in a reduced level of demand for natural gas as a source of energy for heating. Further, natural gas is itself a greenhouse gas that releases carbon dioxide when burned - an attribute to which consumers may grow increasingly resistant.
- ▶ **2213 Water, sewage and other systems:** Disruptions to the quality and supply of water caused by climate change could lead to job growth in the sub-sectors of sewage and water treatment and pumping facilities. Water treatment methods may change or become more costly, as chemicals such as chlorine degrade faster in warmer water.

23 CONSTRUCTION

Within the construction industry group, the weather-related damage and erosion caused to buildings and infrastructure should increase the demand for repair and renovation services. An increased need to repair and raise bridges is another area for potential job growth.

The market for water and energy efficient housing and buildings, including “zero net energy ready” construction, is sure to strengthen through the forecast period, providing opportunities for employment growth. It is also possible that governments or insurers introduce subsidies or regulations to promote efficiency improving retrofits for existing buildings, further driving up demand for construction activity.

Overall, average annual employment growth in this industry group is projected at 1.6% (from 1.45% in the Baseline scenario).

31-33 MANUFACTURING

Some Calgary region manufacturers will be faced with the limited availability and rising prices of production inputs - especially those inputs related to agricultural goods or wood and paper. Water is also used extensively as a production input in many manufacturing sub-sectors, the scarcity and rising price of which has already been discussed above. Supply chains in the manufacturing industry group are also likely to be impacted by degradation to the transportation network. Lastly, government legislation (or shifting consumer preferences) could prohibit the production of plastics and greenhouse gas-related goods, forcing some manufacturers to transition to less cost efficient alternatives. Overall, average annual employment growth in the manufacturing industry group is projected at 0.8% (from 0.9% in the Baseline scenario).

41 WHOLESALE TRADE

Same as Baseline scenario.

44-45 RETAIL TRADE

Overall, average annual employment growth in the retail trade industry group is projected at 1.0% (from 1.1% in the Baseline scenario).

48-49 TRANSPORTATION AND WAREHOUSING

The integrity of Alberta’s transportation infrastructure would be at risk due to the physical damage caused by the increased number of extreme weather events caused by climate change. Alberta’s network of road, rail and pipeline would require additional maintenance/replacement costs; trucks would have their freight capacities reduced due to a degradation in road conditions and route accessibility; and air transport would be less reliable with greater risks of weather-related cancellation or delay. Maintaining Alberta’s transportation infrastructure is of high importance due to Alberta’s economic reliance on trade, as well as the Calgary region’s position as a hub for transportation and logistics activity. Overall, average annual employment growth in this industry group is projected at 1.4% (from 1.5% in the Baseline scenario).

51 INFORMATION AND CULTURAL INDUSTRIES

Same as Baseline scenario.

52 FINANCE AND INSURANCE

The increased number of extreme weather events is likely to significantly impact the insurance sub-sector. The 2013 Southern Alberta floods and 2016 Fort McMurray wildfires resulted in estimated insurance payouts of \$1.6 billion and \$3.7 billion, respectively.³⁰ Weather-related losses now represent the largest cost to property insurers (was previously fire/theft). Further, the stock of buildings in Alberta is relatively young compared to other provinces, resulting in relatively higher repair/replacement costs. Insurers will be faced with the challenge of continuing to offer affordable coverage while remaining solvent as the value and frequency of payouts increase.

The insurance sub-sector is already adapting to the rise in weather-related damage claims through the introduction of new products such as enhanced flood coverage, green buildings insurance, and energy savings insurance (where policies protect the owner of energy-efficient products from underachievement of its predicted savings). Insurance contracts may also offer discounts for homes that comply with regulations regarding resource efficiency or building resilience.

Overall, average annual employment growth in this industry group is projected at 0.9% (from 1.1% in the Baseline scenario).

53 REAL ESTATE AND RENTAL AND LEASING

Same as Baseline scenario.

54 PROFESSIONAL, SCIENTIFIC AND TECHNICAL SERVICES

The rate of employment growth in the professional, scientific and technical services industry group is likely to accelerate as a result of climate change. Overall, average annual employment growth in this industry group is projected at 1.4% (from 1.2% in the Baseline scenario).

55 MANAGEMENT OF COMPANIES AND ENTERPRISES

Same as Baseline scenario.

56 ADMINISTRATIVE AND SUPPORT, WASTE MANAGEMENT AND REMEDIATION SERVICES

While only representing about 6% of the industry group as of 2018, additional employment growth could occur in occupations related to the waste management and remediation services

³⁰ White, Cindy. "Are insurance companies ready to handle a major disaster?", Edmonton City News, October 10, 2019. <https://edmonton.citynews.ca/2019/10/10/are-insurance-companies-ready-to-handle-a-major-disaster/>

sub-sector. The climate change crisis is likely to encourage a greater social emphasis on green methods of waste treatment, disposal and environmental remediation.

Overall, average annual employment growth in the administrative and support, waste management and remediation services industry group is projected at 1.4% (from 1.3% in the Baseline scenario).

61 EDUCATIONAL SERVICES

Same as Baseline scenario.

62 HEALTH CARE AND SOCIAL ASSISTANCE

Potential health impacts resulting from climate change relate to degradation in the quality of food, water and air, along with an increased susceptibility to disease, natural disaster-related injury or death, and harmful exposure to ultra-violet radiation and heat waves. While a degradation in the health of the population could create a short-term increase in the demand for health services, it is also likely that average life expectancy would decline, reducing the number of seniors in the population (who tend to utilize a relatively greater proportion of health services). Overall, average annual employment growth in the health care and social assistance industry group is projected at 1.4% (same as Baseline scenario).

71 ARTS, ENTERTAINMENT AND RECREATION

Same as Baseline scenario.

72 ACCOMMODATION AND FOOD SERVICES

Tourism in Southern Alberta is likely to suffer as a result of climate change. Reduced levels of snowfall will result in a contracting number of areas suitable for skiing/snowmobiling, and rising costs involved in operating those that remain. Similarly, water shortages (along with water quality issues) will increase the costs involved operating golf courses and boating sites. While warmer and longer summers could attract a number of additional tourists to Alberta (with opportunities for “last chance” viewers of glaciers or caribou), rising costs faced by the tourism industry are likely to offset any realized gains. Overall, average annual employment growth in the accommodation and food services industry group is projected at 0.3% (from 0.7% in the Baseline scenario).

81 OTHER SERVICES (EXCEPT PUBLIC ADMINISTRATION)

Rising demand for repair and maintenance services is expected to provide a boost to job growth in related sub-sectors of the other services industry group. Overall, average annual employment growth in the accommodation and food services industry group is projected at 1.5% (up only slightly from the Baseline scenario).

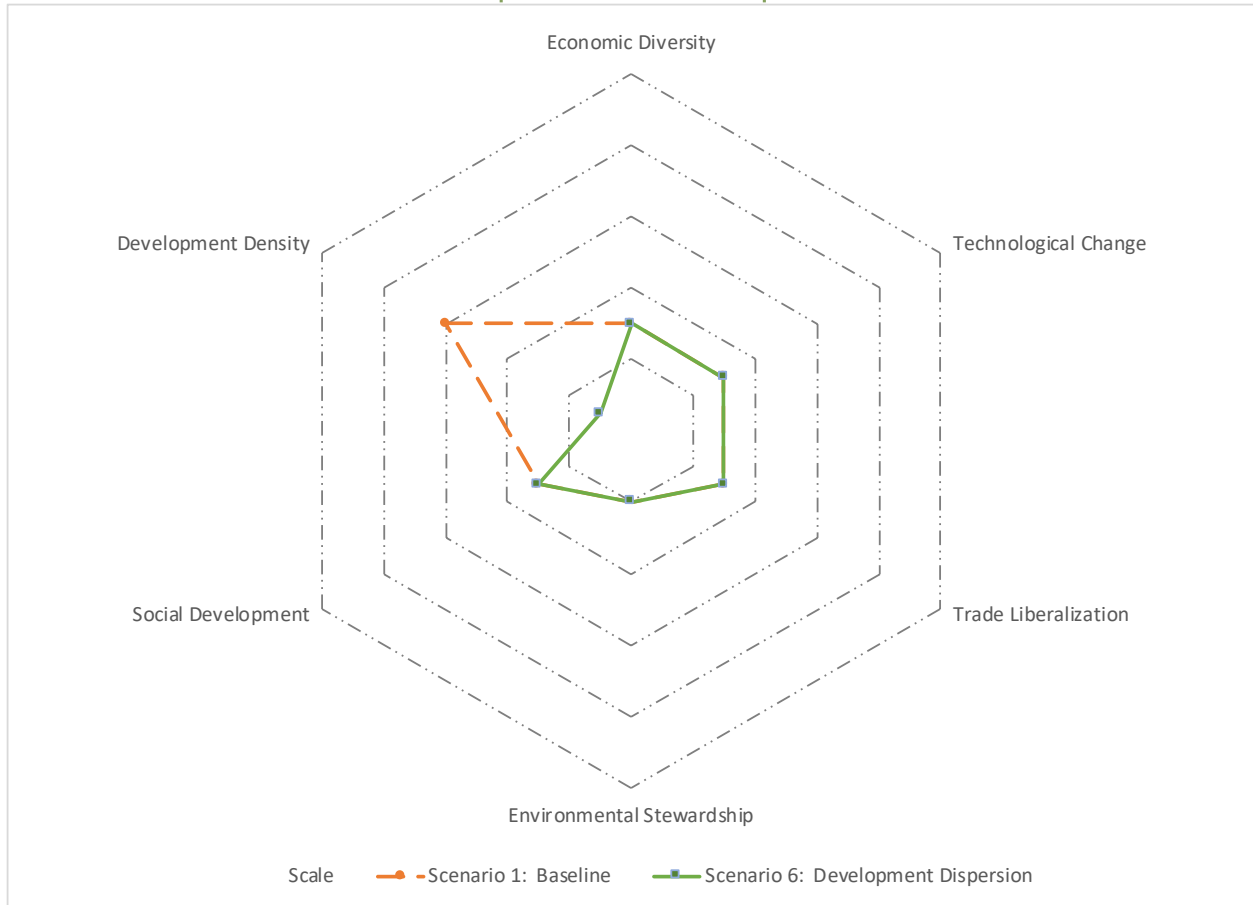
- ▶ **8111 Automotive repair and maintenance; 8113 Commercial and industrial machinery and equipment (except automotive and electronic) repair and maintenance:** If climate change alters weather patterns as anticipated, machinery or equipment that operates outdoors or is exposed to the elements will likely require additional servicing, including autos.

91 PUBLIC ADMINISTRATION

Due to a number of factors, climate change could induce higher rates of employment growth across each level of government in the Calgary region. Overall, average annual employment growth in the accommodation and food services industry group is projected at 1.1% (from 0.8% in the Baseline scenario).

- ▶ **9130 Local, municipal and regional public administration:** The effects of climate change could trigger higher levels of migration into the Calgary region, creating jobs in local government through rising demand for municipal services. Inclement weather conditions could accelerate the rate of degradation to existing transportation infrastructure and the cost of municipal services provision in more remote areas, prompting rural-to-urban migration. As well, local government hiring could grow in occupations related to land use planning and disaster mitigation due to the emergence of unforeseen region-specific problems related to the effects of climate change.
- ▶ **9120 Provincial and territorial public administration; 9112 Other Federal Government Public Administration:** Higher rates of employment growth in the provincial and federal levels of government could be driven by an increased need for scientific researchers and policymakers to address emergent environmental issues and related regulatory considerations. Additional government resources may also be allocated to fields such as weather monitoring, information dissemination, and floodplain modelling.

Scenario 6: Development Dispersion



DESCRIPTION

The Development Dispersion scenario assumes that development in the Calgary region deviates from the developed area/greenfield targets outlined in the Municipal Development Plan, which currently aims for 50% of population growth to be accommodated within already-developed areas of the city.³¹ Relaxing the urban development target and shifting a greater proportion of population growth to greenfield/suburban areas would likely result in a density reduction across both population and employment in Calgary. While future development in the Calgary region is not assumed to be exclusive to the city’s periphery, the rate of infill and urban redevelopment would be significantly lower than the 50% target (assumed in the Baseline scenario)..

This shift will not only have an impact on the locations in which Calgary region residents reside, but could also have implications on industry-specific growth in the local economy. With the concentration of population less centralized, there would likely be an increased demand for

³¹ City of Calgary, Municipal Development Plan, December 2018. <http://publicaccess.calgary.ca/lldm01/livelink.exe?func=ccpa.general&msgID=OTTKcgyTerX&msgAction=Download>

occupations related to road and utility infrastructure. Increased travel distances could also drive regional demand for auto-related goods and associated jobs, with a related decline in public transit employment. Given the environmentally-minded rationale for pursuing increased densification, this scenario also assumes a relative reduction in environmental sustainability efforts, which holds potential job growth implications through the forecast period.

Overall employment growth in Development Dispersion scenario is projected at an average annual rate of 1.2% from 2019 to 2076.

GDP PROJECTIONS

Aggregate real GDP growth in this scenario is nearly identical to that of the Baseline, reaching a total of about \$275 billion by 2076.

Increased rates of residential housing should provide a boost to the construction industry in the Development Dispersion Scenario; and further distances to reach households could generate some moderate gains in the transportation and warehousing sector. Output from government services would also likely increase due to the expanded area requiring servicing.

However, negative impacts in this scenario include a shortage of developable land causing a contraction in agriculture, along with slight reductions in demand across the information and cultural, real estate, and arts and entertainment industries.

Development Dispersion Scenario GDP³² (Chained 2012\$)

NAICS	2018	2076	AAG
Agriculture, Forestry, Fishing and Hunting	413	362	-0.2%
Mining and Oil and Gas Extraction	39,921	74,537	1.1%
Utilities	2,199	3,695	0.9%
Construction	8,988	22,280	1.6%
Manufacturing	8,394	14,490	0.9%
Wholesale Trade	5,290	10,073	1.1%
Retail Trade	5,370	10,569	1.2%
Transportation and Warehousing	9,824	28,913	1.9%
Information and Cultural Industries	4,293	6,371	0.7%
Finance and Insurance	5,467	9,114	0.9%
Real Estate and Rental and Leasing	13,489	22,577	0.9%

³² Measured in millions of chained 2012 dollars

NAICS	2018	2076	AAG
Professional, Scientific and Technical Services	9,965	20,054	1.2%
Management of Companies and Enterprises	1,278	2,540	1.2%
Administrative and Support, Waste Management and Remediation Services	3,109	6,375	1.2%
Educational Services	4,572	7,388	0.8%
Health Care and Social Assistance	7,952	18,068	1.4%
Arts, Entertainment and Recreation	898	1,141	0.4%
Accommodation and Food Services	2,657	4,554	0.9%
Other Services (except Public Administration)	2,289	5,238	1.4%
Public Administration	3,631	6,390	1.0%
Total	140,000	274,728	1.2%

INDUSTRY ASSUMPTIONS

A brief description of the anticipated performance (in terms of job growth) for each 2-digit NAICS through the forecast period is provided below. Where applicable, examples of notable 4-digit NAICS within the industry group are also discussed.

11 AGRICULTURE, FORESTRY, FISHING AND HUNTING

The dispersion of development away from Calgary's urban core is likely to generate an increased level of demand for land in the areas around the city's perimeter, some of which may be suitable for agriculture. Increased competition for these lands will raise prices faced by farms, and potentially dampen the outlook for agricultural expansion. Conversion of existing agricultural land to other purposes is also a possibility. Overall, average annual employment growth in the agriculture industry group is projected at -0.3% (from 0.0% in the Baseline scenario).

21 MINING AND OIL AND GAS EXTRACTION

Same as Baseline scenario.

22 UTILITIES

As development spreads out, population density is expected to decline in the Calgary region. As a result, the provision and maintenance of utilities (electricity, water and sewage) to new subdivisions and commercial developments would likely drive job growth in these sub-sectors.

However, the direct job impact would likely be relatively minimal, with employment in the water, sewage and other systems sub-sector accounting for less than 500 jobs in the Calgary region in 2018. Overall, average annual employment growth in the utilities industry group is projected at 1.1%.

23 CONSTRUCTION

An increased tendency toward greenfield/suburban development in the Calgary region is expected to result in a higher overall rate of employment growth in the construction industry group.

- ▶ **2371 Utility system construction; 2372 Land subdivision; 2373 Highway, street and bridge construction:** Each of the sub-sectors within the heavy and civil engineering construction industry category (NAICS 237) would be expected to benefit from development sparsification. New developments will require servicing in the form of utilities (NAICS 2371), preparatory clearing and excavation (NAICS 2372), and transportation networks (NAICS 2373). The possibility of “leapfrog development”, where subdivisions are separated by large tracts of unused land, can exacerbate the difficulty and expense of providing servicing to low population density areas. While these sub-sectors represented just 10% of total Calgary region construction employment in 2018 (approximately 8,500 positions), job creation related to expanding the city’s infrastructure is projected to result in significantly higher average annual employment growth relative to the Baseline scenario.

Overall, average annual employment growth in the construction industry group is projected at 1.5% (from 1.4% in the Baseline scenario).

31-33 MANUFACTURING

Same as Baseline scenario.

41 WHOLESALE TRADE

Same as Baseline scenario.

44-45 RETAIL TRADE

Retail sub-sectors benefitting from development diffusion primarily include those involved in the sale of automobiles and related goods.

- ▶ **4411 Automobile dealers; 4413 Automotive parts, accessories, and tire stores; 4471 Gasoline stations:** Together, these three sub-sectors accounted for more than 13,000 jobs and represented nearly 15% of total retail trade employment in the Calgary region in 2018. Increasing the rate of development occurring outside of the urban centre is expected to raise demand for autos and related goods, as suburban residents are more likely to lack access to public transit and use autos for commuting and other travel purposes - often at longer distances. Each of these retail sub-sectors is projected to record average annual

employment growth at a rate above that of the Baseline scenario through the forecast period.

- ▶ **4442 Lawns and garden equipment and supplies stores:** It is possible that the higher rate of suburban development results in an increased level of demand for goods related to lawn and garden upkeep, as suburban homes typically feature larger lot sizes and lawns (relative to urban homes) which can require significant effort and expenditure to maintain. While this retail sub-sector is relatively small in the context of the Calgary region (representing approximately 500 jobs in 2018) and any gains resulting from sprawl are likely to be minimal, the employment impact is nonetheless positive and should contribute to overall growth in the retail trade industry group.

Overall, average annual employment growth in the retail trade industry group is projected at 1.1%.

48-49 TRANSPORTATION AND WAREHOUSING

Overall, development dispersion is expected to provide the transportation and warehousing industry group with a slight reduction in job creation through the forecast period, though the employment impact will likely differ across sub-sectors.

- ▶ **4853 Taxi and limousine service; 4854 School and employee bus transportation; 4911 Postal service; 4884 Support activities for road transportation:** A less centralized pattern of development is expected to increase the demand for some types of transportation employment. Residents in newly developed areas may lack access to efficient public transit, and could more frequently choose taxi services as an alternative form of travel. Dispersed residential development may result in schools serving larger areas of the city, reducing the feasibility of students walking to and from school and necessitating increased bussing. Demand for postal carriers may also increase slightly due to a less centralized service area. Lastly, some sub-sectors that support road transportation (such as towing services) could experience more activity due to the higher number of motorists. While these sub-sectors together represented a sizeable 11,000 jobs in the Calgary region in 2018 (16% of total transportation and warehousing employment), the respective boosts to job creation resulting from sprawl are likely to be minimal through the forecast period.
- ▶ **4851 Urban transit systems:** It is assumed that newly developed areas in the Calgary region would be provided public transit (i.e. bus), but likely at a reduced level of service relative to denser urban areas. These low density populations are more challenging to efficiently accommodate with public transit due to the length of travel distances, as well as the reduced propensity of these residents to choose public transit as a travel option. The shift away from centralized development is projected to reduce overall usage of public transit, potentially slowing job growth in this sub-sector.

Overall, average annual employment growth in this industry group is projected at 1.56% (from 1.5% in the Baseline scenario).

51 INFORMATION AND CULTURAL INDUSTRIES

Same as Baseline scenario.

52 FINANCE AND INSURANCE

Same as Baseline scenario.

53 REAL ESTATE AND RENTAL AND LEASING

Same as Baseline scenario.

54 PROFESSIONAL, SCIENTIFIC AND TECHNICAL SERVICES

Same as Baseline scenario.

55 MANAGEMENT OF COMPANIES AND ENTERPRISES

Same as Baseline scenario.

56 ADMINISTRATIVE AND SUPPORT, WASTE MANAGEMENT AND REMEDIATION SERVICES

Similar to the case of utilities and infrastructure construction, job growth in this industry group may increase slightly due to expanded areas of coverage required in the waste management and remediation services sub-sector (NAICS 562).

- ▶ **5621 Waste collection; 5622 Waste treatment and disposal:** While aggregate population growth (and associated waste creation) in the Calgary region is not necessarily higher in this scenario relative to the Baseline, the assumed shift away from centralized population centres implies that a greater amount of effort would be needed to provide an equivalent level of collection and treatment services. A increased number of waste collection routes, transfer stations, land fill sites and other treatment or disposal facilities is expected to accelerate hiring in these sub-sectors. However, waste collection, treatment and disposal accounted for just 1,500 jobs (4% of total industry group employment) in 2018, suggesting that even outsized hiring gains would unlikely to meaningfully impact overall employment growth in the industry group. This is particularly true in the long-term outlook, as technological innovation could potentially replace many workers in these sub-sectors with autonomous vehicles and robotics.³³

Overall, average annual employment growth in the administrative and support, waste management and remediation services industry group is projected at 1.3% (only slightly higher than the Baseline scenario).

³³ Chalmers University of Technology, Robot based Autonomous Refuse handling (ROAR), <https://www.chalmers.se/en/projects/Pages/RObot-based-Autonomous-Refuse-handling-QROARQ.aspx>

61 EDUCATIONAL SERVICES

Same as Baseline scenario.

62 HEALTH CARE AND SOCIAL ASSISTANCE

Same as Baseline scenario.

71 ARTS, ENTERTAINMENT AND RECREATION

Same as Baseline scenario.

72 ACCOMMODATION AND FOOD SERVICES

Same as Baseline scenario.

81 OTHER SERVICES (EXCEPT PUBLIC ADMINISTRATION)

Same as Baseline scenario.

91 PUBLIC ADMINISTRATION

The overall impact of increased sprawl on public sector employment in the Calgary region would likely generate additional job growth due to the dispersed demand for municipal services; as well as an increased need for planning professionals.

- **9130 Local, municipal and regional public administration:** Further decentralization of population density in the Calgary region could create employment opportunities at the local government level through an increased need for occupations such as land use planners, civil engineers, and policy researchers. Demand for these occupations would be driven by an increased prominence of issues associated with urban sprawl such as traffic congestion, environmental degradation, expanded areas requiring infrastructure and municipal services, and heightened competition for land across different uses and developers. However, increased sprawl is also likely to require increased capital and future servicing expenditure on part of local governments to fund and maintain new infrastructure - even if developers are expected to cover some portion of these costs.³⁴ Research findings have suggested that the property taxes paid by homeowners in the Calgary region are disproportionately low relative to the associated development and servicing costs, with non-residential property taxes bearing a greater share of the cost burden.³⁵

Overall, average annual employment growth in the public administration industry group is projected at 1.0% (from 0.8% in the Baseline scenario).

³⁴ Donnan, Jack A. Economic Implications and Consequences of Population Growth, Land Use Trends and Urban Sprawl in Southern Ontario, June 2008. <http://www.auditor.on.ca/en/content/reporttopics/envreports/env08/2008-sprawl.pdf>

³⁵ Fraser Institute, Who Bears the Burden of Property Taxes in Canada's Largest Metropolitan Areas?, October 17, 2019. <https://www.fraserinstitute.org/studies/who-bears-the-burden-of-property-taxes-in-canadas-largest-metropolitan-areas>

Appendix A: NAICS Industry Definition

Please refer to NAICS Industry Classification Table (below) for the industry names corresponding to the industry codes presented in the tables in this report.

NAICS Industry Classification³⁶

2-DIGIT NAICS CODE	INDUSTRY NAME
11	Agriculture, Forestry, Fishing and Hunting
21	Mining and Oil and Gas Extraction
22	Utilities
23	Construction
31-33	Manufacturing
41	Wholesale Trade
44-45	Retail Trade
48-49	Transportation and Warehousing
51	Information and Cultural Industries
52	Finance and Insurance
53	Real Estate and Rental and Leasing
54	Professional, Scientific and Technical Services
55	Management of Companies and Enterprises
56	Administrative and Support, Waste Management and Remediation Services
61	Educational Services
62	Health Care and Social Assistance
71	Arts, Entertainment and Recreation
72	Accommodation and Food Services
81	Other Services (except Public Administration)
91	Public Administration

The following section describes the methodology for describing the employment activities captured or excluded from the 2-digit North American Industry Classification System (NAICS) industry categories.

11 Agriculture, forestry, fishing and hunting

This sector comprises establishments primarily engaged in growing crops, raising animals, harvesting timber, harvesting fish and other animals from their natural habitats and providing related support activities. The establishments that are primarily engaged in agricultural research or that supply veterinary services are not included in this sector.

³⁶ Description of 2-digit NAICS from [Industry Canada](#)

21 Mining and oil and gas extraction

This sector comprises establishments primarily engaged in extracting naturally occurring minerals. These can be solids, such as coal and ores; liquids, such as crude petroleum; and gases, such as natural gas. It also includes establishments engaged in exploration, support activities for mineral, oil and gas extraction as well as those operating on a contract or fee basis.

22 Utilities

This sector comprises establishments primarily engaged in operating electric, gas and water utilities. These establishments generate, transmit, control and distribute electric power; distribute natural gas; treat and distribute water; operate sewer systems and sewage treatment facilities; and provide related services, generally through a permanent infrastructure of lines, pipes and treatment and processing facilities.

23 Construction

This sector comprises establishments primarily engaged in constructing, repairing and renovating buildings and engineering works, and in subdividing and developing land. These establishments may operate on their own account or under contract to other establishments or property owners. These establishments may be involved from the project start till its completion or be involved in joint ventures. Activities include: construction of buildings; land subdivision and land development; engineering construction; construction management; site preparation work; building interior finishing work; building equipment installation, other specialty contractors. Establishments that are excluded from this category are those which are primarily engaged in manufacturing and installing building equipment, such as power boilers; manufacturing pre-fabricated buildings (31-33, Manufacturing); operating highways, streets and bridges (48-49, Transportation and Warehousing); projects management services, when it is a primary activity (54133, Engineering Services); maintenance of rights of way for power, communication and pipe lines; and cleaning building exteriors after construction (56, Administrative and Support, Waste Management and Remediation Services).

31-33 Manufacturing

This sector comprises establishments primarily engaged in the physical or chemical transformation of materials or substances into new products. These products may be finished, in the sense that they are ready to be used or consumed, or semi-finished, in the sense of becoming a raw material for an establishment to use in further manufacturing. Related activities, such as the assembly of the component parts of manufactured goods; the blending of materials; and the finishing of manufactured products by dyeing, heat-treating, plating and similar operations are also treated as manufacturing activities.

Certain activities involving the transformation of goods are classified in other sectors. Some examples are post-harvest activities of agricultural establishments, such as crop drying; logging; the beneficiating of mineral ores; the production of structures by construction establishments; and various activities conducted by retailers, such as meat cutting and the assembly of products such as bicycles and computers.

41 Wholesale trade

This sector comprises establishments primarily engaged in wholesaling merchandise and providing related logistics, marketing and support services. The wholesaling process is generally an intermediate step in the distribution of merchandise; many wholesalers are therefore organized to sell merchandise

in large quantities to retailers, and business and institutional clients. However, some wholesalers, in particular those that supply non-consumer capital goods, sell merchandise in single units to final users.

This sector recognizes two main types of wholesalers, that is, wholesale merchants and wholesale agents and brokers.

Wholesale merchants buy and sell merchandise on their own account, that is, they take title to the goods they sell. They generally operate from warehouse or office locations and they may ship from their own inventory or arrange for the shipment of goods directly from the supplier to the client. Dealers of machinery and equipment, such as dealers of farm machinery and heavy-duty trucks, also fall within this category.

Wholesale Agents and Brokers

Wholesale agents and brokers buy and sell merchandise owned by others on a fee or commission basis. They do not take title to the goods they buy or sell, and they generally operate at or from an office location.

44-45 Retail trade

The retail trade sector comprises establishments primarily engaged in retailing merchandise, generally without transformation, and rendering services incidental to the sale of merchandise.

The retailing process is the final step in the distribution of merchandise; retailers are therefore organized to sell merchandise in small quantities to the general public. This sector comprises two main types of retailers, that is, store and non-store retailers.

Store retailers operate fixed point-of-sale locations, located and designed to attract a high volume of walk-in customers. In general, retail stores have extensive displays of merchandise and use mass-media advertising to attract customers. They typically sell merchandise to the general public for personal or household consumption, but some also serve business and institutional clients. Catalogue sales showrooms, gasoline service stations, and mobile home dealers are treated as store retailers.

Non-store retailers, like store retailers, are organized to serve the general public, but their retailing methods differ. The establishments of this subsector reach customers and market merchandise with methods such as the broadcasting of infomercials, the broadcasting and publishing of direct-response advertising, the publishing of traditional and electronic catalogues, door-to-door solicitation, in-home demonstration, temporary displaying of merchandise (stalls) and distribution by vending machines. The non-store retailers subsector also includes establishments engaged in the home delivery of products. This includes home heating oil dealers and newspaper delivery companies.

48-49 Transportation and warehousing

This sector comprises establishments primarily engaged in transporting passengers and goods, warehousing and storing goods, and providing services to these establishments. The modes of transportation are road (trucking, transit and ground passenger), rail, water, air and pipeline. National post office and courier establishments, which also transport goods, are included in this sector. Many of the establishments in this sector are structured as networks, with activities, workers, and physical facilities distributed over an extensive geographic area.

The establishments excluded from this category are those which are primarily engaged in the renting and leasing of transportation equipment without operator (532, Rental and Leasing Services).

51 Information and cultural industries

This sector comprises establishments primarily engaged in producing and distributing (except by wholesale and retail methods) information and cultural products. Establishments providing the means to transmit or distribute these products or providing access to equipment and expertise for processing data are also included.

The unique characteristics of information and cultural products, and of the processes involved in their production and distribution, distinguish this sector from the goods-producing and services-producing sectors.

Most of these products are protected from unlawful reproduction by copyright laws. Only those possessing the rights to these works are authorized to reproduce, alter, improve and distribute them. Acquiring and using these rights often involves significant costs.

The main components of this sector are the publishing industries (except exclusively on Internet), including software publishing, the motion picture and sound recording industries, the broadcasting industries (except exclusively on Internet), the telecommunications and related services industries (i.e., telephony, including VoIP; cable and satellite television distribution services; Internet access; telecommunications reselling services), data processing industries, and the other information services industries, including Internet publishing and broadcasting and web search portals.

52 Finance and insurance

This sector comprises establishments primarily engaged in financial transactions or in facilitating financial transactions. Included are: Establishments that are primarily engaged in financial intermediation. Establishments that are primarily engaged in the pooling of risk by underwriting annuities and insurance. Establishments that are primarily engaged in providing specialized services that facilitate or support financial intermediation, insurance and employee benefit programs. In addition, establishments charged with monetary control - the monetary authorities - are included in this sector.

53 Real estate and rental and leasing

This sector comprises establishments primarily engaged in renting, leasing or otherwise allowing the use of tangible or intangible assets. Establishments primarily engaged in managing real estate for others; selling, renting and/or buying of real estate for others; and appraising real estate, are also included.

54 Professional, scientific and technical services

This sector comprises establishments primarily engaged in activities in which human capital is the major input. These establishments make available the knowledge and skills of their employees, often on an assignment basis. The individual industries of this sector are defined on the basis of the particular expertise and training of the service provider.

The main components of this sector are legal services industries, accounting and related services industries, architectural, engineering and related services industries, surveying and mapping services industries, design services industries, management, scientific and technical consulting services industries, scientific research and development services industries, and advertising services industries.

Much of the expertise requires a university or college education, though not in every case.

Establishments that have been excluded are those primarily engaged in providing instruction and training in a wide variety of subjects and those primarily engaged in providing health care by diagnosis and treatment are not included in this sector.

55 Management of companies and enterprises

This sector comprises establishments primarily engaged in managing companies and enterprises and/or holding the securities or financial assets of companies and enterprises, for the purpose of owning a controlling interest in them and/or influencing their management decisions. They may undertake the function of management, or they may entrust the function of financial management to portfolio managers.

56 Administrative and support, waste management and remediation services

This sector comprises two different types of establishments: those primarily engaged in activities that support the day-to-day operations of other organizations; and those primarily engaged in waste management activities.

The first type of establishment is engaged in activities such as administration, hiring and placing personnel, preparing documents, taking orders from clients, collecting payments for claims, arranging travel, providing security and surveillance, cleaning buildings, and packaging and labelling products. These activities are often undertaken, in-house, by establishments found in many sectors of the economy. The establishments classified to this sector specialize in one or more of these activities and can therefore provide services to clients in a variety of industries and, in some cases, to households.

Waste management establishments are engaged in the collection, treatment and disposal of waste material, the operation of material recovery facilities, the remediation of polluted sites and the cleaning of septic tanks.

61 Educational services

This sector comprises establishments primarily engaged in providing instruction and training in a wide variety of subjects. This instruction and training is provided by specialized establishments, such as schools, colleges, universities and training centres. These establishments may be privately owned and operated, either for profit or not, or they may be publicly owned and operated. They may also offer food and accommodation services to their students.

62 Health care and social assistance

This sector comprises establishments primarily engaged in providing health care by diagnosis and treatment, providing residential care for medical and social reasons, and providing social assistance, such as counseling, welfare, child protection, community housing and food services, vocational rehabilitation and child care, to those requiring such assistance.

71 Arts, entertainment and recreation

This sector comprises establishments primarily engaged in operating facilities or providing services to meet the cultural, entertainment and recreational interests of their patrons. These establishments produce, promote or participate in live performances, events or exhibits intended for public viewing; provide the artistic, creative and technical skills necessary for the production of artistic products and live performances; preserve and exhibit objects and sites of historical, cultural or educational interest;

and operate facilities or provide services that enable patrons to participate in sports or recreational activities or pursue amusement, hobbies and leisure-time interests.

Establishments that are excluded for the reason that they fall into other related NAICS categories are follows. Establishments primarily engaged in transportation providing sightseeing and pleasure cruises (48-49, Transportation and Warehousing),

motion picture theatres, libraries and archives, and publishers of newspapers, magazines, books, periodicals and computer software (51, Information and Cultural Industries), establishments that provide both accommodation and recreational facilities, such as hunting and fishing camps, resorts and casino hotels (721, Accommodation Services), restaurants and night clubs that provide live entertainment in addition to the sale of food and beverages (722, Food Services and Drinking Places).

72 Accommodation and food services

This sector comprises establishments primarily engaged in providing short-term lodging and complementary services to travellers, vacationers and others, in facilities such as hotels, motor hotels, resorts, motels, casino hotels, bed and breakfast accommodation, housekeeping cottages and cabins, recreational vehicle parks and campgrounds, hunting and fishing camps, and various types of recreational and adventure camps. This sector also comprises establishments primarily engaged in preparing meals, snacks and beverages, to customer order, for immediate consumption on and off the premises.

81 Other services (except public administration)

This sector comprises establishments, not classified to any other sector, primarily engaged in repairing, or performing general or routine maintenance, on motor vehicles, machinery, equipment and other products to ensure that they work efficiently; providing personal care services, funeral services, laundry services and other services to individuals, such as pet care services and photo finishing services; organizing and promoting religious activities; supporting various causes through grant-making, advocating (promoting) various social and political causes, and promoting and defending the interests of their members. Private households are also included.

91 Public administration

This sector comprises establishments primarily engaged in activities of a governmental nature, that is, the enactment and judicial interpretation of laws and their pursuant regulations, and the administration of programs based on them. Legislative activities, taxation, national defence, public order and safety, immigration services, foreign affairs and international assistance, and the administration of government programs are activities that are purely governmental in nature.

Ownership is not a criterion for classification. Government owned establishments engaged in activities that are not governmental in nature are classified to the same industry as privately owned establishments engaged in similar activities.

Government establishments may engage in a combination of governmental and non-governmental activities. When separate records are not available to separate the activities that are not governmental in nature from those that are, the establishment is classified to this sector.

Appendix B: Parameter Descriptions/Diagrams

This analysis uses a set of assumed scenario-specific parameters to forecast industry-specific employment growth. Parameter values are assigned in a range of 0 to 5, in increments of 0.5. Parameter impacts are usually applied at the industry-specific (4-digit NAICS) output (real GDP) level, which are then translated to employment impacts.³⁷ Increasing the assumed value of a parameter amplifies the positive or negative GDP impact. The parameters include:

- **Technological Change:** The magnitude of this parameter reflects the assumed pace at which the economy develops and adopts new forms of productivity-enhancing technology. The impact of technological progress has two components in this analysis. The first is an exclusively non-negative GDP impact related to the relative speed and ease with which an industry is expected to integrate new technology. Technology types include biotechnology, business intelligence, design and information control, geomatics or geospatial, material handling and logistics, medical, nanotechnology, and process innovations. These impacts were estimated based on Statistics Canada's Survey of Advanced Technology.³⁸ The second component of technological change is an exclusively non-positive employment impact related to the likelihood of occupations in that industry being automated. These negative impacts are applied only to employment, as affected workers are assumed to be replaced by capital that is equally productive. These impacts were estimated based on an amalgam of sources.
- **Environmental Stewardship:** The magnitude of this parameter reflects the assumed degree of effort and valuation that society places on environmental sustainability. Industries whose means of production is significantly detrimental to the environment, or are expected to encounter difficulties in adopting new forms of green technology are assumed to grow at a slower pace relative to environmentally "clean" industries, or those industries expected to easily integrate green technology into their production processes. These impacts were estimated based on Statistics Canada's Survey of Advanced Technology.³⁹
- **Trade Liberalization:** The magnitude of this parameter reflects the extent to which interprovincial and international trading conditions will be liberalized in future years. Examples of trade liberalization include the removal or reduction of tariffs, or the implementation of free trade agreements. Each industry's degree of trade exposure, both interprovincially and internationally, was estimated using Statistics Canada's Supply and Use tables (2016).⁴⁰ The extent to which an industry is expected to benefit from further liberalization of trade conditions was generally based on the share of local consumption imported and the share of local production exported. As well, inter-industry trade of inputs to production was considered.
- **Social Development:** This parameter estimates the impact of household income convergence on consumer spending. A larger parameter value assumes that income disparity in the Calgary region is (to an extent) diminished. As households with relatively lower incomes transition into higher income brackets, their spending patterns would be expected to change, with some industries

³⁷ The technological change parameter, as it relates to worker automation, is applied only to employment and does not affect an industry's GDP (output). It is assumed that automated positions are replaced by capital that is (at least) as productive.

³⁸ Statistics Canada, Survey of Advanced Technology (SAT). <https://www23.statcan.gc.ca/imdb/p2SV.pl?Function=getSurvey&SDDS=4223>

³⁹ Ibid.

⁴⁰ Statistics Canada, Supply and Use Tables, Reference period 2016. <https://www150.statcan.gc.ca/n1/pub/15-602-x/15-602-x2017001-eng.htm>

potentially benefitting (and others losing). Spending patterns across income groups in Alberta were estimated using Statistics Canada's Survey of Household Spending.⁴¹

- **Development Density:** Generally, this analysis assumes that future development will follow the target outlined in Calgary's Municipal Development Plan which aims to accommodate 50% of population growth within developed areas of the city. An exception is the Development Dispersion scenario where this guideline is assumed to be removed, resulting in a greater proportion of greenfield development. As such, this parameter is unique to the Development Dispersion scenario, and includes both positive and negative industry-specific GDP impacts. The specific industries expected to be affected by reduced population and employment densities, and the magnitude of each impact, were estimated based on independent research.
- **Economic Diversification:** The industries expected to benefit from increased economic diversification efforts in the Calgary region was generally based on the key sectors outlined by Calgary Economic Development,⁴² as well as those industries underrepresented in the Calgary region that were identified as possessing growth potential.
- **Climate Change:** This parameter is assumed to be unique to the Climate Change scenario, and includes both positive and negative industry-specific GDP impacts. The specific industries expected to be affected by climate change and the magnitude of each impact were estimated based on independent research.
- **Demographic Shift:** This parameter is assumed to be unique to the Baseline with Dynamic Demographic Change scenario, and includes both positive and negative industry-specific GDP impacts. The specific industries expected to be affected by declining fertility and mortality rates, and the magnitude of the impact, were estimated based on independent research.

The table below displays the assumed parameter values for each of the six scenarios.

⁴¹ Statistics Canada, Table 17-10-0223-01, Household spending by household income quintile, Canada, regions and provinces. <https://www150.statcan.gc.ca/t1/tbl/en/tv.action?pid=1110022301>

⁴² Calgary Economic Development, Industries Driving Calgary and Alberta's economy. <https://calgaryeconomicdevelopment.com/industries/>

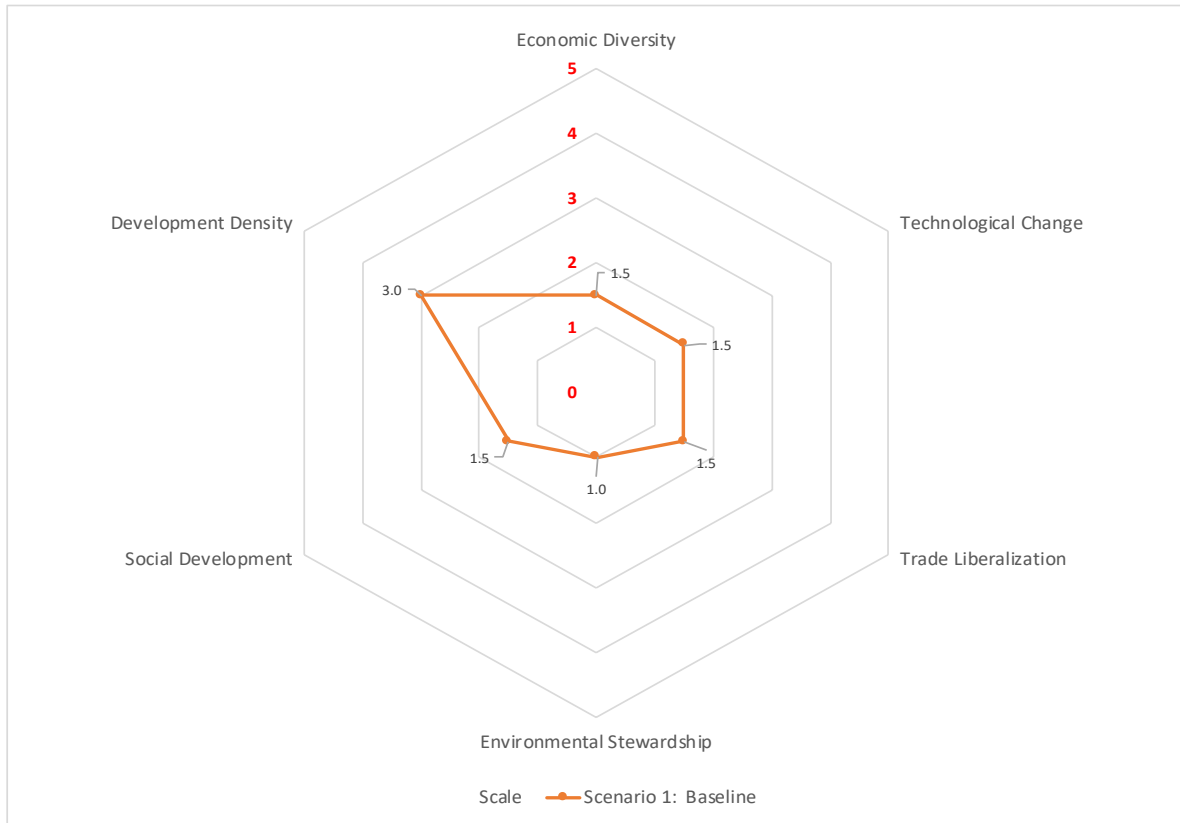
Scenario-Specific Assumed Parameter Values

PARAMETER	SCENARIO					
	BASELINE	BASELINE W/ DEMO. CHANGE	INDUSTRY DIV.	TECH. ADVANCEMENT	CLIMATE CHANGE	DEV. DISPERSION
Technological Change	1.5	2.0	4.0	5.0	1.5	1.5
Environmental Stewardship	1.0	1.0	4.0	3.5	5.0	1.0
Trade Liberalization	1.5	1.5	4.0	3.5	1.5	1.5
Social Development	1.5	2.0	3.0	2.0	1.5	1.5
Development Density	3.0	3.0	3.0	3.0	3.0	0.0
Economic Diversification	1.5	1.5	5.0	3.0	1.5	1.5
Climate Change	0.0	0.0	0.0	0.0	5.0	0.0
Demographic Shift	0.0	5.0	0.0	0.0	5.0	0.0

The diagrams presented at the beginning of each scenario section in this report show how the parameters described above were assumed relative to the Baseline scenario. Parameter values increase moving outward from the centre of the diagram, from a minimum value of 0 (centre of the diagram) to a maximum of 5, in increments of 0.5. Note that the climate change and demographic shift parameters are not shown on the diagrams because they are unique to the Climate Change and Baseline with Dynamic Demographic Change scenarios, respectively.

The example diagram below displays the assumed parameter values for the Baseline scenario (with parameter values in black text), as well as the diagram scale (in red text).

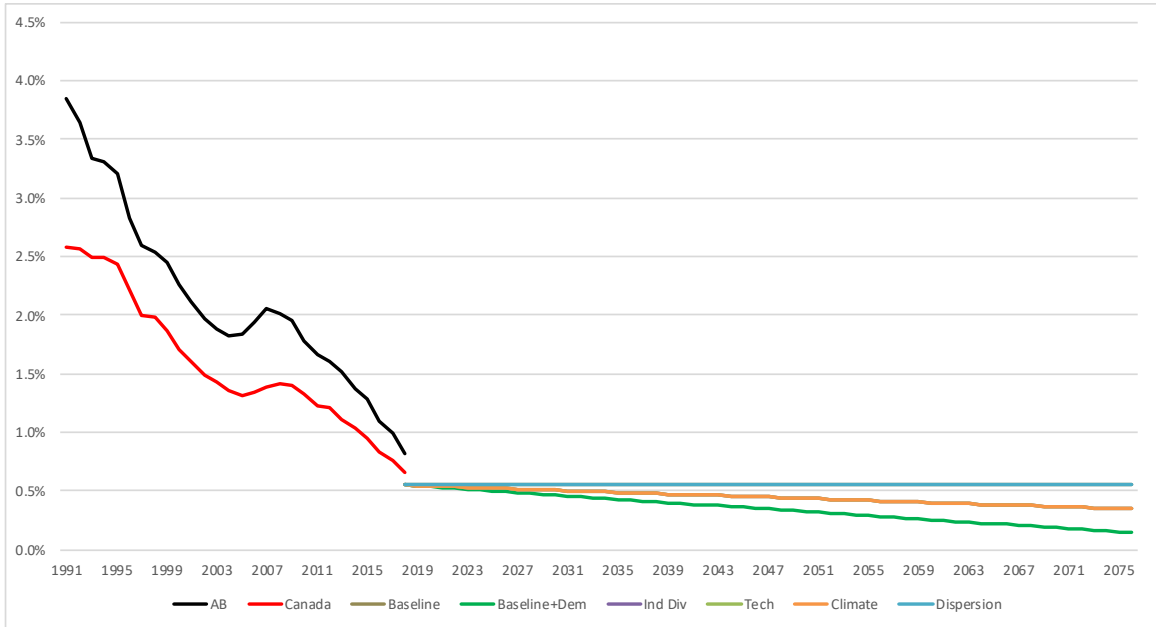
Diagram Example with Scale and Assumed Parameter Values for Baseline Scenario



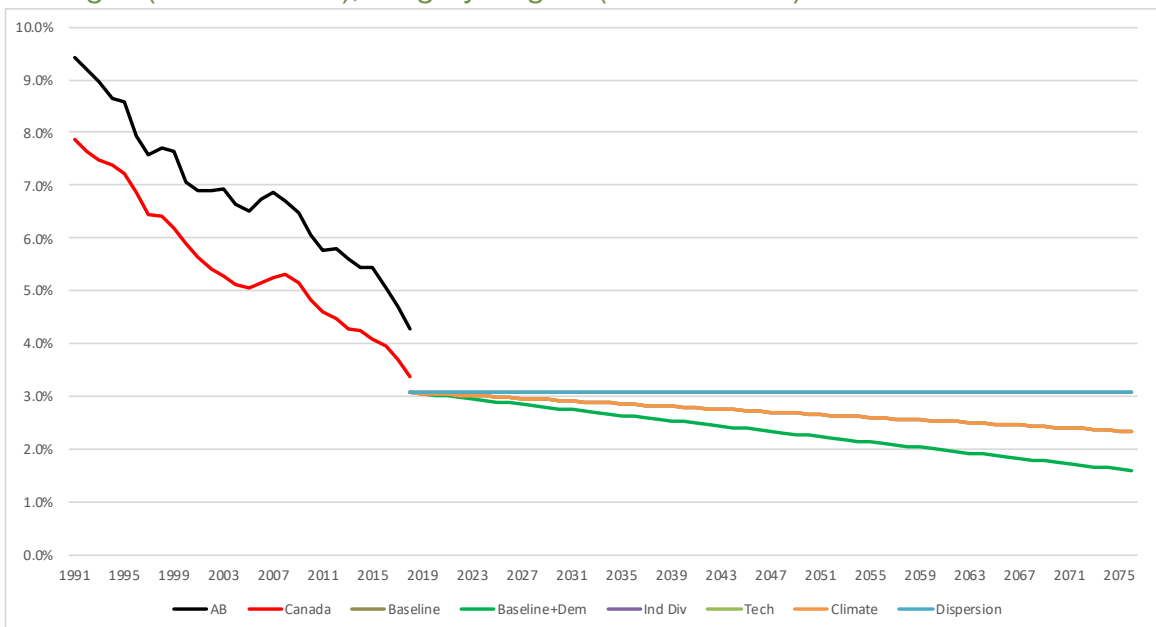
Appendix C: Fertility and Mortality Rate Charts

FERTILITY CHARTS

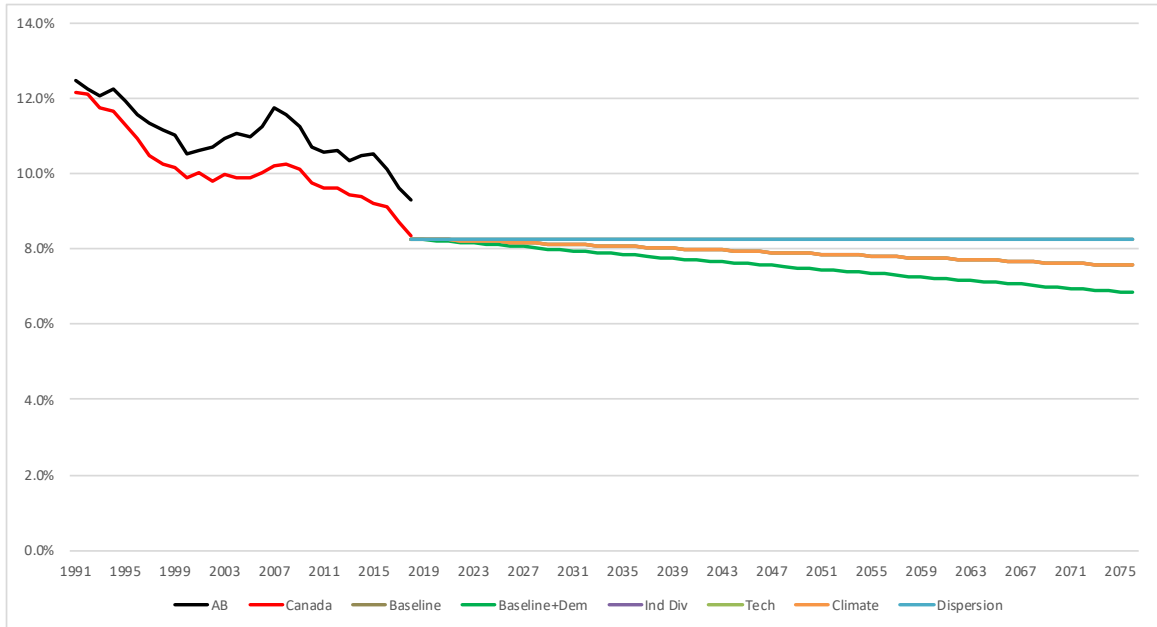
Historical and Projected Fertility Rate (15 to 19 Years), National and Alberta Averages (1991 to 2018), Calgary Region (2018 to 2076)



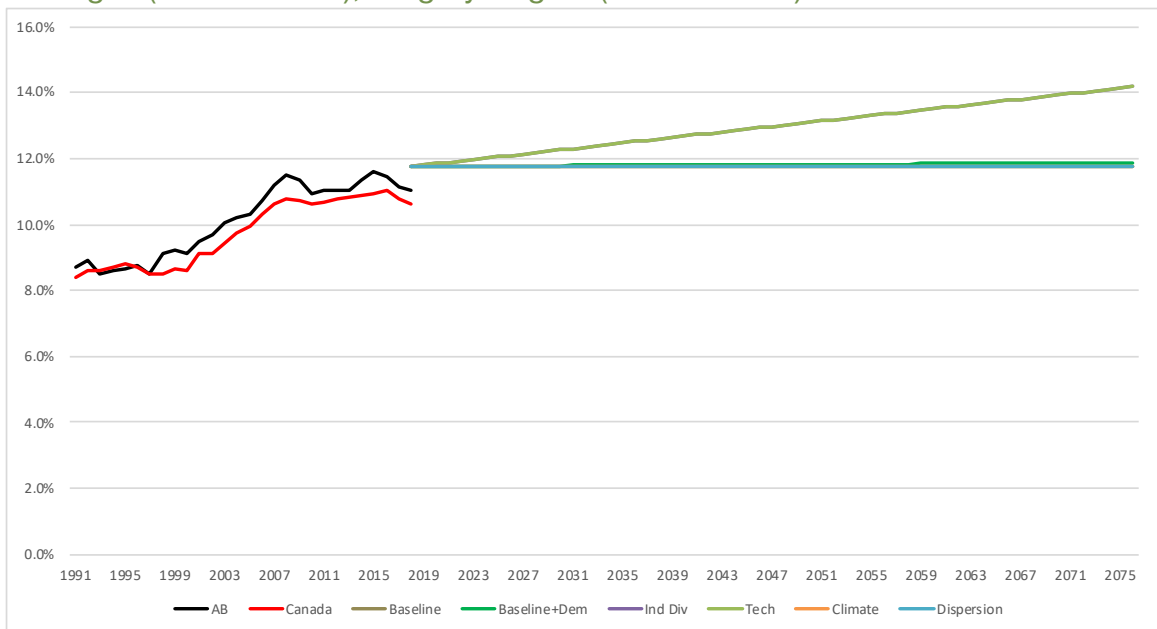
Historical and Projected Fertility Rate (20 to 24 Years), National and Alberta Averages (1991 to 2018), Calgary Region (2018 to 2076)



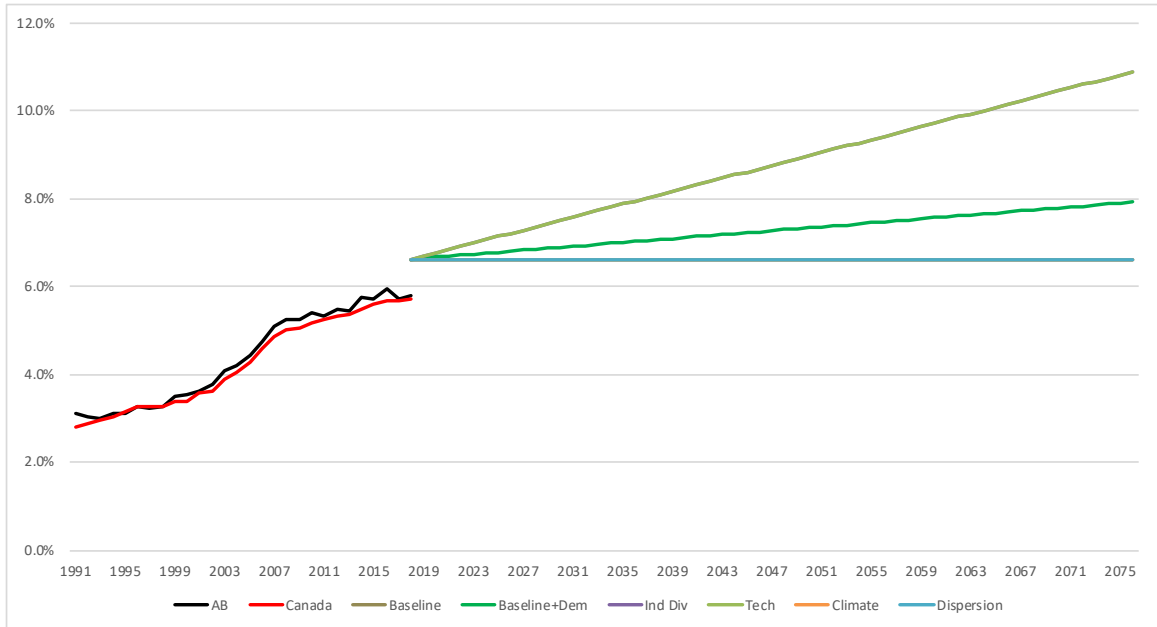
Historical and Projected Fertility Rate (25 to 29 Years), National and Alberta Averages (1991 to 2018), Calgary Region (2018 to 2076)



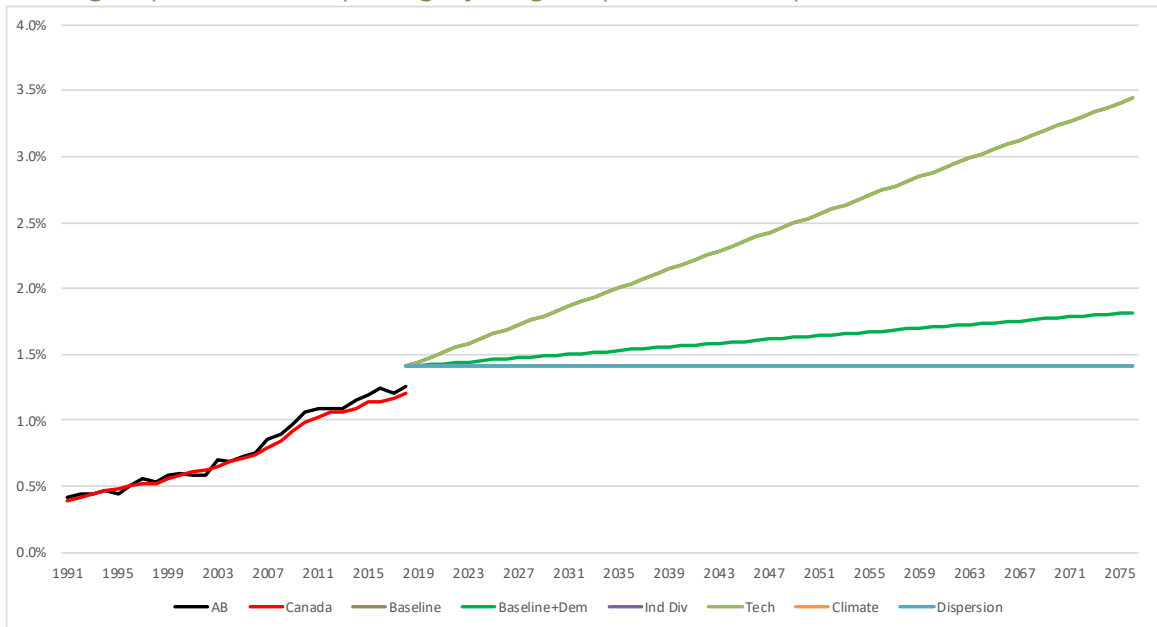
Historical and Projected Fertility Rate (30 to 34 Years), National and Alberta Averages (1991 to 2018), Calgary Region (2018 to 2076)



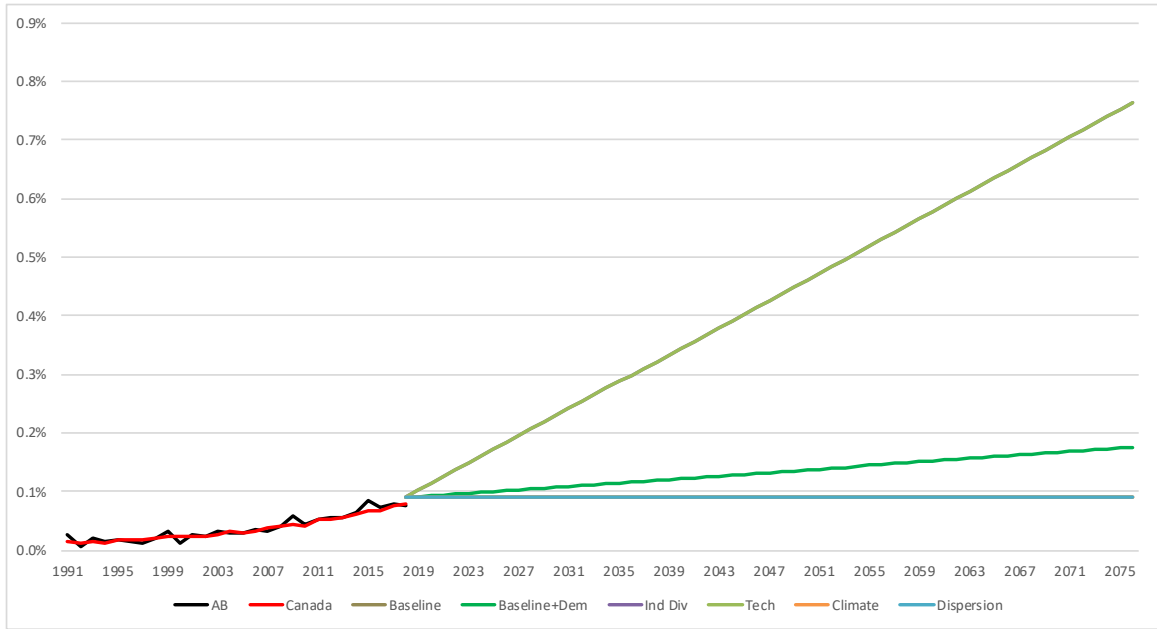
Historical and Projected Fertility Rate (35 to 39 Years), National and Alberta Averages (1991 to 2018), Calgary Region (2018 to 2076)



Historical and Projected Fertility Rate (40 to 44 Years), National and Alberta Averages (1991 to 2018), Calgary Region (2018 to 2076)

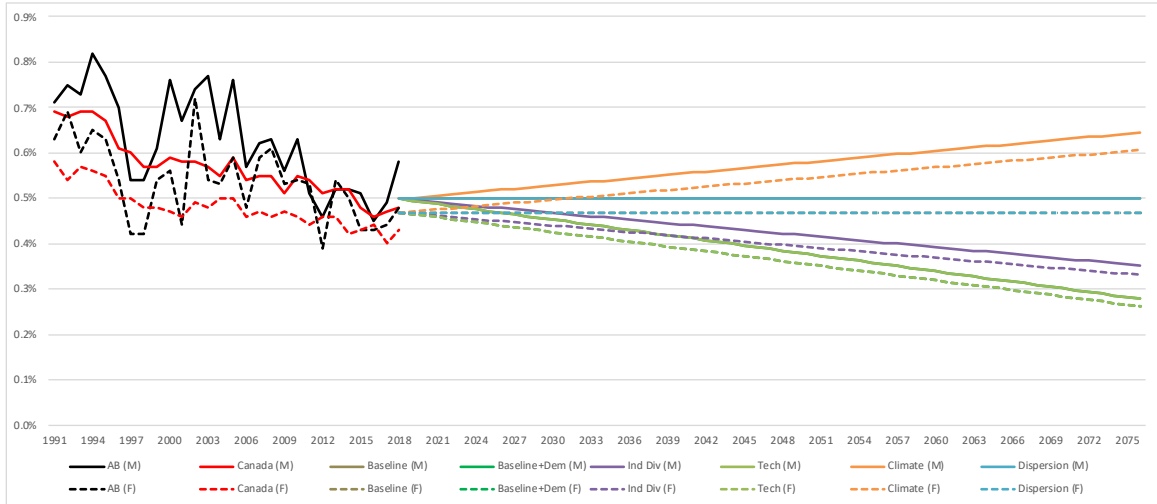


Historical and Projected Fertility Rate (45 to 49 Years), National and Alberta Averages (1991 to 2018), Calgary Region (2018 to 2076)

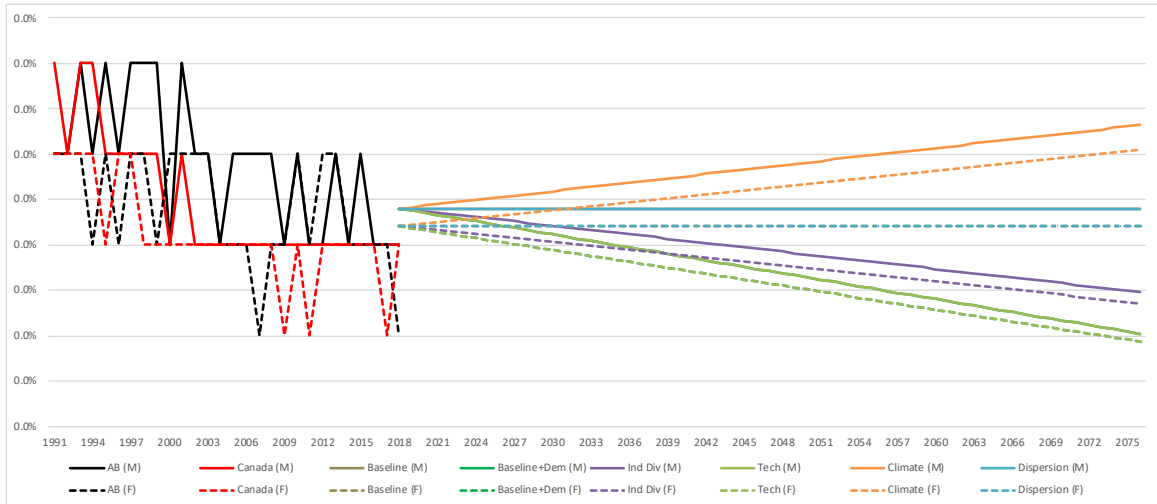


MORTALITY CHARTS

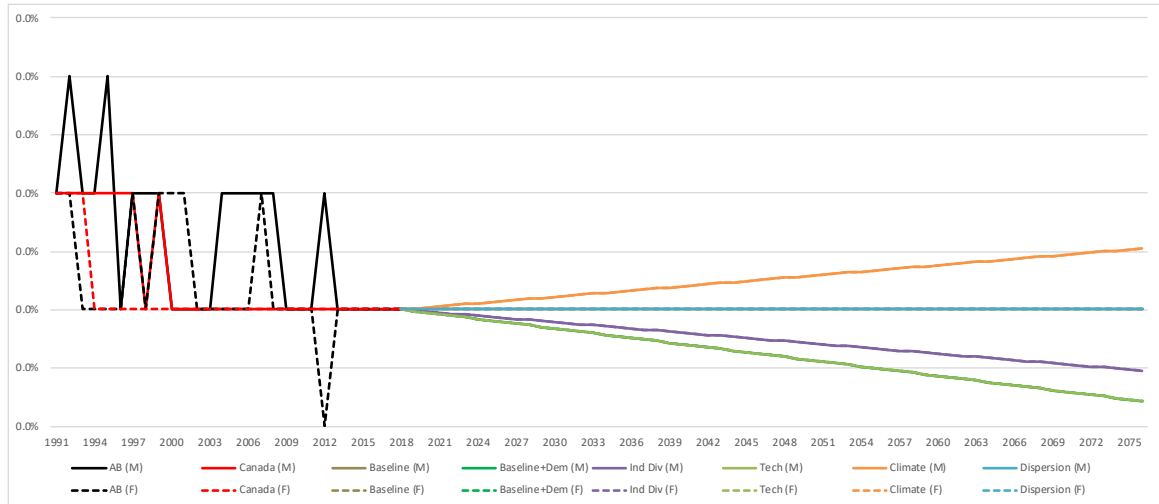
Male and Female Historical and Projected Mortality Rates (Less Than 1 Year), National and Alberta Averages (1991 to 2018), Calgary Region (2018 to 2076)



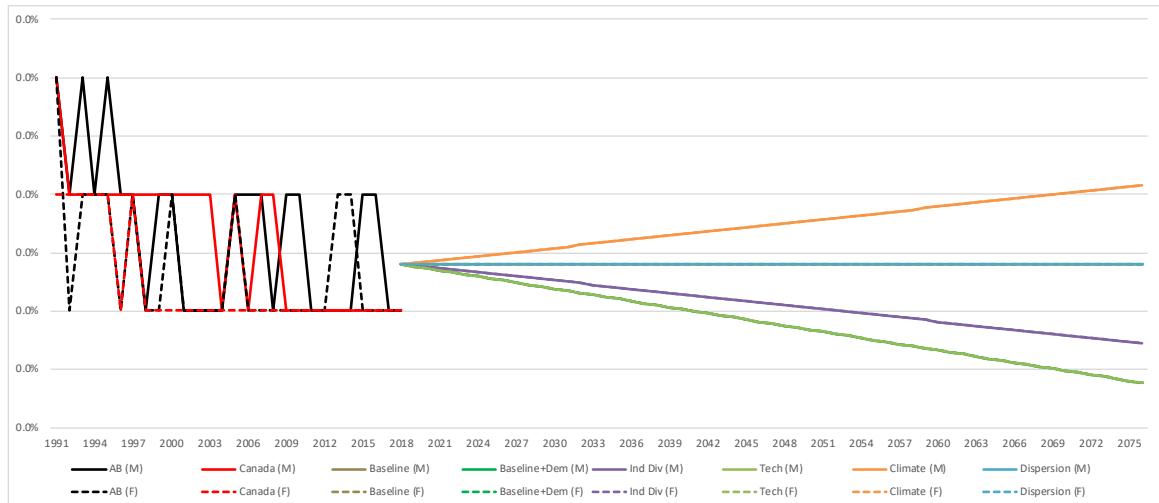
Male and Female Historical and Projected Mortality Rates (1 to 4 Years), National and Alberta Averages (1991 to 2018), Calgary Region (2018 to 2076)



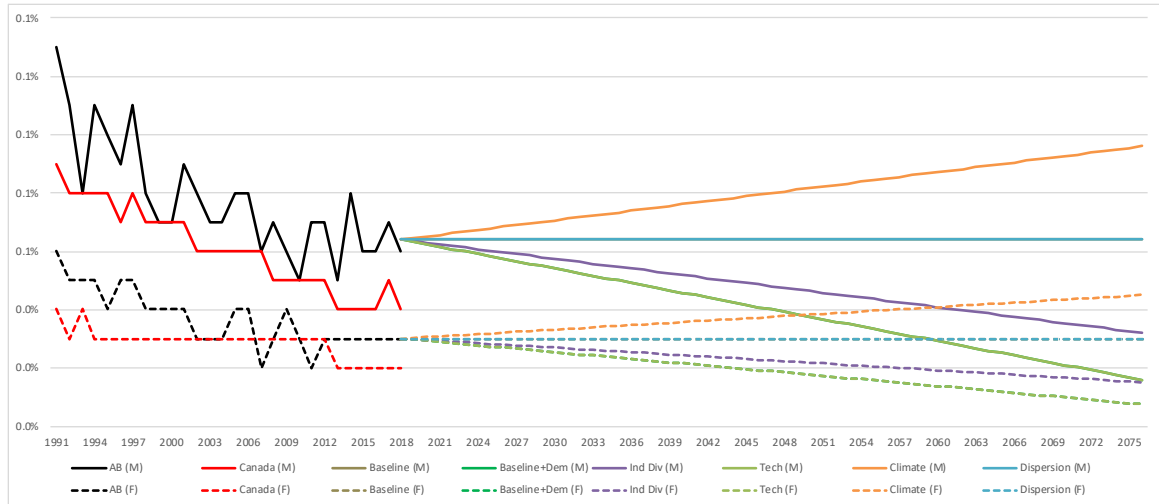
Male and Female Historical and Projected Mortality Rates (5 to 9 Years), National and Alberta Averages (1991 to 2018), Calgary Region (2018 to 2076)



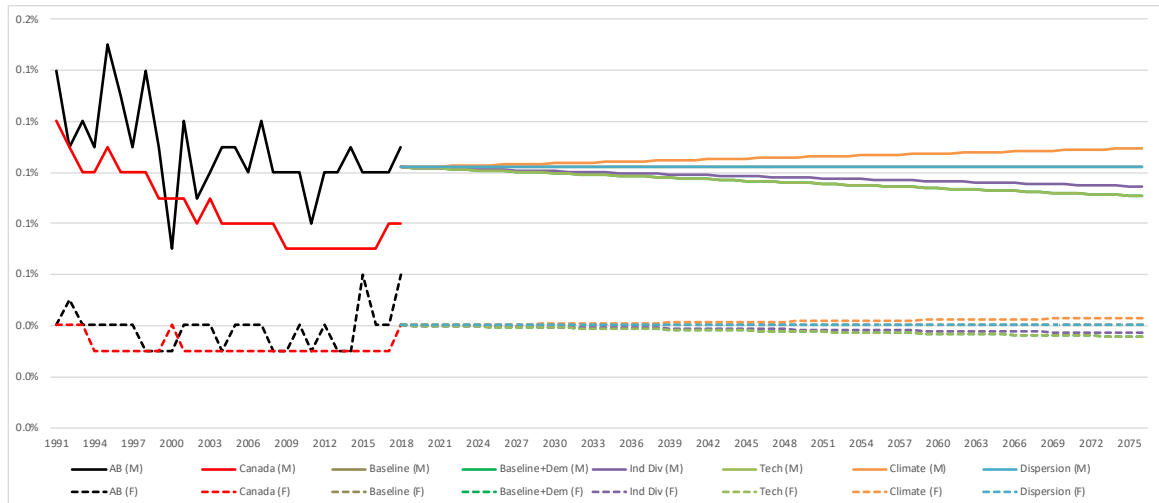
Male and Female Historical and Projected Mortality Rates (10 to 14 Years), National and Alberta Averages (1991 to 2018), Calgary Region (2018 to 2076)



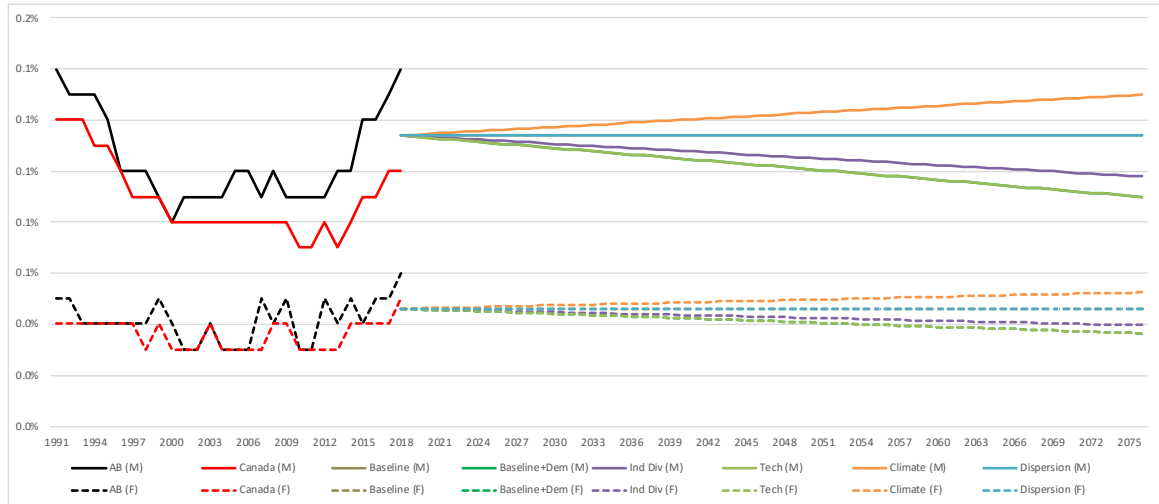
Male and Female Historical and Projected Mortality Rates (15 to 19 Years), National and Alberta Averages (1991 to 2018), Calgary Region (2018 to 2076)



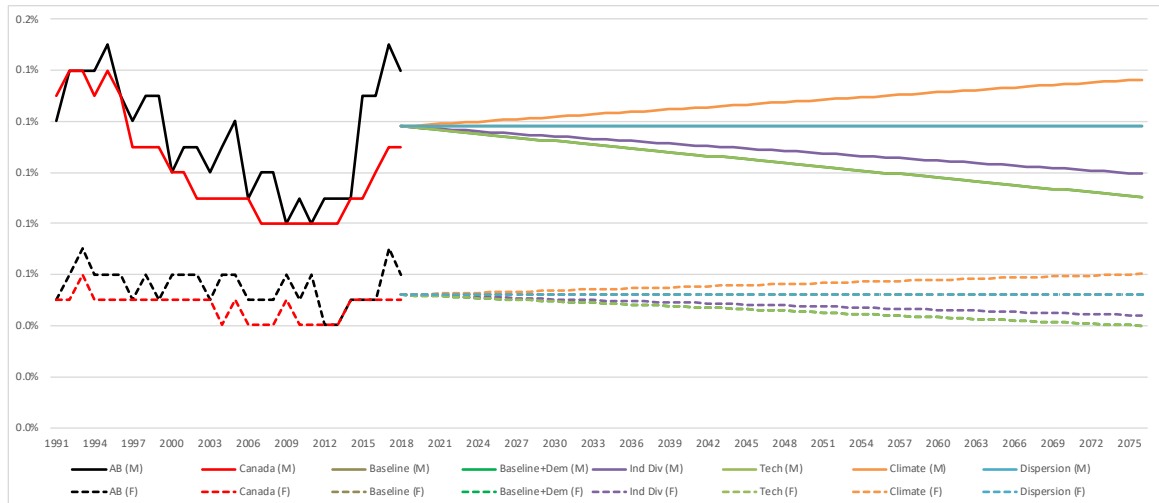
Male and Female Historical and Projected Mortality Rates (20 to 24 Years), National and Alberta Averages (1991 to 2018), Calgary Region (2018 to 2076)



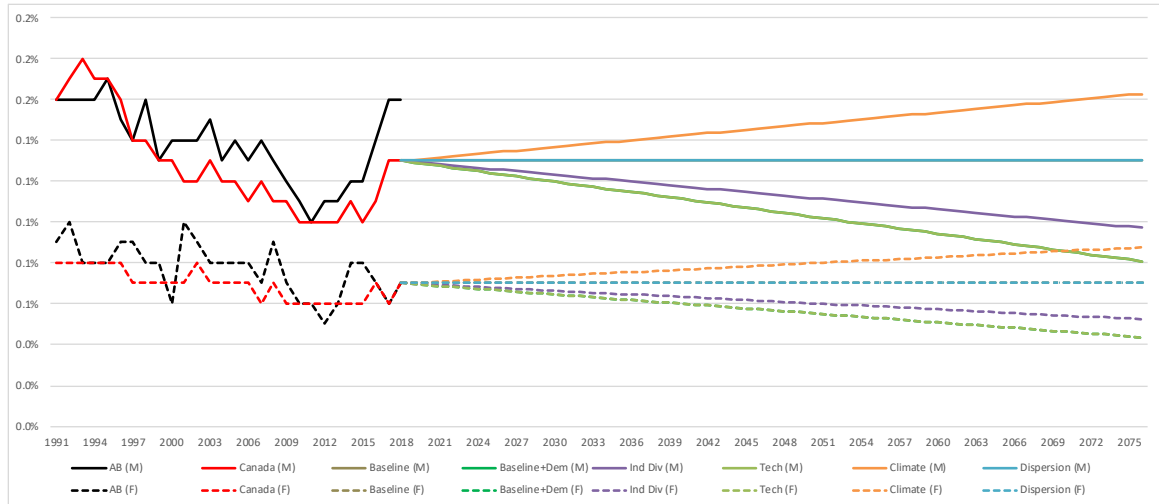
Male and Female Historical and Projected Mortality Rates (25 to 29 Years), National and Alberta Averages (1991 to 2018), Calgary Region (2018 to 2076)



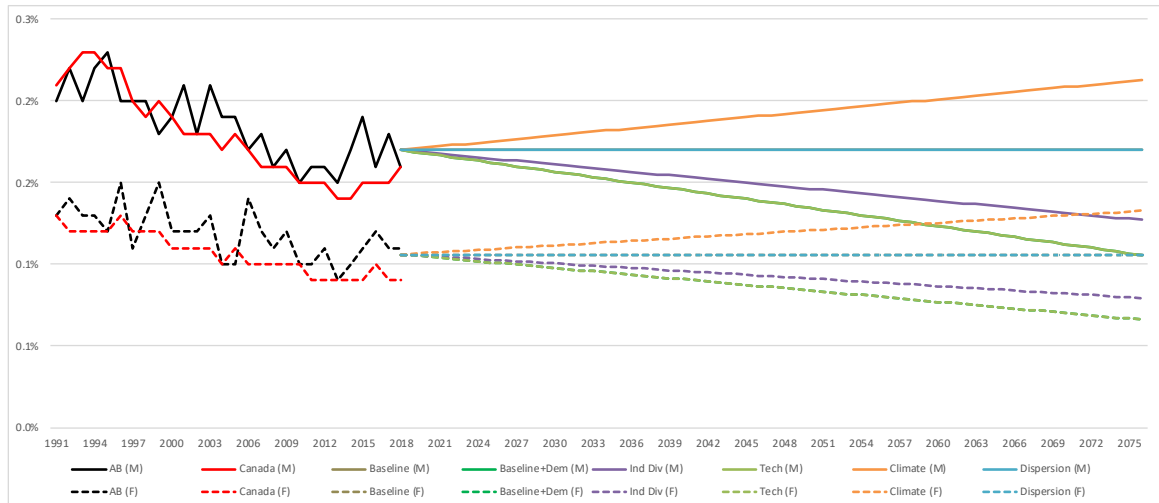
Male and Female Historical and Projected Mortality Rates (30 to 34 Years), National and Alberta Averages (1991 to 2018), Calgary Region (2018 to 2076)



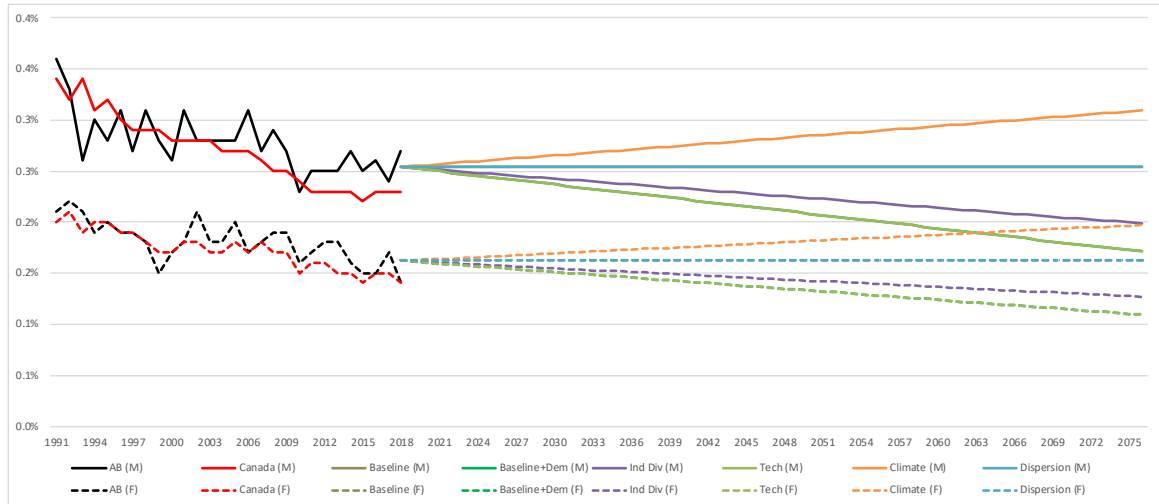
Male and Female Historical and Projected Mortality Rates (35 to 39 Years), National and Alberta Averages (1991 to 2018), Calgary Region (2018 to 2076)



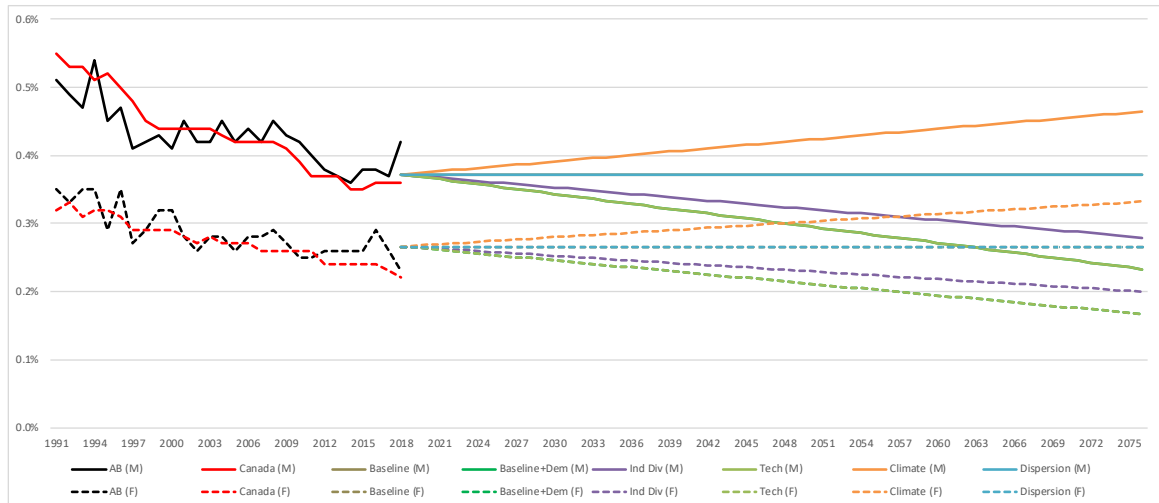
Male and Female Historical and Projected Mortality Rates (40 to 44 Years), National and Alberta Averages (1991 to 2018), Calgary Region (2018 to 2076)



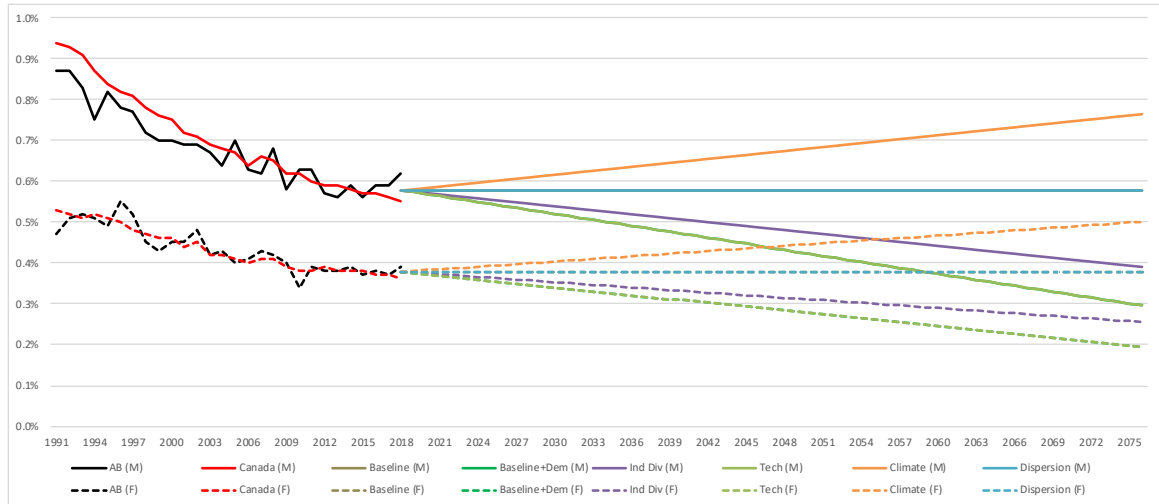
Male and Female Historical and Projected Mortality Rates (45 to 49 Years), National and Alberta Averages (1991 to 2018), Calgary Region (2018 to 2076)



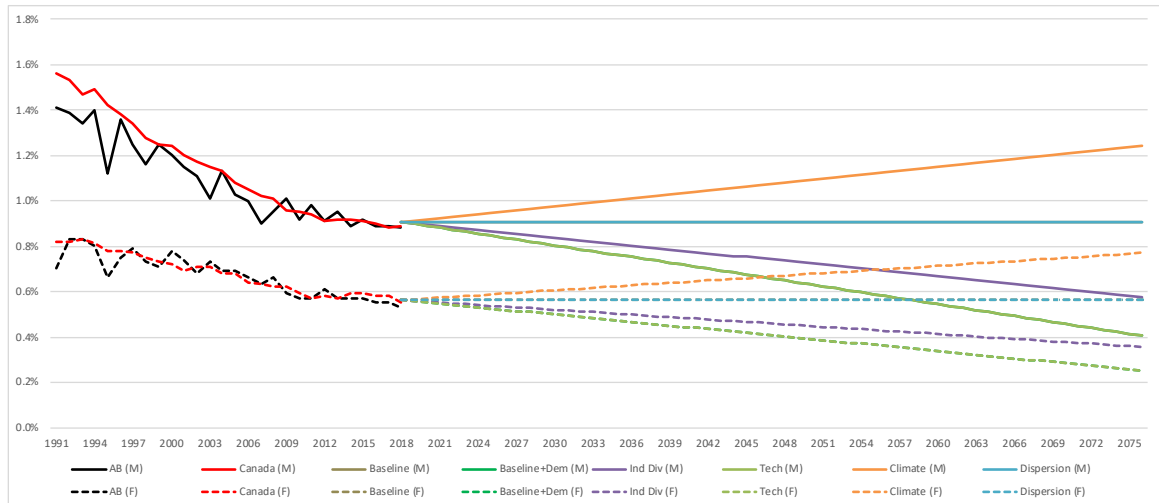
Male and Female Historical and Projected Mortality Rates (50 to 54 Years), National and Alberta Averages (1991 to 2018), Calgary Region (2018 to 2076)



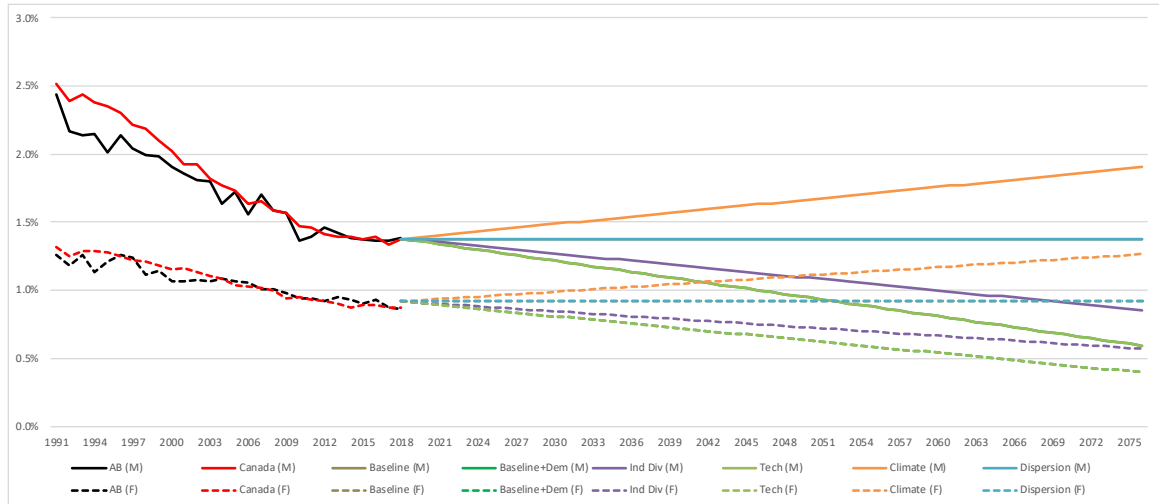
Male and Female Historical and Projected Mortality Rates (55 to 59 Years), National and Alberta Averages (1991 to 2018), Calgary Region (2018 to 2076)



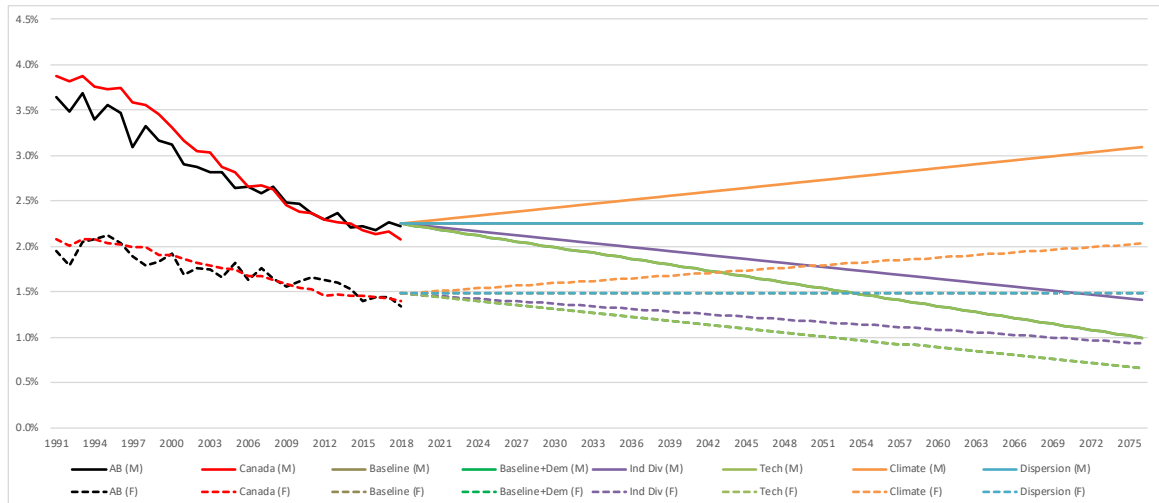
Male and Female Historical and Projected Mortality Rates (60 to 64 Years), National and Alberta Averages (1991 to 2018), Calgary Region (2018 to 2076)



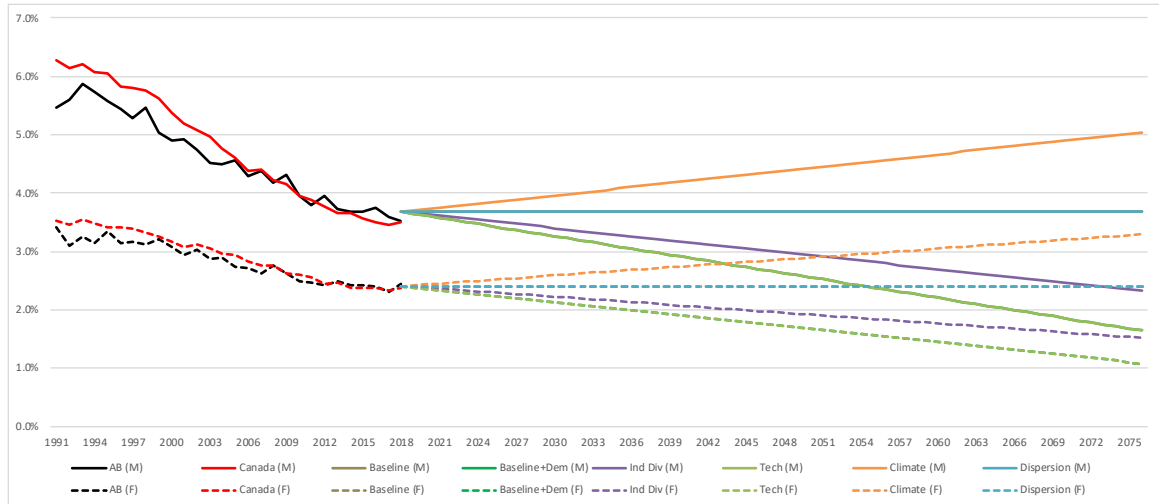
Male and Female Historical and Projected Mortality Rates (65 to 69 Years), National and Alberta Averages (1991 to 2018), Calgary Region (2018 to 2076)



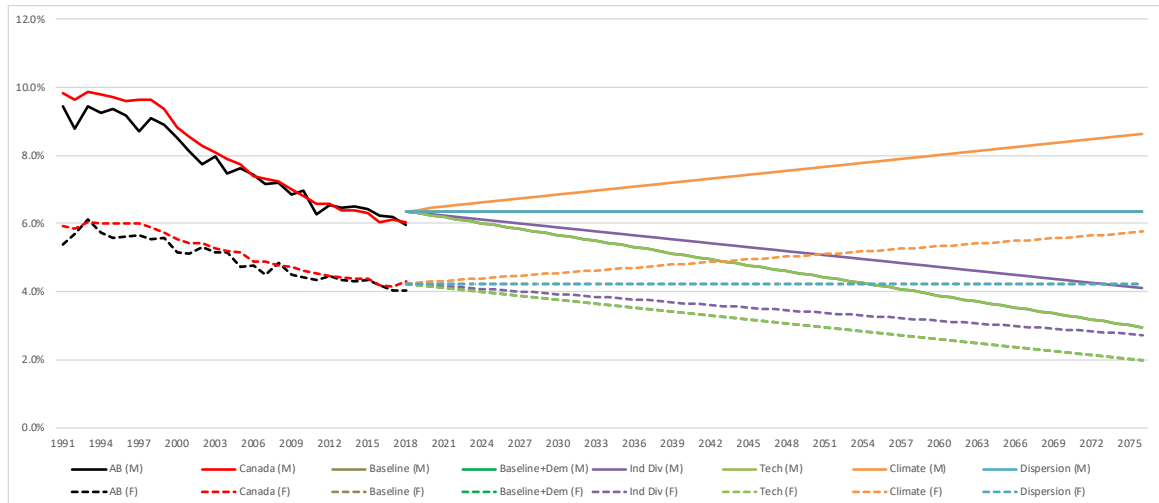
Male and Female Historical and Projected Mortality Rates (70 to 74 Years), National and Alberta Averages (1991 to 2018), Calgary Region (2018 to 2076)



Male and Female Historical and Projected Mortality Rates (75 to 79 Years), National and Alberta Averages (1991 to 2018), Calgary Region (2018 to 2076)



Male and Female Historical and Projected Mortality Rates (80 to 84 Years), National and Alberta Averages (1991 to 2018), Calgary Region (2018 to 2076)



Male and Female Historical and Projected Mortality Rates (85 and Over), National and Alberta Averages (1991 to 2018), Calgary Region (2018 to 2076)

