Office of the Superintendent of Financial Institutions Canada
Bureau du surintendant des institutions financières Canada
Office of the Chief Actuary
Bureau de l´actuaire en chef

Actuarial Report 31st

on the Canada Pension Plan

as at 31 December 2021

Canada

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The Honourable Chrystia Freeland, P.C., M.P.
Minister of Finance
House of Commons
Ottawa, Canada
K1A 0A6

Dear Minister:

In accordance with section 115 of the *Canada Pension Plan*, which provides that an actuarial report shall be prepared every three years for purposes of the financial state review by the Minister of Finance and the ministers of the Crown from the provinces, I am pleased to submit the Thirty-First Actuarial Report on the Canada Pension Plan, prepared as at 31 December 2021.

Yours sincerely,

Assia Billig, FCIA, FSA, PhD
Chief Actuary

TABLE OF CONTENTS

LIST OF TABLES

Page

LIST OF CHARTS

1 Highlights of the Report

Main Findings 31st CPP Actuarial Report

	BASE CPP	ADDITIONAL CPP
Contributions	➢ Legislated contribution rate of 9.9% for year 2022 and thereafter.	➢ Legislated first and second additional contribution rates of 2.0% for 2023 and thereafter and 8.0% for 2024 and thereafter respectively.
	➢ The number of CPP contributors expected to grow from 15.2 million in 2022 to 19.3 million in 2050.	
	➢ Contributions expected to increase from $61 billion in 2022 to $177 billion in 2050.	➢ Contributions expected to increase from $9.3 billion in 2022 to $45 billion in 2050.
	➢ Contributions projected to be higher than expenditures up to the year 2025 inclusive.	➢ Contributions projected to be higher than expenditures up to the year 2057 inclusive.
Expenditures	➢ The number of retirement beneficiaries expected to increase from 6.0 million in 2022 to 9.9 million in 2050. ➢ Total expenditures projected to grow from $56 billion in 2022 to $197 billion in 2050.	➢ The number of retirement beneficiaries expected to increase from 0.8 million in 2022 to 8.9 million in 2050. ➢ Total expenditures projected to grow from $0.3 billion in 2022 to $29 billion in 2050.
Assets	➢ Total assets projected to grow from $544 billion at the end of 2021 to $791 billion by 2030 and $2.2 trillion by 2050. ➢ In 2050, investment income is projected to represent 42% of revenues.	➢ Total assets projected to grow from $11 billion at the end of 2021 to $200 billion by 2030 and $1.4 trillion by 2050. ➢ In 2050, investment income is projected to represent 61% of revenues.
Minimum Contribution Rates needed to sustain the CPP	➢ The minimum contribution rate is 9.56% of contributory earnings for years 2025 to 2033 and 9.54% for years 2034 and thereafter.	➢ The first additional minimum contribution rate as a percentage of contributory earnings is 1.97% for years 2025 and thereafter. ➢ The second additional minimum contribution rate as a percentage of contributory earnings above the YMPE up to the YAMPE is 7.88% for years 2025 and thereafter.
	➢ **The respective legislated contribution rates are higher than the minimum contribution rates needed to sustain the Plan, and thus are sufficient to finance both the base and additional CPP over the long term.**	

Uncertainty 31st CPP Actuarial Report (1), (2)

	BASE CPP	ADDITIONAL CPP
Rate of Return Assumption	The 31st CPP Actuarial Report is based on an assumed 75-year average annual nominal rate of return of 5.79% for the base CPP and 5.37% for the additional CPP.	
	If lower average returns are assumed (4.20% for the base CPP and 4.17% for the additional CPP), this would result in:	
	➢ The MCR increasing from 9.54% to 11.22%.	➢ the FAMCR increasing from 1.97% to 2.86%.
	If higher average returns are assumed (7.39% for the base CPP and 6.57% for the additional CPP), this would result in:	
	➢ The MCR decreasing from 9.54% to 7.89%.	➢ the FAMCR decreasing from 1.97% to 1.38%.
Intervaluation Investment Experience	Based on the best-estimate assumptions of this report, the MCR at the next valuation as at 31 December 2024 is expected to be 9.55%, and the FAMCR is expected to be 1.97%.	
	➢ However, there is a 16% probability that the MCR at the next valuation as at 31 December 2024 will exceed the legislated rate of 9.9% due to investment experience alone.	➢ It is very unlikely that short-term investment experience would cause the AMCRs to fall outside the "no action" ranges prescribed by the *Additional Canada Pension Plan Sustainability Regulations.* ➢ As the plan matures, it will become much more sensitive to intervaluation investment experience. ➢ The probability of the FAMCR as at 31 December 2048 falling outside the 1.8% to 2.1% range due to investment experience during the 2046-2048 period is 32%.
Mortality Assumption	The 31st CPP Actuarial Report is based on the assumption that mortality will continue to improve but at a slower pace than over the last few decades.	
	If longevity were to improve faster than assumed (life expectancies at age 65 in 2050 that are about 2 years higher), this would result in:	
	➢ The MCR increasing from 9.54% to 9.86%.	➢ the FAMCR increasing from 1.97% to 2.12%.
	If longevity were to improve slower than assumed (life expectancies at age 65 in 2050 that are about 2 years lower), this would result in:	
	➢ The MCR decreasing from 9.54% to 9.17%	➢ the FAMCR decreasing from 1.97% to 1.79%.
Economic Growth	The 31st CPP Actuarial Report is based on the assumption of moderate and sustained economic growth.	
	If lower economic growth is assumed with total employment earnings in 2035 being 11% lower, this would result in:	
	➢ The MCR increasing from 9.54% to 10.12%.	➢ the FAMCR decreasing from 1.97% to 1.73%.
	If higher economic growth is assumed with total employment earnings in 2035 being 15% higher, this would result in:	
	➢ The MCR decreasing from 9.54% to 9.11%.	➢ the FAMCR increasing from 1.97% to 2.34%.
	The impacts are in the opposite direction for the base and additional Plans due to the different financing approaches of the two components of the CPP. The base CPP relies more heavily on contributions as a source of revenues than the additional CPP.	

(1) Unless specified otherwise, the MCR quoted in the table are for years 2034 and thereafter. The FAMCR are for years 2025 and thereafter.
(2) The SAMCR is equal to four times the FAMCR.

Illustrating Downside Risk 31st CPP Actuarial Report – Base CPP (1)

The 31st CPP Actuarial Report includes a new section that focuses on understanding and assessing downside risks due to three potential or emerging trends. Since the additional CPP is still at its early stages, it focuses on the base CPP only. Furthermore, given the purpose of the section, only adverse scenarios are presented. It is not meant to represent forecasts or predictions, and should be interpreted with caution.

Earnings Distribution	The 31st CPP Actuarial Report assumes the same increase in earnings at each earnings level. If different nominal wage increases by earnings level are assumed until 2045, with lower increases assumed for lower level earners and vice-versa (no change in overall nominal wage growth compared to the best-estimate assumption), this would result in: ➢ Total contributory earnings in 2050 that are 7% lower than under the best-estimate scenario. ➢ The MCR increasing to 9.88%, which on a relative basis, is 4% higher than the MCR under the best-estimate assumptions.
Stagflation Scenario	The 31st CPP Actuarial Report is based on the assumption that the current environment of high inflation is temporary and that the Bank of Canada will be successful in reaching its current mid-point inflation target of 2.0% by 2026. Elevated inflation over a long period of time can lead to stagflation, which is characterized by a simultaneous economic stagnation and increase in inflation. A hypothetical stagflation scenario was developed in which inflation and unemployment rates are higher than under the best-estimate assumptions, while real-wage growth and investment returns are lower. This hypothetical stagflation scenario would result in: ➢ The MCR increasing to 9.85%, which on a relative basis, is 3% higher than the MCR under the best-estimate assumptions.
Climate Scenarios	Climate change can affect the CPP through various channels. The demographic, economic and investment environments can all be affected by climate change in the future. However, there is a lot of uncertainty on the direction and magnitude of these potential impacts, and the risk is evolving constantly. In order to illustrate the potential downside risk, three intentionally adverse hypothetical climate change scenarios were developed based on publicly available information. The scenarios focus on differences in GDP growth rates from different transition pathways. Based on the three hypothetical scenarios: ➢ The MCR could vary between 9.75% and 10.06% depending on the assumed pace and timing of the transition.

(1) Unless specified otherwise, the MCR quoted in the table are for years 2034 and thereafter.

2 Introduction

2.1 Purpose of the report

This is the 31st Actuarial Report on the Canada Pension Plan since the inception of the Canada Pension Plan (CPP or the Plan) in 1966. The valuation date is 31 December 2021. This report has been prepared in compliance with the timing and information requirements of the *Canada Pension Plan*. Section 113.1 of the *Canada Pension Plan* provides that the Minister of Finance and ministers of the Crown from the provinces shall review the financial state of the CPP once every three years and may consequently make recommendations to change the benefits or contribution rates, or both. Section 113.1 identifies the factors the ministers consider in their review, including information to be provided by the Chief Actuary.

Since 1 January 2019, the CPP has two components: the base and additional Plans. The CPP consisted only of the base Plan (or base CPP) prior to 2019, and this component continues. The additional Plan (or additional CPP) is the new enhancement to the CPP as of 2019. When not qualified, the term "CPP" or the "Plan" used in this report refers to the entire CPP, that is, to both its components.

An important purpose of the report is to inform contributors and beneficiaries of the current and projected financial states of the base and additional CPP. The report provides information to evaluate the financial sustainability of the base and additional Plans over a long period, assuming that the legislation remains unchanged. Such information facilitates a better understanding of the financial states of the base and additional Plans and the factors that influence costs, and thus contributes to an informed public discussion of issues related to the finances of the two components of the CPP.

The previous triennial report was the 30th Actuarial Report on the Canada Pension Plan as at 31 December 2018, which was tabled in the House of Commons on 10 December 2019.

This 31st CPP Actuarial Report takes into account all amendments to date regarding the CPP statute, with the most recent listed in the following section. This CPP Actuarial Report also takes into account: recent demographic, economic, and investment experience data as described in section B.2 of Appendix B of this report; various forecasts by demographic, economic and investment experts; the continuing and evolving impacts of the COVID-19 pandemic; and the impacts of the escalation of the conflict in Ukraine, which was considered a subsequent event for the purpose of this CPP Actuarial Report, as described in section 2.3.

The report presents projections of its revenues and expenditures for both of its components, the base and additional CPP, over a long period of time. Given the length of the projection period and the number of assumptions required, it is unlikely that actual future experience will develop precisely in accordance with the best-estimate projections.

2.2 Recent Amendments

The *Canada Pension Plan* was subject to amendments after 31 December 2018 as follows:

- Under the *Budget Implementation Act, 2019, No. 1*, which received Royal Assent on 21 June 2019, the application for a CPP retirement pension is waived upon reaching age 70, effective 1 January 2020. This amendment is taken into account in this 31st CPP Actuarial Report. It was also taken into account and treated as a subsequent event in the 30th CPP Actuarial Report.[1]
- Under the *Budget Implementation Act, 2022, No. 1*, which received Royal Assent on 23 June 2022, technical amendments are made regarding eligibility for the base CPP post-retirement disability benefit and determination of the additional CPP drop-in provisions.[2] The amendments reflect the original intent of the given benefit and drop-in provisions and thus were included in the projections of previous CPP actuarial reports. The amendments are likewise included in the projections of this 31st CPP Actuarial Report. As such, the amendments have no impact on the projections in this report.

2.3 Subsequent Events

The continuing and evolving impacts of the COVID-19 pandemic were exacerbated by the conflict in Ukraine, notably its escalation as of 24 February 2022. This escalation is considered to be a subsequent event for the purpose of this 31st CPP Actuarial Report since it started subsequent to the valuation date but before the date of this report. There is much uncertainty surrounding the evolving conflict and potential impacts on the projected financial state of the CPP, in particular resulting from changing levels of inflation and volatility in the financial markets. This uncertainty was taken into account for the purpose of this 31st CPP Actuarial Report.

There were no other events determined by the Chief Actuary to be subsequent events with material effects on the financial state of the CPP as projected under this 31st CPP Actuarial Report.

2.4 Independent Peer Review Process

As part of its policy of ensuring that it provides sound and relevant actuarial advice to Members of Parliament and to the Canadian population, as was done for previous reports, the Office of the Chief Actuary (OCA) has commissioned an external peer review[3] of this actuarial report on the CPP.

The external peer review is intended to ensure that the actuarial reports meet high professional standards, and are based on reasonable methods and assumptions. Over the years, peer review recommendations have been carefully considered and many of them implemented.

[1] For the purpose of a CPP actuarial report, a subsequent event is one which first comes to the attention of the Chief Actuary after the valuation date but before the report date.
[2] Amendments are pending provincial approval.
[3] More information on the CPP independent peer review process and past reviews can be found at http://www.osfi-bsif.gc.ca/Eng/oca-bac/ipr-rip/Pages/default.aspx

2.5 Scope of the Report

Section 3 presents a general overview of the methodology used in preparing the actuarial estimates included in this report, which are based on the best-estimate assumptions described in section 4. The results for the base Plan and additional Plan are presented separately in sections 5 and 6, respectively, and include for each component the projections of the revenues, expenditures, and assets over more than the next 75 years. Section 7 provides the reconciliation of the results for the base and additional Plans with those of the 30th CPP Actuarial Report, while section 8 provides the actuarial opinion.

The various appendices provide a summary of the Plan provisions, a description of the data, assumptions and methodology employed, supplemental information on the financing of the CPP, detailed reconciliations of the results with the previous report, the uncertainty of results, and acknowledgements of data providers and staff who contributed to this report.

3 Methodology

The actuarial examination of the CPP involves projections of the revenues and expenditures of both components (base CPP and additional CPP) over a long period of time, so that the future impact of historical and projected trends in demographic, economic and investment factors can be properly assessed. The actuarial estimates in this report are based on the provisions of the *Canada Pension Plan* as at 31 December 2021,[1] historical experience data used for the starting point of the projections, and best-estimate assumptions that take into account the subsequent event described in section 2.3.

The revenues of the base and additional Plans include both contributions and investment income. The projection of contributions begins with a projection of the working-age population. This requires assumptions regarding demographic factors such as fertility, migration, and mortality. Total contributory earnings for each component of the Plan are derived by applying labour force participation and job creation rates to the projected population and by projecting future average employment earnings. This requires assumptions about various factors such as wage increases, an earnings distribution, and unemployment rates. Contributions for each of the components of the CPP are obtained by applying the respective component's contribution rate(s) to the respective contributory earnings. Investment income is projected on the basis of the existing portfolios of assets for the base and additional CPP, the respective projected net cash flows (contributions less expenditures), and the respective assumptions regarding the future asset mix and rates of return on investments net of investment expenses. Since the assumptions regarding the future asset mix differ between the base and additional Plans, the resulting assumptions regarding investment returns differ as well.

Expenditures for each component of the Plan consist of the benefits paid out and operating expenses. Newly emerging benefits are projected by applying assumptions regarding retirement, disability, and death to the populations eligible for benefits, together with the benefit provisions and the earnings histories of participants (actual and projected). The projection of total benefits, which includes the continuation of benefits already in pay at the valuation date, requires further assumptions. Operating expenses, excluding operating expenses relating to professional management of the CPP Fund by the Canada Pension Plan Investment Board (CPPIB), are projected by considering the historical and projected relationship between expenses and total employment earnings, while CPPIB operating expenses are considered in the determination of the rates of return.

The assumptions and results presented in the following sections make it possible to measure the financial states of the base and additional CPP separately in each projection year and to calculate the minimum contribution rates.

[1] The *Budget Implementation Act, 2022, No. 1*, which received Royal Assent on 23 June 2022, contains technical amendments to the CPP statute. These amendments, which are pending provincial approval, are already reflected in this 31st CPP Actuarial Report, as described in Section 2.2 of this report.

For the base Plan, the minimum contribution rate (MCR) is the sum of two types of rates. The first of these is separate from the full funding provision for increased or new benefits, and is referred to as the "steady-state" contribution rate. The second type of rate that makes up the MCR is the full funding rate for increased or new benefits.

For the additional CPP, there are two additional minimum contribution rates (AMCRs), the first additional minimum contribution rate (FAMCR) and the second additional minimum contribution rate (SAMCR). The FAMCR is applicable to contributory earnings below the Year's Maximum Pensionable Earnings (YMPE) and the SAMCR is applicable to contributory earnings between the YMPE and the Year's Additional Maximum Pensionable Earnings (YAMPE).

Details of the methodology used to determine the MCR and AMCRs are presented in Appendix C.

A wide variety of factors influence both the current and projected financial states of the components of the CPP. Accordingly, the results shown in this report differ from those shown in previous reports. Likewise, future actuarial examinations will reveal results that differ from the projections included in this report.

4 Best-Estimate Assumptions

4.1 Introduction

The information required by statute, which is presented in sections 5 and 6 of this report, necessitates making numerous assumptions regarding future demographic, economic, and investment trends. The projections included in this report cover a long period of time (over 75 years), and the assumptions are determined by examining historical long-term and short-term trends and applying judgment as to the extent these trends will continue in the future. These assumptions reflect the Chief Actuary's best judgment and are referred to in this report as the best-estimate assumptions. The assumptions were chosen to be independently reasonable and appropriate in the aggregate, taking into account certain interrelationships between them.

The assumptions were developed taking into account subsequent events, that is, events that became known to the Chief Actuary after the valuation date, but before the report date, that were deemed to have an effect on the financial states of the base or additional CPP as at the valuation date or during the projection period. The continuing and evolving impacts of the COVID-19 pandemic were exacerbated by the conflict in Ukraine, notably its escalation as of 24 February 2022. For the purpose of this 31st CPP Actuarial Report, this escalation, was considered to be a subsequent event with significant impacts on the projected financial state of the CPP. The following assumptions were therefore reviewed in light of this subsequent event: inflation, real wage increases, interest rates as well as expected returns on various asset classes. These assumptions were revised to reflect updated data and forecasts available up to the end of June 2022, as well as continued short-term uncertainty.

All past and recent amendments to the CPP statute are reflected in this CPP Actuarial Report. The most recent amendments are contained in the *Budget Implementation Act, 2022, No. 1*, which received Royal Assent on 23 June 2022. That Act contains technical amendments regarding eligibility for the base CPP post-retirement disability benefit and determination of the additional CPP drop-in provisions under the CPP statute.[1] The amendments reflect the original intent of the given benefit and drop-in provisions and thus were included in the projections of previous CPP actuarial reports. The amendments continue to be reflected in the projections of this 31st CPP Actuarial Report and have no impact.

The Chief Actuary held a virtual seminar in September 2021 on the long-term demographic, economic, and investment outlook for Canada to obtain opinions from a wide range of individuals with relevant expertise. Nine experts in the fields of demographics, economics, and investments were invited to present their views. The topics discussed included short-term and long-term perspectives on mortality, immigration, the labour market and the economy, as well as the potential implications of climate change on the macroeconomic and investment outlook.

[1] Amendments are pending provincial approval.

Among the participants at the seminar were representatives from the OCA, federal departments including Statistics Canada, Employment and Social Development Canada (ESDC), and the Department of Finance, representatives from provincial and territorial governments, as well as

representatives from Retraite Québec, the CPPIB, and other organizations. Representatives of the OCA also attended a virtual seminar on the demographic and economic perspectives relating to retirement held by Retraite Québec in October 2021.

In addition to the above mentioned seminars, OCA staff sought expert perspectives on demographic, economic, and investment-related topics by attending various webinars, consulting numerous publications, and consulting with other experts. These expert perspectives were all considered in developing the best-estimate assumptions for this 31st CPP Actuarial Report.

Table 1 presents a summary of the most important assumptions used in this report compared with those used in the previous triennial report. The assumptions are described in more detail in Appendix B of this report.

Table 1 Best-Estimate Assumptions

Canada	31st Report (as at 31 December 2021)		30th Report (as at 31 December 2018)	
Total Fertility Rate	1.54 (2029+)		1.62 (2027+)	
Mortality	Statistics Canada Life Tables (CLT 1-year table: 2019) with assumed future improvements		Statistics Canada Life Tables (CLT 3-year average table: 2014 – 2016) with assumed future improvements	
Canadian Life Expectancy	Males	Females	Males	Females
at birth in 2022	86.7 years	90.0 years	87.1 years	90.1 years
at age 65 in 2022	21.3 years	23.8 years	21.6 years	24.0 years
Net Migration Rate	0.64% of population (for 2031+)		0.62% of population (for 2021+)	
Participation Rate (age group 18-69)	80.0%	(2035)	79.2%	(2035)
Employment Rate (age group 18-69)	75.3%	(2035)	74.4%	(2035)
Unemployment Rate (age group 18-69)	5.9%	(2027+)	6.0%	(2030+)
Rate of Increase in Prices	2.0%	(2026+)	2.0%	(2019+)
Real Wage Increase	0.9%	(2026+)	1.0%	(2025+)
Real Rate of Return (average 2022-2096)	Base CPP Assets	3.7%	4.0%	
	Additional CPP Assets	3.3%	3.5%	
Retirement Rates for Cohort at Age 60	Males	26.0% (2022+)	Males	27.0% (2021+)
	Females	28.0% (2022+)	Females	29.5% (2021+)
CPP Disability Incidence Rates (per 1,000 eligible)	Males	2.90 (2026+)	Males	2.97 (2019+) (1)
	Females	3.60 (2026+)	Females	3.66 (2019+) (1)

(1) The ultimate disability incidence rates assumption of the 30th CPP Actuarial Report have been adjusted based on the 2021 eligible population in order to compare on the same basis with the assumption of the 31st CPP Actuarial Report.

4.2 Demographic Assumptions

The population projections start with the Canada and Québec populations on 1 July 2021, to which are applied fertility, migration, and mortality assumptions. The relevant population for the Canada Pension Plan is the population of Canada less that of Québec and is obtained by subtracting the projected results for Québec from those for Canada. The population projections are essential in determining the future number of CPP contributors and beneficiaries.

The age distribution of the population has changed significantly since the inception of the Plan in 1966. The proportion of the Canadian population aged 65 and above has increased from 7.6% in 1966 to 18.5% in 2021, which indicates an aging population. It is assumed that the population aging will continue in the future, albeit to a more modest extent.

4.2.1 Fertility

The first cause of the aging of the Canadian population is the decline in the total fertility rate that has occurred over the last 60 years. The total fertility rate in Canada decreased rapidly from a level of about 4.0 children per woman in the late 1950s to 1.6 by the mid-1980s. The total fertility rate rose slightly in the early 1990s, but then declined to a level of 1.5 by the late 1990s. Canada is one of many industrialized countries that saw their fertility rates increase starting in the 2000s. By 2008, the total fertility rate for Canada reached 1.68. However, in some industrialized countries, including Canada, the total fertility rate has decreased since 2008, which could be largely attributable to the 2008 economic downturn and continuing economic uncertainty. The total fertility rate for Canada stood at 1.47 in 2019, and decreased further to 1.40 in 2020. The significant decrease in 2020 could be due to the high level of uncertainty and much lower immigration caused by the COVID-19 pandemic.

Similar to Canada, the total fertility rate in Québec fell from a high of about 4.0 children per woman in the 1950s; however, the Québec rate fell to a greater degree, reaching 1.4 by the mid-1980s. The Québec rate then recovered somewhat in the early 1990s to over 1.6 and subsequently declined to below 1.5 by the late 1990s. Subsequently, Québec fertility rate increased for certain age groups with the introduction of the Québec Childcare Centres in 1997 and with the introduction of the Québec Parental Insurance Plan in 2006. There was a significant increase in the Québec fertility rate in the 2000s, with the rate reaching 1.74 in 2008. However, similar to Canada's fertility rate, the fertility rate for Québec has been decreasing in recent years and stood at 1.57 in 2019 and 1.52 in 2020.

The overall decrease in the total fertility rate over the last 60 years occurred as a result of changes in a variety of social, medical, economic and environmental-related factors. Although there have been periods of growth in the total fertility rates in recent decades, it is unlikely that the rates will return to historical levels in the absence of significant societal changes.

In 2021, the Government of Canada announced that it would work with provinces and territories to establish a Canada-Wide Early Learning and Child Care Plan[1]. Consistent with what was experienced in Québec with the introduction of Childcare Centres, the proposed plan is assumed to result in increases in fertility rates for certain age groups following the adoption of the Early Learning and Child Care Plan.

Given the uncertainty surrounding the effect of the COVID-19 pandemic on fertility rates for the year 2020 (the last year of available data at the time this report was prepared), the data for 2020 were excluded from the analysis for purposes of setting the fertility rates for years 2021 and beyond. A 15-year period ending in 2019 of data is used to establish a linear trending model which is also adjusted for the upcoming Canada-Wide Early Learning and Child Care Plan. The assumed age-specific fertility rates lead to an assumed total fertility rate for Canada that will increase from its 2019 level of 1.47 children per woman to an ultimate level of 1.54 in 2029. The assumed age-specific fertility rates for Québec lead to a total fertility rate for the province that will decrease from its 2019 level of 1.57 to an ultimate level of 1.55 in 2029.

4.2.2 Mortality

Another element that has contributed to the aging of the population is the significant reduction in the age-specific mortality rates. This can be measured by the increase in life expectancy at age 65, which directly affects how long retirement benefits will be paid to beneficiaries. Male life expectancy (without future mortality improvements, i.e. reductions in mortality) at age 65 increased by 44% between 1966 and 2019, rising from 13.6 to 19.6 years. For women, life expectancy at age 65 (without future improvements) increased by 31%, from 16.9 to 22.1 years over the same period. Although the overall gains in life expectancy at age 65 since 1966 are similar for males and females (between 5 and 6 years), about 70% of the increase occurred after 1990 for males, while for females, only about 50% of the increase occurred in that period.

Future mortality rates are determined by applying assumed mortality improvement rates to Statistics Canada's 2019 life tables.

Statistics Canada's 2020 life tables published in January 2022 were used to derive the annual mortality improvement rates for 2020. These tables reflect significant rate increases related to COVID-19 deaths. In 2020, life expectancy at birth (without future mortality improvements) stood at 79.5 for males and 84.0 for females, a decrease from 2019 of 0.7 and 0.4 for males and females respectively.

The 15-year average mortality improvement rates by age and sex for the period ending in 2019 are the starting point for the projected annual mortality improvement rates from 2021 onward. These projections disregard the impact of the COVID-19 pandemic. Mortality improvements are expected to continue in the future, but at a slower pace than most recently observed over the 15-year period ending in 2019. Further, it is assumed that ultimately, mortality improvement rates

[1] All provinces and territories have subsequently signed a Canada-Wide Early Learning and Child Care Plan (CWELCC) agreement with the federal Government.

will be the same for males and females. The assumed mortality improvement rates are based on the analysis of the Canadian experience over the period 1921 to 2019 and of the possible drivers of future mortality improvements.

The projected mortality improvement rates are assumed to gradually reduce to their ultimate levels in 2039, which are for both sexes 0.8% per year for ages below 90, 0.5% for ages 90 to 94, and 0.2% for ages 95 and above.

In the short term, mortality rates were also adjusted to reflect assumed additional increases in mortality rates due to the COVID-19 pandemic. These assumed increases are related to two factors: i) direct increases in mortality due to COVID-19 deaths, affecting older age groups more and ii) indirect increases in mortality due to the impact of the pandemic on the opioids crisis, affecting mostly men in the age group 25 to 49. [1]

For the direct increases in mortality due to COVID-19 deaths in 2021, mortality rates were adjusted using data on the number of COVID-19 deaths from both Health Canada and Statistics Canada. The pandemic is assumed to have a residual effect on mortality in 2022, followed by an assumed full recovery and reversion to the projected unadjusted mortality rates for years 2023 and onward. For the indirect increases related to the opioid crisis, projected mortality rates for affected age groups are assumed to revert back to normal levels, leading to a period of high growth in mortality improvement rates.

The resulting adjustments lead to mortality rates for the full population that are 5.5% higher on average in 2021 and 2.0% higher on average in 2022 than the rates developed using the information up to and including 2019.

Considering the above, life expectancy (with future improvements) at age 65 in 2022 is projected to be 21.3 years for males, and 23.8 years for females.

To project CPP benefits, the mortality rates for CPP retirement, survivor, and disability beneficiaries reflect actual experience for those segments of the population. Specific mortality experience for CPP beneficiaries is discussed further in Appendix B of this report.

4.2.3 Net Migration

Net migration corresponds to the number of immigrants less the net number of emigrants, plus the net increase in the number of non-permanent residents.

The components of net migration were analyzed separately by looking at trends in the historical data in order to select the assumptions regarding the short-term and ultimate rates. Over the past two years, net migration for Canada decreased significantly due to various COVID-19 safety measures such as border closures and flight cancellations. As such, data for the years 2020 and 2021 were excluded from the analysis. Consideration was given to the federal government's

[1] Over the last decade, Canada has been faced with an important increase in accidental drug poisoning deaths and the COVID-19 pandemic has exacerbated the issue.

short-term immigration targets and to long-term perspectives of various experts regarding future immigration levels, net increases in the number of non-permanent residents, and the impacts of the COVID-19 pandemic.

The net migration rate for Canada is projected to increase from its current (year ending June 2021) level of 0.41% of the population to 1.04% in 2022, 1.05% in 2023, 0.93% in 2024 and gradually reach an ultimate level of 0.64% of the population for the year 2031 and thereafter. The ultimate net migration rate of 0.64% corresponds to the average experience observed over the 10 years ending in 2019, excluding the net increase in non-permanent residents during that period. The assumed short-term net migration rate is higher than the ultimate rate of 0.64% due to the federal government's short-term targets and the assumed gradual decrease to zero for the net increase in the number of non-permanent residents from 2022 through 2026.

For the Québec population, the 2031 ultimate net migration rate assumption corresponds to the 10-year average historical experience ending in 2019 for the province of 0.43%, excluding the net increase in non-permanents residents.

4.2.4 Population Projections

Table 2 shows the population of Canada less Québec for three age groups (0-19, 20-64 and 65 and over) throughout the projection period. The ratio of the number of people aged 20-64 to those aged 65 and over is a measure that approximates the ratio of the number of working-age people to retirees. Because of the aging population, this ratio is projected to drop from an estimated value of 3.3 in 2022 to 1.9 by 2070 and remain at that level thereafter.

Table 2 Population of Canada less Québec
(thousands)

Year	Total	Age 0-19	Age 20-64	Age 65 and Over	Ratio of 20-64 to 65 and Over
2022	30,074	6,335	18,203	5,536	3.3
2023	30,519	6,429	18,344	5,746	3.2
2024	30,937	6,510	18,471	5,957	3.1
2025	31,333	6,581	18,579	6,173	3.0
2026	31,708	6,644	18,674	6,390	2.9
2027	32,073	6,705	18,768	6,600	2.8
2028	32,426	6,759	18,851	6,815	2.8
2029	32,764	6,814	18,929	7,022	2.7
2030	33,087	6,866	19,012	7,209	2.6
2035	34,557	7,105	19,580	7,873	2.5
2040	35,854	7,328	20,191	8,335	2.4
2045	37,008	7,474	20,836	8,699	2.4
2050	38,078	7,494	21,402	9,182	2.3
2055	39,128	7,548	21,797	9,783	2.2
2060	40,229	7,706	22,020	10,504	2.1
2065	41,398	7,932	22,211	11,255	2.0
2070	42,581	8,167	22,665	11,750	1.9
2080	44,799	8,531	23,763	12,505	1.9
2090	46,894	8,829	25,021	13,045	1.9
2100	49,228	9,267	25,996	13,966	1.9

4.3 Economic and Investment Assumptions

The main economic assumptions for the CPP are regarding: labour force participation rates, job creation rates, unemployment rates, the rate of increase in prices, and real increases in average employment earnings. For asset projections, further assumptions on real rates of return on invested assets are required.

One of the key elements underlying the best-estimate economic assumptions relates to the continued trend toward longer working lives. Older workers are expected to exit the workforce at a later age, which could alleviate the impact of the aging of the population on future labour force growth. However, despite the expected later exit ages, labour force growth is projected to weaken as the working-age population expands at a slower pace and baby boomers exit the labour force.

4.3.1 Labour Force

Employment levels vary with the rate of unemployment, and reflect trends in increased workforce participation by women, longer periods of formal education among young adults, changes in the age structure of the working-age population, as well as changing retirement patterns of older workers.

As the population ages, older age groups with lower labour force participation increase in size. As a result, the labour force participation rate for Canadians aged 15 and over is expected to decline from an estimated value of 65.1% in 2022 to 64.1% in 2035. A more useful measure of the working-age population is the participation rate of those aged 18 to 69, which is expected to increase from an estimated 76.7% in 2022 to 80.0% in 2035. The increase in the participation rate for those aged 18 to 69 reflects several trends.

For example, it is assumed that female participation rates will continue to grow at a faster pace than male participation rates thereby continuing to reduce the gap in participation rates between males and females, albeit at a slower pace than in the past. A part of this reduction comes from the expected impact on the female labour force participation due to the Early Learning and Child Care Plan initiative announced by the federal Government in 2021.

It is also assumed that participation rates for age groups 55 and over for both genders will increase as a result of an expected continued trend toward longer working lives.

Despite the assumed future increase in participation rates of women and older workers, it is still expected that there will be continued labour shortages in the future as the working-age population expands at a slower pace and as baby boomers continue to retire and exit the labour force. The participation rates for all age groups are therefore expected to increase due to the attractive employment opportunities resulting from labour shortages.

Overall, the male participation rate of those aged 18 to 69 is expected to be 80.8% in 2022 and to increase to 83.2% in 2035, while the female participation rate for the same age group is expected to be 72.6% in 2022 and to increase to 76.8% in 2035. As such, the difference between male and female participation rates for the age group 18 to 69 is projected to be 8.2 percentage points in 2022 and decrease to 6.4 percentage points by 2035. Thereafter, the gap between males and females in the age group 18 to 69 is projected to vary between 6.3 and 6.4 percentage points.

The job creation rate (i.e. the change in the number of persons employed) in Canada was on average 1.5% from 1976 to 2021 based on available employment data, and it is assumed that the rate will be 2.9% in 2022 as the labour market recovers from the COVID-19 pandemic. The job creation rate assumption is determined on the basis of expected moderate economic growth and an unemployment rate for Canada, ages 15 and over, that is expected to decrease from 7.5% in 2021 to 6.0% in 2022, 5.7% in 2023 and then increase to reach an ultimate level of 6.1% by 2027. The assumed job creation rate for Canada, ages 15 and over, is on average about 0.8% from 2024 to 2027, which is slightly lower than the labour force growth rate. It is assumed that, starting in 2027, the job creation rate will follow the labour force growth rate, with both averaging 0.8% per year between 2027 and 2035, and 0.4% per year thereafter. The aging of the population is the main reason behind the expected slower long-term growth in the labour force and job creation rate.

4.3.2 Price Increases

On December 13, 2021, the Bank of Canada and the federal Government renewed their commitment to keep inflation between 1% and 3% with a target at the mid-point of 2% until the end of 2026. They further noted that the Bank of Canada will use the flexibility of the 1% to 3% range to actively seek the maximum sustainable level of employment to an extent that is consistent with keeping medium-term inflation expectations at 2%.

Despite the mid-point target of 2%, price increases (inflation), as measured by changes in the Consumer Price Index (CPI), tend to fluctuate from year to year. The COVID-19 pandemic had an impact on the CPI. In 2020, the CPI rose by only 0.7% as a result of a decline in consumer spending stemming from various pandemic-related measures and restrictions. However, as the pandemic evolved and restrictions were lifted, consumer demand increased and supply issues arose. As a result, the increase in CPI was 3.4% in 2021, the fastest pace since 1991. The uncertainty surrounding high inflation due to the demand and supply shocks caused by the pandemic has been exacerbated by the escalation of the conflict in Ukraine.

This report considers the escalation of the conflict in Ukraine as a subsequent event. It is therefore assumed that inflation will be higher than the 2% target up until 2025. Increases in prices are assumed to be 6.9% in 2022, 3.0% in 2023, 2.5% in 2024, 2.25% in 2025, and 2.0% for 2026 and thereafter. These assumed price increases are based on short-term forecasts from various economists[1] as well as on the expectation that the Bank of Canada and federal Government will continue to renew the inflation target at 2.0% and that the Bank of Canada will be successful in keeping inflation at its mid-point target in the long term.

4.3.3 Real Wage Increases

Wage increases affect the financial state of the CPP in two ways. In the short term, an increase in the average wage translates into higher contribution income, with little immediate impact on benefits. Over the long term, higher average wages produce higher benefits. The difference between nominal wage increases and inflation represents increases in the real wage, which is also referred to in this report as the real wage increase.

Two wage measures are used in this report: the average annual earnings (AAE) and the average weekly earnings (AWE). The assumed increase in AAE is used to project the total employment earnings of CPP contributors, while the assumed increase in the AWE is used to project the increase in the YMPE from one year to the next. The average difference between both measures has been relatively small over the period 1966 to 2019, and the two measures are assumed to grow at the same pace over the long term. However, they tend to grow at different paces in times of economic expansions and slowdowns.

Based on information up to the end of June 2022, the real AAE is projected to decrease by 2.4% in 2022 and by 0.1% in 2023. Real AAE are then projected to increase, with an ultimate real increase

[1] As of June 2022

of 0.9% reached in 2026. The negative real AAE growth in the early years of the projection is a result of assumed wage dynamics in periods of high inflation stemming from the COVID-19 pandemic and exarcerbated by the escalation of the conflict in Ukraine, which is considered a subsequent event. The ultimate real AAE increase assumption is developed taking into account historical trends, labour productivity, labour shortages, and other contributing factors. The ultimate real AAE increase assumption combined with the ultimate price increase assumption results in an assumed nominal annual increase of 2.9% in 2026 and thereafter.

Real AWE are projected to decrease by 3.3% in 2022 and by 0.1% in 2023. In the following years, and consistent with the historical long-term relationship between the real change in the AWE and AAE, AWE is projected to increase, with an ultimate real increase of 0.9% reached in 2026, equal to the same ultimate real increase in AAE that year.

4.3.4 Real Rates of Return on Investments

Real rates of return on investments are the excess of the nominal rates of return over price increases and are required for the projection of revenue arising from investment income. A real rate of return is assumed for each year in the projection period and for each of the main asset categories in which the base and additional CPP assets are invested. The assumed long-term real rates of return on base and additional CPP assets take into account the assumed asset mixes of investments of each CPP component. The real rates of return on investments are net of all investment expenses, including the CPPIB operating expenses.

The escalation of the conflict in Ukraine has had significant impacts on financial markets. In an effort to control rising inflation exacerbated by this escalation, the Bank of Canada has increased its benchmark interest rate by 225 basis points so far in 2022 (as of July 13, 2022), which has impacted returns on fixed income investments. In addition, stock market indices in the first half of 2022 have decreased significantly across geographies and sectors.

This report considers the escalation of the conflict in Ukraine a subsequent event, and the assumed rates of return have been adjusted accordingly. More specifically, for 2022, the assumed nominal return is -9.0% for the base CPP and -7.7% for the additional CPP. In real terms, this translates into 2022 assumed returns of -15.9% and -14.6% for the base CPP and additional CPP respectively. These returns reflect actual CPPIB results up to 30 June 2022, and continued uncertainty for the remainder of the year. In addition, fixed income returns beyond 2022 are based on a revised interest rate path that reflects the significant rate hikes that occurred in the first half of 2022.

For the period 2023 to 2032, the assumed annual real rates of return are lower than the assumed ultimate real rates of return in 2033 due to lower expected bond returns between 2023 and 2033, and high inflation in the first few years. The average real rates of return for the 5-year period 2023-2027 for the base and additional CPP are respectively 3.56% and 2.70%, while the average real rates of return for the 10-year period 2023-2032 for the base and additional CPP are respectively 3.73% and 2.98%.

The ultimate real rates of return for the base and additional CPP are respectively 4.0% and 3.6%. The 75-year average real rate of return on the assets over the 2022-2096 projection period is assumed to be 3.69% for the base CPP and 3.27% for the additional CPP.

Table 3 summarizes the main economic assumptions over the projection period.

Table 3 Economic Assumptions
(percentages)

				Labour Force (Canada, 15+)				Real Rates of Return on Investments	
Year	Real Increase Average Annual Earnings	Real Increase Average Weekly Earnings (YMPE)	Price Increase	Participation Rate	Job Creation Rate	Unemployment Rate	Labour Force Annual Increase	Base CPP	Additional CPP
2022	(2.4)	(3.3)	6.9	65.1	2.9	6.0	1.3	(15.9)	(14.6)
2023	(0.1)	(0.1)	3.0	65.0	1.5	5.7	1.1	2.9	1.9
2024	0.4	0.4	2.5	64.8	0.9	5.8	1.0	3.4	2.5
2025	0.6	0.6	2.3	64.6	0.8	5.9	0.9	3.6	2.8
2026	0.9	0.9	2.0	64.5	0.8	6.0	0.9	3.9	3.1
2027	0.9	0.9	2.0	64.4	0.8	6.1	0.9	3.9	3.2
2028	0.9	0.9	2.0	64.3	0.8	6.1	0.8	3.9	3.2
2029	0.9	0.9	2.0	64.2	0.8	6.1	0.8	3.9	3.2
2030	0.9	0.9	2.0	64.1	0.7	6.1	0.7	3.9	3.3
2035	0.9	0.9	2.0	64.1	0.7	6.1	0.7	4.0	3.6
2040	0.9	0.9	2.0	63.7	0.5	6.1	0.5	4.0	3.6
2045	0.9	0.9	2.0	63.2	0.5	6.1	0.5	4.0	3.6
2050	0.9	0.9	2.0	62.8	0.4	6.1	0.4	4.0	3.6
2055	0.9	0.9	2.0	62.2	0.2	6.1	0.2	4.0	3.6
2060	0.9	0.9	2.0	61.5	0.2	6.1	0.2	4.0	3.6
2065	0.9	0.9	2.0	60.8	0.3	6.1	0.3	4.0	3.6
2070	0.9	0.9	2.0	60.4	0.4	6.1	0.4	4.0	3.6
2080	0.9	0.9	2.0	60.1	0.4	6.1	0.4	4.0	3.6
2090	0.9	0.9	2.0	60.1	0.4	6.1	0.4	4.0	3.6
2100	0.9	0.9	2.0	59.7	0.4	6.1	0.4	4.0	3.6

4.4 Other Assumptions

This report is based on several other key assumptions, such as retirement benefit take-up rates and disability incidence rates.

4.4.1 Retirement Benefit Take-up Rates

The retirement benefit take-up rates are determined on a cohort basis. The sex-distinct retirement benefit take-up rate for any given age and year from age 60 and above corresponds to the number of emerging (new) retirement beneficiaries divided by the total number of people eligible for retirement benefits for the given sex, age, and year.

The unreduced pension age under the Canada Pension Plan is 65. In 1987, the flexible retirement age provision became effective such that a person can choose to receive a reduced retirement pension as early as age 60 (as well as an increased pension after age 65). This provision had the overall effect of lowering the average age at pension take-up to below age 65. In 1986, the average age at pension take-up was 65.2, compared to an average age of 62.7 over the decade ending in 2019.

Since 2012, the age 60 retirement benefit take-up rates have continually decreased. For cohorts reaching age 60 in 2019 (before the pandemic), the retirement take-up rates were 27.8% for males and 30.3% for females. For cohorts reaching age 60 in 2021, the retirement take-up rates were 23.3% for males and 25.0% for females. The 2021 take-up rate for males is the lowest one since 1989, while the 2021 take-up rate for females is a record low since the flexible retirement age provision was first introduced in 1987. At this time, it is not clear to what extent the COVID-19 pandemic contributed to the significant reduction in retirement take-up rates at age 60 during the years 2020 and 2021. The decreasing trend will be monitored for the next CPP valuation.

The assumption reflects the pre-pandemic trend in retirement take-up rates at age 60, while giving partial credibility to the years 2020 and 2021. For cohorts reaching age 60 in 2022 and thereafter, the retirement benefit take-up rates are assumed to be 26.0% for males and 28.0% for females. The retirement take-up rates at age 65 are derived such that the sum of the retirement rates for each cohort is 100%. The resulting rates at age 65 are determined to be 42.5% for males and 43.8% for females in 2031 and thereafter. These rates result in projected average ages at retirement pension take-up in 2031 of 63.6 for males and 63.4 for females. The same retirement take-up rates for the base CPP apply to the additional CPP.

4.4.2 Disability Incidence Rates - Disability Pension and Post-Retirement Disability Benefit

The sex-distinct disability incidence rate in respect of a disability benefit – either the disability pension or post-retirement disability benefit – at any given age is the number of new disability beneficiaries divided by the total number of people eligible for the disability benefit at that age. The disability incidence rates for the base Plan in respect of the disability pension are the same as for the additional Plan. The disability incidence rates in respect of the post-retirement disability benefit apply only to the base Plan, since the benefit pertains only to the base Plan.

The assumptions for the disability incidence rates in respect of the disability pension recognize that current disability incidence rates are significantly below the levels experienced from the mid-1970s to mid-1990s for males and during the early 1980s and early to mid-1990s for females. With the exception of more recent years (2019-2021), the incidence rates for both sexes have been relatively stable since the late 1990s as a result of administrative changes made to the disability program. Volatility was observed in the incidence rates over the period 2019 to 2021, which is attributable to administrative and COVID-19 related factors. Such volatility is not expected to continue, and as such, the years 2019 to 2021 were not considered in developing the ultimate assumptions for the disability incidence rates.

Based on the above and experience over the period 2007 to 2018, incidence rates in respect of the disability pension are expected to increase gradually from 2021 to 2026 and are then assumed to remain constant thereafter at values of 2.90 per thousand eligible for males and 3.60 per thousand eligible for females.

For the base CPP post-retirement disability benefit, which came into effect in 2019 and applies only to early retirement beneficiaries (before age 65) who become disabled, the incidence rates by age and sex were derived based on post-retirement disability benefit data for years 2019 and 2020 along with historical records of earnings data of early retirement beneficiaries. It is projected that, in 2026, the overall disability incidence rates in respect of the post-retirement disability benefit for early retirement beneficiaries will be 10.08 per 1,000 eligible males and 9.06 per 1,000 eligible females . As more experience data regarding post-retirement disability benefits become available, the assumptions for the incidence rates will be revised accordingly for future CPP actuarial reports.

5 Results - Base CPP

5.1 Overview

The key observations and findings of the actuarial projections of the financial state of the base CPP presented in this report are as follows.

- With the legislated contribution rate of 9.9%, contributions to the base CPP are projected to be more than sufficient to cover the expenditures over the period 2022 to 2025. Thereafter, a portion of investment income is required to make up the difference between contributions and expenditures. In 2030, about 9% of investment income will be required to pay for expenditures. This is expected to gradually increase to about 16% by 2050 and about 34% by 2070, after which it is expected to be fairly stable.
- With the legislated contribution rate of 9.9%, total assets of the base Plan are expected to decrease in 2022 as a result of the current financial markets environment. Assets are then expected to increase over the projection period, with more significant growth in the first few years. Total assets are expected to decrease from $544 billion at the end of 2021 to $499 billion at the end of 2022 and then grow to $791 billion by the end of 2030. Assets are then projected to reach $2.2 trillion by 2050 and $17 trillion by 2100. The ratio of assets to the following year's expenditures is projected to increase slightly from 8.1 to 8.4 between 2022 and 2030 and to continue to grow thereafter to values of 10.7 in 2050 and 13.2 in 2100.
- With the legislated contribution rate of 9.9%, investment income of the base Plan, which is expected to represent 32% of revenues (i.e. contributions and investment income) in 2023, is further projected to represent 34% of revenues in 2030, 42% of revenues in 2050 and 51% of revenues by 2100. This illustrates the importance of investment income as a source of revenues for the base Plan.
- The minimum contribution rate (MCR) to sustain the base Plan is 9.56% of contributory earnings for years 2025 to 2033 and 9.54% for the year 2034 and thereafter. The legislated contribution rate of 9.9% applies to the first three years after the valuation year, that is, to the current triennial review period of 2022-2024.
- The MCR consists of two separate components. First, the steady-state contribution rate, which is the lowest rate that results in the projected ratio of the assets to the following year's expenditures of the base Plan remaining generally constant over the long term, before consideration of any full funding of increased or new benefits, is 9.53% for the year 2025 and thereafter. The second component is the full funding rate that is required to fully fund the amendments made to the *Canada Pension Plan* under the *Budget Implementation Act, 2018, No. 1*. The full funding rate is 0.03% for years 2025 to 2033 and 0.01% for the year 2034 and thereafter.
- Under the MCR, the ratio of assets to the following year's expenditures is projected to increase slightly from 8.1 in 2025 to 8.4 in 2034 and to be the same fifty years later in 2084.
- The MCR determined for this report is lower than the MCR of 9.72% for years 2034 and thereafter determined under the 30th CPP Actuarial Report. Experience over the period 2019 to 2021 was better than expected overall, leading to a decrease in the MCR. The main contributing factor for

this was better than expected investment experience, which lowers the MCR by 0.35. This decrease is partially offset by changes in real rate of return assumptions for 2022. The net result of all changes since the 30th CPP Actuarial Report is a decrease in the MCR of 0.18 percentage points for the year 2034 and thereafter.

- Overall, changes to the assumptions to reflect the subsequent event resulted in an increase in the MCR of 0.31. A large portion of this increase is due to reductions in the 2022 assumed nominal rate of return. The reduction in MCR due to 2019-2021 investment experience is therefore partially offset by lower assumed returns in 2022.
- Although the pay-as-you-go rate is expected to increase over time from 9.1% in 2022 to 13.3% by 2100 due to the retirement of the baby boom generation and the projected continued aging of the population, the legislated contribution rate of 9.9% is sufficient to finance the base Plan over the long term. The pay-as-you-go rate is the contribution rate that would need to be paid if there were no assets.
- The number of contributors to the CPP is expected to grow from 15.2 million in 2022 to 19.3 million in 2050 and 24.0 million by 2100. Under the legislated contribution rate of 9.9%, base CPP contributions are expected to increase from $61 billion in 2022 to $177 billion in 2050 and $929 billion by 2100.
- The number of base CPP retirement beneficiaries is expected to increase from 6.0 million in 2022 to 9.9 million in 2050 and 15.3 million by 2100.
- Total expenditures of the base Plan are expected to grow rapidly from approximately $56 billion in 2022 to $89 billion in 2030. Thereafter, total expenditures are projected to grow at a slower pace, reaching $197 billion in 2050 and $1.2 trillion by 2100.

5.2 Contributions

Projected contributions are the product of the contribution rate, the number of contributors, and the average contributory earnings. The contribution rate for the base CPP is set by law and is 9.9%. As of 1 January 2019, all contributors to the base CPP also contribute to the additional CPP.

Table 4 presents the projected number of CPP contributors, including CPP retirement beneficiaries who are working (i.e. “working beneficiaries”), their base CPP contributory earnings and contributions. The number of contributors who are not working beneficiaries is directly linked to the assumed labour force participation rates applied to the projected working-age population and the job creation rates. The number of working beneficiaries who are contributors is derived from the number of retirement beneficiaries in pay. Hence, the demographic, economic, and retirement-related assumptions have a great influence on the expected level of contributions. In this report, the number of CPP contributors is expected to increase continuously throughout the projection period, but at a generally decreasing pace, from an estimated 15.2 million in 2022 to 16.7 million in 2030, 19.3 million in 2050, and 24.0 million by 2100. The future increase in the number of contributors is limited due to the projected lower growth in the working-age population and labour force.

The growth in base CPP contributory earnings, which are derived by subtracting the Year’s Basic

Exemption (YBE) from pensionable earnings (up to the YMPE) is linked to the growth in average employment earnings through the assumption regarding annual increases in wages and is affected by the freeze on the YBE since 1998.

Contributions to the base CPP are expected to increase from an estimated $61 billion in 2022 to $86 billion in 2030, $177 billion in 2050 and to continue increasing thereafter, reaching $929 billion in 2100 as shown in Table 4. The projected YMPE is also shown, which is assumed to increase according to the increases in the average weekly earnings assumption. The YMPE for 2023 reflects actual data up to April 2022. The YMPE is projected to increase from $64,900 in 2022 to $82,200 in 2030, $145,600 in 2050, and $608,200 by 2100.

Since the legislated contribution rate is constant at 9.9% for the year 2019 and thereafter, contributions to the base CPP increase at the same rate as total contributory earnings over the projection period.

Table 4 Contributions - Base CPP

Year	Contribution Rate (%)	YMPE ($)	Number of Contributors (thousands)	Contributory Earnings ($ million)	Contributions ($ million)
2022	9.9	64,900	15,235	616,668	61,050
2023	9.9	66,900	15,534	648,785	64,230
2024	9.9	69,200	15,751	680,189	67,339
2025	9.9	71,200	15,959	710,485	70,338
2026	9.9	73,300	16,114	739,632	73,224
2027	9.9	75,400	16,264	769,230	76,154
2028	9.9	77,600	16,419	800,229	79,223
2029	9.9	79,900	16,566	832,186	82,386
2030	9.9	82,200	16,708	864,552	85,591
2035	9.9	94,800	17,464	1,047,401	103,693
2040	9.9	109,400	18,057	1,254,280	124,174
2045	9.9	126,200	18,686	1,499,428	148,443
2050	9.9	145,600	19,263	1,784,712	176,687
2055	9.9	168,000	19,687	2,108,096	208,701
2060	9.9	193,800	19,992	2,474,655	244,991
2065	9.9	223,600	20,289	2,903,032	287,400
2070	9.9	258,000	20,699	3,421,988	338,777
2080	9.9	343,300	21,805	4,803,930	475,589
2090	9.9	457,000	22,975	6,744,599	667,715
2100	9.9	608,200	23,973	9,379,076	928,529

5.3 Expenditures

The projected number of base CPP beneficiaries by type of benefit is given in Table 5, while Table 6 presents information for male and female beneficiaries separately. The number of retirement, disability, and survivor beneficiaries increases throughout the projection period. In particular, the number of retirement beneficiaries is expected to increase from an estimated 6.0 million in 2022 to 7.7 million by 2030 or by 27% due to the aging of the population and retirement of the baby boomers.

By 2050, the number of retirement beneficiaries is projected to be 9.9 million and to then further increase to 15.3 million by 2100. Female retirement beneficiaries continue to outnumber their male counterparts, and by 2050 there is projected to be 793 thousand or 17% more female than male retirement beneficiaries. By 2100, the number of female retirement beneficiaries is projected to exceed the number of male beneficiaries by 1.1 million or 15%. Over the projection period, the number of disability and survivor beneficiaries is also projected to increase but at a slower average pace than for retirement beneficiaries.

Table 5 Beneficiaries - Base CPP [1]
(thousands)

Year	Retirement [2],[3],[4],[5]	Disability [4],[6]	Survivor [5],[6]	Children	Death [7]
2022	6,025	365	1,353	221	176
2023	6,230	363	1,377	224	178
2024	6,444	365	1,403	228	184
2025	6,671	370	1,430	234	189
2026	6,893	375	1,458	241	194
2027	7,093	380	1,486	248	200
2028	7,288	384	1,515	254	205
2029	7,476	388	1,545	262	212
2030	7,651	393	1,575	269	218
2035	8,334	429	1,729	301	251
2040	8,834	476	1,874	335	285
2045	9,300	526	1,991	359	312
2050	9,869	562	2,070	368	332
2055	10,564	583	2,116	366	344
2060	11,353	586	2,148	362	350
2065	12,088	580	2,191	363	358
2070	12,661	594	2,261	369	373
2080	13,551	633	2,450	386	418
2090	14,266	685	2,554	394	447
2100	15,260	709	2,545	402	450

(1) Numbers of beneficiaries by sex in Table 6 may not sum to total numbers of beneficiaries shown in Table 5 due to rounding.
(2) The number given for retirement beneficiaries includes working beneficiaries.
(3) The number given for retirement beneficiaries does not take into account that the retirement pension can be shared between spouses.
(4) A beneficiary who receives concurrently a retirement and post-retirement disability benefit is counted in each of the retirement and disability benefit categories.
(5) A beneficiary who receives concurrently a retirement and a survivor's benefit is counted in each category.
(6) A beneficiary who receives concurrently a disability and survivor's benefit is counted in each category.
(7) This is the number of deceased contributors whose estates or persons or institutions as prescribed are entitled to the death benefit during the given year.

Table 6 Beneficiaries by Sex - Base CPP [1]
(thousands)

	Males				Females			
Year	Retirement[2],[3],[4],[5]	Disability[4],[6]	Survivor[5],[6]	Death[7]	Retirement[2],[3],[4],[5]	Disability[4],[6]	Survivor[5],[6]	Death[7]
2022	2,889	163	278	104	3,136	202	1,075	73
2023	2,982	161	287	104	3,248	201	1,090	74
2024	3,079	162	297	107	3,365	203	1,107	77
2025	3,182	164	306	109	3,488	207	1,124	80
2026	3,283	166	315	112	3,611	210	1,142	82
2027	3,372	167	325	114	3,721	213	1,161	85
2028	3,459	168	334	117	3,829	215	1,181	89
2029	3,542	170	344	120	3,934	219	1,201	92
2030	3,619	171	353	123	4,033	221	1,222	95
2035	3,904	186	396	138	4,430	244	1,333	113
2040	4,097	205	430	152	4,738	271	1,444	132
2045	4,281	227	453	164	5,019	299	1,537	149
2050	4,538	243	466	171	5,331	319	1,604	161
2055	4,878	252	473	176	5,686	331	1,643	168
2060	5,279	252	482	178	6,074	334	1,666	172
2065	5,646	247	495	183	6,442	333	1,695	175
2070	5,911	253	512	191	6,750	341	1,749	182
2080	6,296	270	538	214	7,255	363	1,912	204
2090	6,610	293	540	227	7,655	392	2,014	220
2100	7,090	303	536	227	8,170	406	2,009	223

(1) Numbers of beneficiaries by sex in Table 6 may not sum to total numbers of beneficiaries shown in Table 5 due to rounding.
(2) The number given for retirement beneficiaries includes working beneficiaries.
(3) The number given for retirement beneficiaries does not take into account that the retirement pension can be shared between spouses.
(4) A beneficiary who receives concurrently a retirement and post-retirement disability benefit is counted in each of the retirement and disability benefit categories.
(5) A beneficiary who receives concurrently a retirement and a survivor's benefit is counted in each category.
(6) A beneficiary who receives concurrently a disability and survivor's benefit is counted in each category.
(7) This is the number of deceased contributors whose estates or persons or institutions as prescribed are entitled to the death benefit during the given year.

Table 7 shows the amount of projected base CPP expenditures by type. Total expenditures of the base Plan are expected to grow rapidly from approximately $56 billion in 2022 to $89 billion in 2030. Thereafter, total expenditures are projected to grow at a slower pace, reaching $197 billion in 2050 and $1.2 trillion by 2100. Table 8 shows the same information but in millions of 2022 constant dollars.

Table 9 shows the projected base CPP expenditures by type expressed as a percentage of contributory earnings. These are referred to as the pay-as-you-go (or "PayGo") rates. A pay-as-you-go rate corresponds to the contribution rate that would need to be paid to cover expenditures if there were no assets. Although the total pay-as-you-go rate is expected to increase significantly from approximately 9.1% in 2022 to 13.3% by the end of the projection period, the legislated contribution rate of 9.9% is sufficient to finance the base Plan over the projection period.

Table 7 Expenditures - Base CPP
($ million)

Year	Retirement [1]	Disability [2]	Survivor	Children	Death	Operating Expenses [3]	Total
2022	44,846	4,397	4,975	571	440	775	56,005
2023	49,774	4,650	5,338	617	445	768	61,592
2024	53,281	4,768	5,514	648	459	756	65,425
2025	56,821	4,891	5,679	680	472	787	69,330
2026	60,460	5,034	5,845	715	485	817	73,356
2027	63,978	5,186	6,013	750	499	847	77,273
2028	67,526	5,335	6,197	787	513	879	81,237
2029	71,148	5,504	6,400	825	528	912	85,318
2030	74,802	5,694	6,623	865	544	945	89,472
2031	78,441	5,918	6,866	906	559	979	93,670
2032	82,040	6,172	7,129	946	575	1,015	97,877
2033	85,635	6,443	7,409	986	592	1,052	102,118
2034	89,272	6,729	7,707	1,029	609	1,091	106,436
2035	92,973	7,028	8,023	1,074	626	1,130	110,853
2036	96,745	7,338	8,355	1,120	643	1,169	115,370
2037	100,557	7,678	8,704	1,169	660	1,210	119,977
2038	104,408	8,043	9,067	1,221	677	1,252	124,669
2039	108,332	8,438	9,446	1,272	694	1,296	129,478
2040	112,382	8,843	9,839	1,323	711	1,341	134,439
2041	116,578	9,269	10,244	1,374	726	1,387	139,577
2042	120,925	9,707	10,658	1,423	740	1,436	144,889
2043	125,452	10,163	11,081	1,471	754	1,487	150,409
2044	130,197	10,627	11,515	1,520	768	1,540	156,167
2045	135,200	11,098	11,957	1,568	780	1,595	162,197
2046	140,488	11,570	12,404	1,613	791	1,651	168,516
2047	146,085	12,040	12,856	1,652	801	1,709	175,143
2048	152,016	12,511	13,312	1,690	811	1,768	182,108
2049	158,300	12,985	13,772	1,728	820	1,830	189,435
2050	164,967	13,462	14,237	1,765	829	1,892	197,151
2051	172,035	13,939	14,704	1,800	836	1,956	205,269
2052	179,500	14,423	15,171	1,834	842	2,021	213,791
2053	187,371	14,907	15,641	1,867	848	2,088	222,722
2054	195,698	15,381	16,115	1,900	853	2,156	232,103
2055	204,541	15,835	16,594	1,933	858	2,226	241,987
2060	255,758	18,027	19,116	2,112	874	2,602	298,489
2065	317,002	20,269	22,144	2,339	894	3,038	365,685
2070	385,069	23,475	26,057	2,631	931	3,562	441,724
2075	461,732	27,477	31,097	2,972	985	4,203	528,466
2080	549,340	32,208	37,189	3,350	1,043	4,971	628,102
2085	649,803	38,098	44,038	3,750	1,089	5,882	742,661
2090	771,028	44,855	51,349	4,169	1,116	6,950	879,465
2095	921,488	51,845	59,097	4,634	1,122	8,188	1,046,375
2100	1,103,304	59,859	67,667	5,180	1,123	9,634	1,246,767

(1) Retirement expenditures include expenditures related to post-retirement benefits for working beneficiaries.
(2) Disability expenditures include expenditures related to post-retirement disability benefits for disabled retirement beneficiaries.
(3) Plan operating expenses exclude CPPIB operating expenses, which are accounted for separately in the investment expenses assumption.

Table 8 Expenditures - Base CPP [1]
(millions of 2022 constant dollars)

Year	Retirement [2]	Disability [3]	Survivor	Children	Death	Operating Expenses [4]	Total
2022	44,846	4,397	4,975	571	440	775	56,005
2023	48,324	4,515	5,182	599	432	746	59,798
2024	50,468	4,516	5,223	613	435	716	61,970
2025	52,637	4,531	5,260	630	437	729	64,224
2026	54,909	4,572	5,309	650	440	742	66,621
2027	56,965	4,617	5,354	668	444	754	68,803
2028	58,945	4,657	5,410	687	448	767	70,914
2029	60,889	4,710	5,477	706	452	780	73,015
2030	62,760	4,777	5,557	726	456	793	75,069
2031	64,523	4,868	5,648	745	460	805	77,050
2032	66,161	4,977	5,749	763	464	819	78,932
2033	67,706	5,094	5,858	780	468	832	80,738
2034	69,197	5,216	5,974	797	472	845	82,502
2035	70,653	5,341	6,097	816	476	859	84,241
2036	72,078	5,467	6,225	835	479	871	85,954
2037	73,449	5,608	6,357	854	482	884	87,634
2038	74,766	5,760	6,493	874	485	897	89,275
2039	76,056	5,924	6,632	893	488	910	90,901
2040	77,352	6,087	6,772	911	489	923	92,534
2041	78,666	6,254	6,912	927	490	936	94,186
2042	80,000	6,422	7,051	941	490	950	95,853
2043	81,368	6,592	7,187	954	489	965	97,554
2044	82,789	6,758	7,322	966	488	979	99,303
2045	84,284	6,919	7,454	977	486	994	101,115
2046	85,864	7,072	7,581	986	483	1,009	102,995
2047	87,534	7,215	7,703	990	480	1,024	104,946
2048	89,302	7,349	7,820	993	477	1,039	106,979
2049	91,170	7,479	7,932	995	473	1,054	109,102
2050	93,147	7,601	8,039	996	468	1,068	111,319
2051	95,233	7,716	8,139	996	463	1,083	113,631
2052	97,417	7,827	8,234	995	457	1,097	116,027
2053	99,695	7,932	8,322	993	451	1,111	118,504
2054	102,084	8,023	8,406	991	445	1,125	121,074
2055	104,605	8,098	8,487	989	439	1,138	123,755
2060	118,468	8,350	8,855	978	405	1,205	138,261
2065	132,994	8,503	9,290	981	375	1,274	153,418
2070	146,321	8,920	9,901	1,000	354	1,353	167,849
2075	158,912	9,457	10,703	1,023	339	1,447	181,880
2080	171,241	10,040	11,593	1,044	325	1,550	195,793
2085	183,463	10,756	12,433	1,059	307	1,661	209,679
2090	197,167	11,470	13,131	1,066	285	1,777	224,897
2095	213,429	12,008	13,688	1,073	260	1,896	242,354
2100	231,450	12,557	14,195	1,087	236	2,021	261,546

(1) For a given year, the value in 2022 constant dollars is equal to the corresponding value in current dollars divided by the cumulative projected increases in prices since 2022.
(2) Retirement expenditures include expenditures related to post-retirement benefits for working beneficiaries.
(3) Disability expenditures include expenditures related to post-retirement disability benefits for disabled retirement beneficiaries.
(4) Plan operating expenses exclude CPPIB operating expenses, which are accounted for separately in the investment expenses assumption.

Table 9 Expenditures as Percentage of Contributory Earnings - Base CPP
(pay-as-you-go rates) (%)

Year	Retirement [1]	Disability [2]	Survivor	Children	Death	Operating Expenses [3]	Total
2022	7.27	0.71	0.81	0.09	0.07	0.13	9.08
2023	7.67	0.72	0.82	0.10	0.07	0.12	9.49
2024	7.83	0.70	0.81	0.10	0.07	0.11	9.62
2025	8.00	0.69	0.80	0.10	0.07	0.11	9.76
2026	8.17	0.68	0.79	0.10	0.07	0.11	9.92
2027	8.32	0.67	0.78	0.10	0.06	0.11	10.05
2028	8.44	0.67	0.77	0.10	0.06	0.11	10.15
2029	8.55	0.66	0.77	0.10	0.06	0.11	10.25
2030	8.65	0.66	0.77	0.10	0.06	0.11	10.35
2031	8.73	0.66	0.76	0.10	0.06	0.11	10.43
2032	8.79	0.66	0.76	0.10	0.06	0.11	10.49
2033	8.83	0.66	0.76	0.10	0.06	0.11	10.53
2034	8.86	0.67	0.76	0.10	0.06	0.11	10.56
2035	8.88	0.67	0.77	0.10	0.06	0.11	10.58
2036	8.91	0.68	0.77	0.10	0.06	0.11	10.63
2037	8.93	0.68	0.77	0.10	0.06	0.11	10.66
2038	8.94	0.69	0.78	0.10	0.06	0.11	10.68
2039	8.95	0.70	0.78	0.11	0.06	0.11	10.70
2040	8.96	0.71	0.78	0.11	0.06	0.11	10.72
2041	8.97	0.71	0.79	0.11	0.06	0.11	10.74
2042	8.98	0.72	0.79	0.11	0.05	0.11	10.76
2043	8.98	0.73	0.79	0.11	0.05	0.11	10.77
2044	9.00	0.73	0.80	0.11	0.05	0.11	10.79
2045	9.02	0.74	0.80	0.10	0.05	0.11	10.82
2046	9.04	0.74	0.80	0.10	0.05	0.11	10.85
2047	9.08	0.75	0.80	0.10	0.05	0.11	10.89
2048	9.12	0.75	0.80	0.10	0.05	0.11	10.93
2049	9.18	0.75	0.80	0.10	0.05	0.11	10.98
2050	9.24	0.75	0.80	0.10	0.05	0.11	11.05
2051	9.32	0.76	0.80	0.10	0.05	0.11	11.12
2052	9.40	0.76	0.79	0.10	0.04	0.11	11.19
2053	9.49	0.75	0.79	0.09	0.04	0.11	11.28
2054	9.59	0.75	0.79	0.09	0.04	0.11	11.37
2055	9.70	0.75	0.79	0.09	0.04	0.11	11.48
2060	10.34	0.73	0.77	0.09	0.04	0.11	12.06
2065	10.92	0.70	0.76	0.08	0.03	0.10	12.60
2070	11.25	0.69	0.76	0.08	0.03	0.10	12.91
2075	11.40	0.68	0.77	0.07	0.02	0.10	13.04
2080	11.44	0.67	0.77	0.07	0.02	0.10	13.07
2085	11.40	0.67	0.77	0.07	0.02	0.10	13.03
2090	11.43	0.67	0.76	0.06	0.02	0.10	13.04
2095	11.58	0.65	0.74	0.06	0.01	0.10	13.15
2100	11.76	0.64	0.72	0.06	0.01	0.10	13.29

(1) Retirement expenditures include expenditures related to post-retirement benefits for working beneficiaries.
(2) Disability expenditures include expenditures related to post-retirement disability benefits for disabled retirement beneficiaries.
(3) Plan operating expenses exclude CPPIB operating expenses, which are accounted for separately in the investment expenses assumption.

5.4 Financial Projections with Legislated Contribution Rate

5.4.1 Market Value of Assets as at 31 December 2021

Prior to 2001, CPP assets were valued at cost because they were traditionally limited to short-term investments and 20-year non-marketable bonds in the form of loans to the provinces. With the creation of the CPPIB in 1997, excess cash flows (contributions less Plan expenditures) not needed to pay benefits are invested in the capital markets as of 1999. Those assets, as is usually the case for private pension plans, are valued at market. The market value of base CPP assets is $544 billion as at 31 December 2021.

5.4.2 Projected Financial State

Table 10 presents historical results of the base CPP while Table 11 and Table 12 present the projected financial state of the base CPP using the legislated contribution rate of 9.9% in current dollars and in 2022 constant dollars, respectively. The projected financial state of the base CPP using the minimum contribution rate of 9.56% for years 2025-2033, and 9.54% for 2034 and thereafter is discussed in the next section 5.5.

Base CPP assets are projected to decrease in 2022 due to the market downturn observed in the first half of 2022 and assumed continued volatility for the remainder of 2022. They are then projected to continuously increase throughout the projection horizon. As shown in Table 10, the base CPP assets as at 31 December 2021 are $544 billion. As shown in Table 11, base CPP assets are projected to increase to $791 billion in 2030, $2.2 trillion in 2050 and $17 trillion by 2100.

Despite projected volatility and lower returns in the first few years of the projections, the investment experience over the 2018-2021 period leads to projected base CPP assets that are higher than projected under the previous triennial actuarial report (the 30th CPP Actuarial Report as at 31 December 2018).

Table 10 Historical Results - Base CPP

Year	PayGo Rate[1] (%)	Contribution Rate (%)	Contributions ($ million)	Expenditures ($ million)	Net Cash Flows ($ million)	Net Investment Income [2] ($ million)	Assets at 31 Dec. [3] ($ million)	Yield/ Return [2] (%)	Assets/ Expenditures Ratio
1966	0.05	3.6	531	8	523	2	525	0.7	52.5
1970	0.45	3.6	773	97	676	193	3,596	6.2	24.1
1975	1.42	3.6	1,426	561	865	607	9,359	7.2	11.5
1980	2.72	3.6	2,604	1,965	639	1,466	18,433	8.7	7.6
1985	4.31	3.6	4,032	4,826	(794)	3,113	31,130	10.8	5.7
1986	4.20	3.6	4,721	5,503	(782)	3,395	33,743	10.9	4.7
1987	5.02	3.8	5,393	7,130	(1,737)	3,654	35,660	10.9	4.3
1988	5.41	4.0	6,113	8,272	(2,159)	3,886	37,387	11.0	4.0
1989	5.89	4.2	6,694	9,391	(2,697)	4,162	38,852	11.3	3.7
1990	5.82	4.4	7,889	10,438	(2,549)	4,386	40,689	11.4	3.5
1991	6.31	4.6	8,396	11,518	(3,122)	4,476	42,043	11.2	3.2
1992	7.07	4.8	8,883	13,076	(4,193)	4,497	42,347	11.0	3.0
1993	7.79	5.0	9,166	14,273	(5,107)	4,480	41,720	10.9	2.7
1994	8.33	5.2	9,585	15,362	(5,777)	4,403	40,346	11.0	2.5
1995	7.91	5.4	10,911	15,986	(5,075)	4,412	39,683	11.3	2.4
1996	8.71	5.6	10,757	16,723	(5,966)	4,177	37,894	11.0	2.2
1997	8.67	6.0	12,165	17,570	(5,405)	3,971	36,460	10.8	2.0
1998	8.11	6.4	14,473	18,338	(3,865)	3,938	36,535	10.9	1.9
1999	8.23	7.0	16,052	18,877	(2,825)	764	42,783	1.7	2.2
2000	7.69	7.8	19,977	19,683	294	4,446	47,523	9.9	2.3
2001	7.85	8.6	22,469	20,515	1,954	3,154	52,631	6.2	2.4
2002	8.16	9.4	24,955	21,666	3,289	187	56,107	0.3	2.5
2003	8.19	9.9	27,454	22,716	4,738	6,769	67,614	11.1	2.8
2004	8.29	9.9	28,459	23,833	4,626	6,475	78,715	8.9	3.2
2005	8.37	9.9	29,539	24,976	4,563	11,083	94,361	13.2	3.6
2006	8.33	9.9	31,000	26,080	4,920	14,300	113,581	14.4	4.1
2007	8.15	9.9	33,621	27,691	5,930	3,269	122,780	2.7	4.2
2008	8.03	9.9	36,053	29,259	6,794	(18,350)	111,224	-14.2	3.6
2009	8.16	9.9	37,492	30,901	6,591	9,021	126,836	7.6	4.0
2010	8.83	9.9	35,885	32,023	3,862	11,804	142,502	8.9	4.2
2011	8.73	9.9	38,202	33,691	4,511	8,057	155,070	5.4	4.3
2012	8.84	9.9	40,682	36,321	4,361	15,664	175,095	9.7	4.7
2013	8.73	9.9	42,632	37,575	5,057	23,887	204,039	13.2	5.3
2014	8.70	9.9	44,181	38,808	5,373	32,136	241,548	15.2	5.9
2015	8.79	9.9	46,026	40,883	5,143	38,667	285,358	15.6	6.7
2016	9.06	9.9	46,492	42,561	3,931	12,244	301,533	4.2	6.8
2017	9.17	9.9	48,139	44,596	3,543	35,257	340,333	11.4	7.3
2018	9.30	9.9	49,594	46,591	3,003	28,364	371,700	8.2	7.6
2019	9.27	9.9	52,166	48,844	3,322	47,041	422,063	12.4	8.2
2020	9.62	9.9	52,833	51,322	1,511	51,320	474,894	12.0	9.0
2021	9.46	9.9	55,535	53,045	2,490	66,341	543,725	13.8	9.7

(1) PayGo rates for years 2020 and 2021 were affected by the impact of COVID-19 on contributions and expenditures.
(2) Rates of return and Investment Income are net of all investment expenses of the CPPIB for the year 1999 and thereafter.
(3) Results for years 1966 to 1998 are on a cost basis, while results for years 1999 to 2021 are presented on a market value basis. If assets were shown at market value at the end of 1998, total assets would be $44,864 million instead of $36,535 million.

Table 11 Financial Projections - Base CPP, 9.9% Legislated Contribution Rate

Year	PayGo Rate (%)	Contribution Rate (%)	Contributory Earnings ($ million)	Contributions ($ million)	Expenditures ($ million)	Net Cash Flows ($ million)	Net Investment Income [1] ($ million)	Assets at 31 Dec. ($ million)	Net Rate of Return [1] (%)	Assets/ Expenditures Ratio
2022	9.08	9.9	616,668	61,050	56,005	5,045	(49,808)	498,962	(9.02)	8.1
2023	9.49	9.9	648,785	64,230	61,592	2,638	29,938	531,538	5.91	8.1
2024	9.62	9.9	680,189	67,339	65,425	1,914	31,994	565,445	5.93	8.2
2025	9.76	9.9	710,485	70,338	69,330	1,008	33,776	600,229	5.90	8.2
2026	9.92	9.9	739,632	73,224	73,356	(132)	35,854	635,950	5.90	8.2
2027	10.05	9.9	769,230	76,154	77,273	(1,119)	38,111	672,942	5.93	8.3
2028	10.15	9.9	800,229	79,223	81,237	(2,015)	39,924	710,851	5.87	8.3
2029	10.25	9.9	832,186	82,386	85,318	(2,931)	42,343	750,262	5.90	8.4
2030	10.35	9.9	864,552	85,591	89,472	(3,882)	44,822	791,202	5.92	8.4
2031	10.43	9.9	898,197	88,922	93,670	(4,748)	46,868	833,322	5.87	8.5
2032	10.49	9.9	933,295	92,396	97,877	(5,480)	49,567	877,408	5.90	8.6
2033	10.53	9.9	969,910	96,021	102,118	(6,097)	53,397	924,709	6.04	8.7
2034	10.56	9.9	1,007,917	99,784	106,436	(6,652)	56,231	974,287	6.04	8.8
2035	10.58	9.9	1,047,401	103,693	110,853	(7,161)	59,198	1,026,325	6.03	8.9
2036	10.63	9.9	1,085,658	107,480	115,370	(7,890)	62,310	1,080,745	6.03	9.0
2037	10.66	9.9	1,125,623	111,437	119,977	(8,540)	65,575	1,137,780	6.03	9.1
2038	10.68	9.9	1,167,224	115,555	124,669	(9,114)	69,002	1,197,668	6.03	9.2
2039	10.70	9.9	1,210,287	119,818	129,478	(9,660)	72,592	1,260,600	6.02	9.4
2040	10.72	9.9	1,254,280	124,174	134,439	(10,266)	76,391	1,326,725	6.02	9.5
2041	10.74	9.9	1,299,423	128,643	139,577	(10,934)	80,378	1,396,170	6.02	9.6
2042	10.76	9.9	1,346,635	133,317	144,889	(11,572)	84,570	1,469,168	6.02	9.8
2043	10.77	9.9	1,396,342	138,238	150,409	(12,171)	88,998	1,545,994	6.02	9.9
2044	10.79	9.9	1,446,964	143,249	156,167	(12,918)	93,638	1,626,714	6.02	10.0
2045	10.82	9.9	1,499,428	148,443	162,197	(13,753)	98,509	1,711,470	6.02	10.2
2046	10.85	9.9	1,553,431	153,790	168,516	(14,727)	103,620	1,800,363	6.02	10.3
2047	10.89	9.9	1,608,638	159,255	175,143	(15,888)	108,975	1,893,450	6.02	10.4
2048	10.93	9.9	1,666,000	164,934	182,108	(17,174)	114,581	1,990,858	6.02	10.5
2049	10.98	9.9	1,724,766	170,752	189,435	(18,683)	120,443	2,092,618	6.02	10.6
2050	11.05	9.9	1,784,712	176,687	197,151	(20,464)	126,560	2,198,713	6.02	10.7
2051	11.12	9.9	1,846,030	182,757	205,269	(22,512)	132,931	2,309,132	6.02	10.8
2052	11.19	9.9	1,909,767	189,067	213,791	(24,724)	139,560	2,423,968	6.02	10.9
2053	11.28	9.9	1,974,826	195,508	222,722	(27,214)	146,449	2,543,202	6.02	11.0
2054	11.37	9.9	2,040,986	202,058	232,103	(30,046)	153,593	2,666,750	6.02	11.0
2055	11.48	9.9	2,108,096	208,701	241,987	(33,286)	160,987	2,794,451	6.02	11.1
2060	12.06	9.9	2,474,655	244,991	298,489	(53,498)	201,589	3,494,394	6.02	11.2
2065	12.60	9.9	2,903,032	287,400	365,685	(78,285)	248,302	4,298,794	6.02	11.3
2070	12.91	9.9	3,421,988	338,777	441,724	(102,947)	302,454	5,233,283	6.02	11.4
2075	13.04	9.9	4,051,490	401,097	528,466	(127,369)	366,783	6,345,944	6.02	11.6
2080	13.07	9.9	4,803,930	475,589	628,102	(152,513)	444,660	7,695,451	6.02	11.8
2085	13.03	9.9	5,697,857	564,088	742,661	(178,573)	540,461	9,358,546	6.02	12.2
2090	13.04	9.9	6,744,599	667,715	879,465	(211,750)	659,172	11,419,461	6.02	12.5
2095	13.15	9.9	7,958,860	787,927	1,046,375	(258,447)	804,984	13,948,338	6.02	12.9
2100	13.29	9.9	9,379,076	928,529	1,246,767	(318,238)	982,413	17,024,497	6.02	13.2

(1) Rates of Return and Investment Income are net of all investment expenses.

Table 12 Financial Projections – Base CPP, 9.9% Legislated Contribution Rate [1]
(millions of 2022 constant dollars)

Year	PayGo Rate (%)	Contribution Rate (%)	Contributory Earnings ($ million)	Contributions ($ million)	Expenditures ($ million)	Net Cash Flows ($ million)	Net Investment Income [2] ($ million)	Assets at 31 Dec. ($ million)
2022	9.08	9.9	616,668	61,050	56,005	5,045	(49,808)	498,962
2023	9.49	9.9	629,888	62,359	59,798	2,561	29,066	516,056
2024	9.62	9.9	644,270	63,783	61,970	1,813	30,304	535,587
2025	9.76	9.9	658,158	65,158	64,224	934	31,288	556,023
2026	9.92	9.9	671,724	66,501	66,621	(120)	32,562	577,562
2027	10.05	9.9	684,907	67,806	68,803	(997)	33,933	599,174
2028	10.15	9.9	698,537	69,155	70,914	(1,759)	34,850	620,517
2029	10.25	9.9	712,189	70,507	73,015	(2,509)	36,237	642,078
2030	10.35	9.9	725,380	71,813	75,069	(3,257)	37,607	663,838
2031	10.43	9.9	738,833	73,144	77,050	(3,906)	38,552	685,468
2032	10.49	9.9	752,651	74,512	78,932	(4,420)	39,973	707,581
2033	10.53	9.9	766,842	75,917	80,738	(4,820)	42,218	731,104
2034	10.56	9.9	781,266	77,345	82,502	(5,157)	43,586	755,198
2035	10.58	9.9	795,952	78,799	84,241	(5,442)	44,987	779,935
2036	10.63	9.9	808,848	80,076	85,954	(5,878)	46,423	805,187
2037	10.66	9.9	822,179	81,396	87,634	(6,238)	47,897	831,059
2038	10.68	9.9	835,848	82,749	89,275	(6,526)	49,412	857,649
2039	10.70	9.9	849,692	84,119	90,901	(6,782)	50,964	885,015
2040	10.72	9.9	863,311	85,468	92,534	(7,066)	52,579	913,175
2041	10.74	9.9	876,846	86,808	94,186	(7,378)	54,239	942,130
2042	10.76	9.9	890,887	88,198	95,853	(7,655)	55,948	971,950
2043	10.77	9.9	905,658	89,660	97,554	(7,894)	57,723	1,002,722
2044	10.79	9.9	920,089	91,089	99,303	(8,214)	59,542	1,034,388
2045	10.82	9.9	934,755	92,541	101,115	(8,574)	61,411	1,066,944
2046	10.85	9.9	949,432	93,994	102,995	(9,001)	63,331	1,100,353
2047	10.89	9.9	963,896	95,426	104,946	(9,520)	65,298	1,134,555
2048	10.93	9.9	978,694	96,891	106,979	(10,089)	67,311	1,169,531
2049	10.98	9.9	993,349	98,342	109,102	(10,760)	69,367	1,205,206
2050	11.05	9.9	1,007,719	99,764	111,319	(11,555)	71,461	1,241,480
2051	11.12	9.9	1,021,904	101,168	113,631	(12,462)	73,587	1,278,262
2052	11.19	9.9	1,036,457	102,609	116,027	(13,418)	75,741	1,315,521
2053	11.28	9.9	1,050,751	104,024	118,504	(14,480)	77,921	1,353,168
2054	11.37	9.9	1,064,659	105,401	121,074	(15,673)	80,120	1,391,082
2055	11.48	9.9	1,078,104	106,732	123,755	(17,023)	82,331	1,429,114
2060	12.06	9.9	1,146,263	113,480	138,261	(24,781)	93,376	1,618,607
2065	12.60	9.9	1,217,925	120,575	153,418	(32,843)	104,172	1,803,497
2070	12.91	9.9	1,300,308	128,731	167,849	(39,118)	114,928	1,988,575
2075	13.04	9.9	1,394,382	138,044	181,880	(43,836)	126,234	2,184,053
2080	13.07	9.9	1,497,486	148,251	195,793	(47,541)	138,610	2,398,834
2085	13.03	9.9	1,608,706	159,262	209,679	(50,417)	152,591	2,642,249
2090	13.04	9.9	1,724,728	170,748	224,897	(54,149)	168,563	2,920,183
2095	13.15	9.9	1,843,378	182,494	242,354	(59,860)	186,445	3,230,621
2100	13.29	9.9	1,967,536	194,786	261,546	(66,760)	206,090	3,571,388

(1) For a given year, the value in 2022 constant dollars is equal to the corresponding value in current dollars divided by the cumulative projected increases in prices since 2022.

(2) Investment Income is net of all investment expenses.

Over the period 2022 to 2025, contributions are projected to exceed expenditures for the base CPP. Thereafter, a small but increasing portion of investment income is required to cover the shortfall. This causes the total revenues (contributions and investment income) to continue to be higher than expenditures but to a lesser extent over the long term, which causes the assets to grow at a slower pace.

Chart 1 shows historical and projected revenues and expenditures of the base CPP for the period 2000 to 2050 on a year 2022 constant dollar basis.

Table 13 shows in more detail the sources of the revenues required to cover the expenditures, from which several observations can be made:

- From 2026 onward, a portion of investment income is required to fund net cash outflows. It is project that in 2050, 16% of investment income is required to pay for expenditures.
- Investment income, which is expected to represent 32% of revenues in 2023 is further projected to represent 42% of revenues in 2050. This clearly illustrates the importance of investment income as a source of revenues for the base Plan.

Chart 1 Revenues and Expenditures - Base CPP, 9.9% legislated contribution rate (billions of 2022 constant dollars)

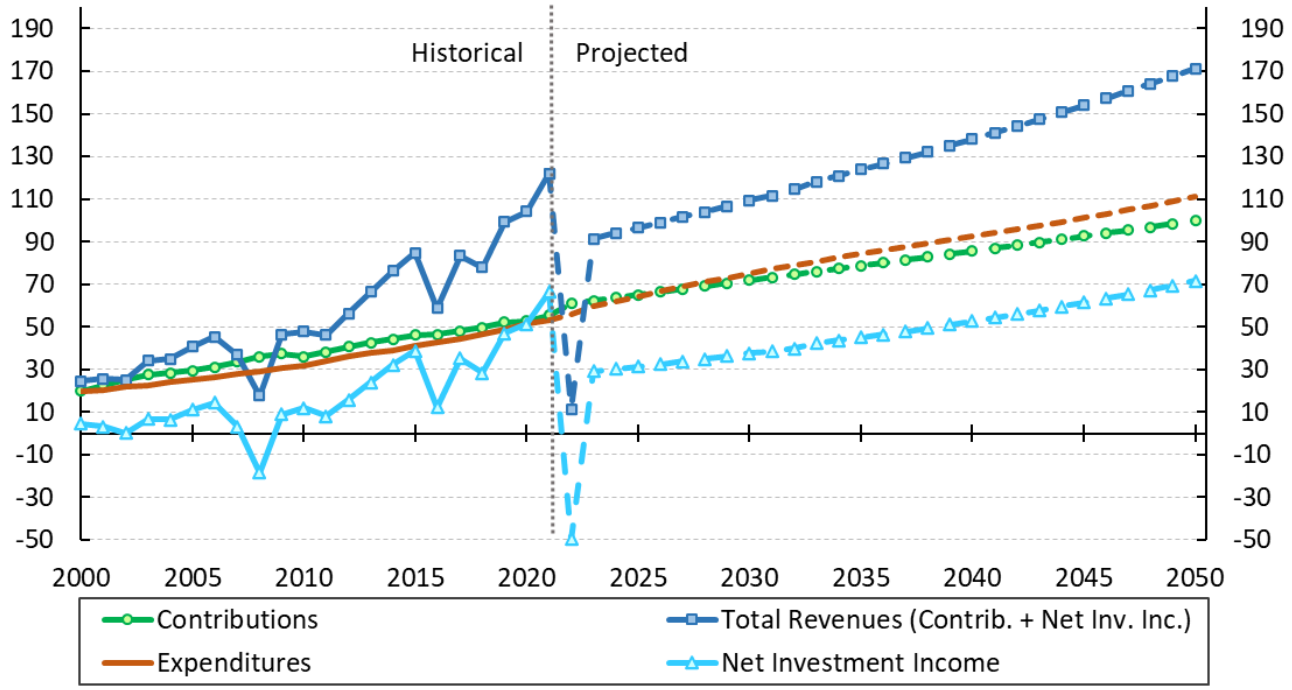


Table 13 Sources of Revenues and Funding of Expenditures - Base CPP, 9.9% Legislated Contribution Rate
($ million)

Year	Contributions	Net Investment Income [1]	Total Revenues	Net Investment Income as % of Total Revenues (%)	Expenditures	Expenditures as % of Total Revenues (%)	Net Cash Flows (Contributions less Expenditures)	% of Net Investment Income Needed to Pay Expenditures (%)
2022	61,050	(49,808)	11,242	(443.0)	56,005	498.2	5,045	0.0
2023	64,230	29,938	94,168	31.8	61,592	65.4	2,638	0.0
2024	67,339	31,994	99,332	32.2	65,425	65.9	1,914	0.0
2025	70,338	33,776	104,114	32.4	69,330	66.6	1,008	0.0
2026	73,224	35,854	109,077	32.9	73,356	67.3	(132)	0.4
2027	76,154	38,111	114,264	33.4	77,273	67.6	(1,119)	2.9
2028	79,223	39,924	119,146	33.5	81,237	68.2	(2,015)	5.0
2029	82,386	42,343	124,729	33.9	85,318	68.4	(2,931)	6.9
2030	85,591	44,822	130,413	34.4	89,472	68.6	(3,882)	8.7
2031	88,922	46,868	135,789	34.5	93,670	69.0	(4,748)	10.1
2032	92,396	49,567	141,963	34.9	97,877	68.9	(5,480)	11.1
2033	96,021	53,397	149,418	35.7	102,118	68.3	(6,097)	11.4
2034	99,784	56,231	156,014	36.0	106,436	68.2	(6,652)	11.8
2035	103,693	59,198	162,891	36.3	110,853	68.1	(7,161)	12.1
2036	107,480	62,310	169,791	36.7	115,370	67.9	(7,890)	12.7
2037	111,437	65,575	177,012	37.0	119,977	67.8	(8,540)	13.0
2038	115,555	69,002	184,557	37.4	124,669	67.6	(9,114)	13.2
2039	119,818	72,592	192,410	37.7	129,478	67.3	(9,660)	13.3
2040	124,174	76,391	200,564	38.1	134,439	67.0	(10,266)	13.4
2041	128,643	80,378	209,021	38.5	139,577	66.8	(10,934)	13.6
2042	133,317	84,570	217,887	38.8	144,889	66.5	(11,572)	13.7
2043	138,238	88,998	227,235	39.2	150,409	66.2	(12,171)	13.7
2044	143,249	93,638	236,888	39.5	156,167	65.9	(12,918)	13.8
2045	148,443	98,509	246,952	39.9	162,197	65.7	(13,753)	14.0
2046	153,790	103,620	257,409	40.3	168,516	65.5	(14,727)	14.2
2047	159,255	108,975	268,230	40.6	175,143	65.3	(15,888)	14.6
2048	164,934	114,581	279,515	41.0	182,108	65.2	(17,174)	15.0
2049	170,752	120,443	291,195	41.4	189,435	65.1	(18,683)	15.5
2050	176,687	126,560	303,246	41.7	197,151	65.0	(20,464)	16.2
2051	182,757	132,931	315,688	42.1	205,269	65.0	(22,512)	16.9
2052	189,067	139,560	328,627	42.5	213,791	65.1	(24,724)	17.7
2053	195,508	146,449	341,956	42.8	222,722	65.1	(27,214)	18.6
2054	202,058	153,593	355,651	43.2	232,103	65.3	(30,046)	19.6
2055	208,701	160,987	369,688	43.5	241,987	65.5	(33,286)	20.7
2060	244,991	201,589	446,580	45.1	298,489	66.8	(53,498)	26.5
2065	287,400	248,302	535,702	46.4	365,685	68.3	(78,285)	31.5
2070	338,777	302,454	641,230	47.2	441,724	68.9	(102,947)	34.0
2075	401,097	366,783	767,880	47.8	528,466	68.8	(127,369)	34.7
2080	475,589	444,660	920,249	48.3	628,102	68.3	(152,513)	34.3
2085	564,088	540,461	1,104,549	48.9	742,661	67.2	(178,573)	33.0
2090	667,715	659,172	1,326,887	49.7	879,465	66.3	(211,750)	32.1
2095	787,927	804,984	1,592,911	50.5	1,046,375	65.7	(258,447)	32.1
2100	928,529	982,413	1,910,942	51.4	1,246,767	65.2	(318,238)	32.4

(1) Investment income is net of all investment expenses.

5.5 Financial Projections with Minimum Contribution Rate

The results presented in Table 14 are based on the best-estimate assumptions, but use the MCR of 9.56% for 2025-2033 and 9.54% thereafter as opposed to the legislated contribution rate of 9.9% for 2022 and thereafter. The financial projections of the base Plan under the legislated rate of 9.9% were previously presented in Table 11. Under the MCR, the ratio of assets to the following year's expenditures is projected to increase slightly from 8.1 in 2025 to 8.4 in 2034 and to be the same fifty years later in 2084.

In the case that the MCR, as determined by an actuarial report, exceeds the legislated rate, the insufficient rates provisions of the CPP statute would result in adjustments to the base CPP legislated contribution rate and possibly indexation of benefits in pay if the federal and provincial governments make no recommendation to either increase the legislated rate or maintain it. In respect of this 31st CPP Actuarial Report, the MCR is less than the legislated rate of 9.9%, and thus the insufficient rates provisions do not apply. Therefore, in the absence of specific action by the federal and provincial governments, the legislated contribution rate will remain at 9.9% for the year 2022 and thereafter.

Table 14 Financial Projections - Base CPP, Minimum Contribution Rate of 9.56% for 2025-2033, 9.54% for 2034+

Year	PayGo Rate (%)	Contribution Rate (%)	Contributory Earnings ($ million)	Contributions ($ million)	Expenditures ($ million)	Net Cash Flows ($ million)	Net Investment Income [1] ($ million)	Assets at 31 Dec. ($ million)	Assets/ Expenditures Ratio
2022	9.08	9.90	616,668	61,050	56,005	5,045	(49,808)	498,962	8.1
2023	9.49	9.90	648,785	64,230	61,592	2,638	29,938	531,538	8.1
2024	9.62	9.90	680,189	67,339	65,425	1,914	31,994	565,445	8.2
2025	9.76	9.56	710,485	67,922	69,330	(1,408)	33,697	597,735	8.1
2026	9.92	9.56	739,632	70,709	73,356	(2,647)	35,625	630,713	8.2
2027	10.05	9.56	769,230	73,538	77,273	(3,735)	37,716	664,694	8.2
2028	10.15	9.56	800,229	76,502	81,237	(4,735)	39,353	699,312	8.2
2029	10.25	9.56	832,186	79,557	85,318	(5,761)	41,572	735,124	8.2
2030	10.35	9.56	864,552	82,651	89,472	(6,821)	43,833	772,136	8.2
2031	10.43	9.56	898,197	85,868	93,670	(7,802)	45,653	809,987	8.3
2032	10.49	9.56	933,295	89,223	97,877	(8,654)	48,091	849,424	8.3
2033	10.53	9.56	969,910	92,723	102,118	(9,394)	51,601	891,631	8.4
2034	10.56	9.54	1,007,917	96,155	106,436	(10,281)	54,117	935,467	8.4
2035	10.58	9.54	1,047,401	99,922	110,853	(10,931)	56,734	981,270	8.5
2036	10.63	9.54	1,085,658	103,572	115,370	(11,798)	59,466	1,028,938	8.6
2037	10.66	9.54	1,125,623	107,384	119,977	(12,592)	62,319	1,078,665	8.7
2038	10.68	9.54	1,167,224	111,353	124,669	(13,316)	65,301	1,130,650	8.7
2039	10.70	9.54	1,210,287	115,461	129,478	(14,017)	68,410	1,185,043	8.8
2040	10.72	9.54	1,254,280	119,658	134,439	(14,781)	71,689	1,241,951	8.9
2041	10.74	9.54	1,299,423	123,965	139,577	(15,612)	75,116	1,301,456	9.0
2042	10.76	9.54	1,346,635	128,469	144,889	(16,420)	78,703	1,363,739	9.1
2043	10.77	9.54	1,396,342	133,211	150,409	(17,198)	82,480	1,429,020	9.2
2044	10.79	9.54	1,446,964	138,040	156,167	(18,127)	86,419	1,497,312	9.2
2045	10.82	9.54	1,499,428	143,045	162,197	(19,151)	90,534	1,568,695	9.3
2046	10.85	9.54	1,553,431	148,197	168,516	(20,319)	94,833	1,643,209	9.4
2047	10.89	9.54	1,608,638	153,464	175,143	(21,679)	99,316	1,720,846	9.4
2048	10.93	9.54	1,666,000	158,936	182,108	(23,171)	103,984	1,801,659	9.5
2049	10.98	9.54	1,724,766	164,543	189,435	(24,892)	108,840	1,885,607	9.6
2050	11.05	9.54	1,784,712	170,262	197,151	(26,889)	113,876	1,972,593	9.6
2051	11.12	9.54	1,846,030	176,111	205,269	(29,158)	119,089	2,062,524	9.6
2052	11.19	9.54	1,909,767	182,192	213,791	(31,599)	124,476	2,155,401	9.7
2053	11.28	9.54	1,974,826	188,398	222,722	(34,324)	130,034	2,251,112	9.7
2054	11.37	9.54	2,040,986	194,710	232,103	(37,393)	135,754	2,349,473	9.7
2055	11.48	9.54	2,108,096	201,112	241,987	(40,875)	141,622	2,450,220	9.7
2060	12.06	9.54	2,474,655	236,082	298,489	(62,407)	172,854	2,984,644	9.6
2065	12.60	9.54	2,903,032	276,949	365,685	(88,736)	206,531	3,558,899	9.4
2070	12.91	9.54	3,421,988	326,458	441,724	(115,266)	242,642	4,175,026	9.1
2075	13.04	9.54	4,051,490	386,512	528,466	(141,954)	282,104	4,848,978	8.9
2080	13.07	9.54	4,803,930	458,295	628,102	(169,807)	325,822	5,596,049	8.6
2084	13.04	9.54	5,506,585	525,328	718,260	(192,931)	364,577	6,258,813	8.4
2085	13.03	9.54	5,697,857	543,576	742,661	(199,085)	374,859	6,434,587	8.4
2090	13.04	9.54	6,744,599	643,435	879,465	(236,030)	429,733	7,370,234	8.1
2095	13.15	9.54	7,958,860	759,275	1,046,375	(287,099)	488,645	8,367,616	7.7
2100	13.29	9.54	9,379,076	894,764	1,246,767	(352,003)	548,051	9,364,140	7.3

(1) Investment Income is net of all investment expenses.

Table 15 shows the progression of the MCR over time under the best-estimate assumptions of this report.

As shown in Table 15, the MCR is relatively stable over the periods considered. If the best-estimate assumptions of this report are realized, the MCR will increase between 0.01% and 0.05% for each of the next four reports and will remain below the legislated contribution rate of 9.9%. Thus, the current legislated contribution rate is projected to be sufficient over subsequent reports as long as the best-estimate assumptions remain the same and base Plan experience does not deviate materially from the assumptions.

Table 15 Progression of Minimum Contribution Rate over Time – Base CPP

Valuation Year [1]	Steady-State Target Years [2]	Steady-State Target A/E Ratio [3]	Steady-State Contribution Rate [4]	Full Funding Rate [5]		Minimum Contribution Rate (MCR) [6]		Average PayGo Rate Over Target Years Period
				Prior to 2034	2034+	Prior to 2034	2034+	
2021	2034 and 2084	8.5	9.53%	0.03%	0.01%	9.56%	9.54%	11.9
2024	2037 and 2087	8.8	9.54%	0.03%	0.01%	9.57%	9.55%	12.0
2027	2040 and 2090	9.2	9.56%	0.02%	0.01%	9.58%	9.57%	12.2
2030	2043 and 2093	9.6	9.60%	N/A	N/A [7]	N/A	9.60%	12.3
2033	2046 and 2096	10.0	9.62%	N/A	N/A	N/A	9.62%	12.5

(1) Reports are prepared as at 31 December of the valuation year.
(2) Target years refer to the beginning and end of the 50-year interval over which the steady-state contribution rate is determined. This rate is the lowest level rate that results in the assets/expenditures (A/E) ratio being the same in the two target years. For a given triennial review period of the Plan, the target years are 13 and 63 years after the valuation year. For this report, the valuation year is 2021 and thus the target years are 2034 and 2084.
(3) The steady-state target A/E ratio is the ratio obtained in the target years relating to the determination of the corresponding steady-state contribution rate. Where the ratios in the target years do not match exactly, the ratio presented pertains to the first target year.
(4) The steady-state contribution rate determined by a valuation is effective following the corresponding triennial review period. That is, for the current valuation as at 31 December 2021, the corresponding triennial review period is 2022-2024, and the steady-state rate applies from 2025 onward.
(5) The full funding rate, in respect of amendments to the *Canada Pension Plan* that introduce or increase benefits, is determined by a valuation such that the rate is effective following the corresponding triennial review period, or as at the effective date of the amendments if later. For the current valuation, the full funding rate is in respect of the amendments to the CPP statute under the *Budget Implementation Act, 2018, No. 1*, and the rate applies from 2025 onward. The full funding rates prior to 2034 shown in the table decrease over time due to rounding of the rates as per the regulations.
(6) The minimum contribution rate equals the sum of the rounded steady-state contribution rate and the rounded full funding rate.
(7) The full funding rate for the 2030 valuation applies for the year 2034 and onward and as such consists only of the permanent rate with the temporary rate no longer applying, since the amortization of benefit improvements under the *Budget Implementation Act, 2018, No. 1* in respect of past Plan participation ends in 2033. The permanent full funding rate is determined to be 0.01%, which falls below the de minimis rate of 0.02% as set out in the regulations. As such, the rate is deemed to equal 0%, the benefit improvements of the *Budget Implementation Act, 2018, No. 1* in respect of future Plan participation are financed entirely by the steady-state contribution rate, and the MCR for 2034 and onward equals the steady-state contribution rate.

6 Results – Additional CPP

6.1 Overview

The key observations and findings of the actuarial projections of the financial state of the additional CPP presented in this report are as follows.

- With the legislated first and second additional contribution rates of 2.0% for 2023 and thereafter and 8.0% for 2024 and thereafter, respectively, contributions to the additional CPP are projected to be higher than expenditures up to the year 2057 inclusive. Thereafter, a portion of investment income is required to make up the difference between contributions and expenditures.
- With the legislated first and second additional contribution rates of 2.0% for 2023 and thereafter and 8.0% for 2024 and thereafter, total assets are expected to increase rapidly over the first several decades as contributions are projected to exceed expenditures. The additional CPP assets are projected to grow from $11 billion at the end of 2021 to $200 billion by 2030, $1.4 trillion by 2050, and $12 trillion by 2100. The ratio of assets to the following year's expenditures is projected to increase rapidly until 2026 and then decrease after that, reaching a level of about 26 by 2080 and remaining close to that level for the years following up to 2100.
- Due to the financing approach of the additional Plan, as it matures, investment income will become the major source of revenues of the additional Plan. With the legislated first and second additional contribution rates of 2.0% for 2023 and thereafter and 8.0% for 2024 and thereafter, investment income is projected to represent about 50% of revenues (i.e. contributions and investment income) by 2040. This proportion is expected to continue increasing to about 61% of revenues by 2050 and 73% of revenues by 2100.
- The first additional minimum contribution rate (FAMCR) applicable to pensionable earnings between the YBE and YMPE is 1.97% for the year 2025 and thereafter. The second additional minimum contribution rate (SAMCR) applicable to pensionable earnings above the YMPE up to the YAMPE is 7.88% for the year 2025 and thereafter.
- Under the FAMCR and SAMCR of 1.97% and 7.88%, respectively, for 2025 and thereafter, the additional CPP open group assets represent 105% of its open group actuarial obligations as at 31 December 2021, and the ratio of invested assets to expenditures stabilizes at a value of 24 for the target years 2088 and 2098.
- The AMCRs determined for this report are slightly lower than the AMCRs of 1.98% and 7.92% determined under the 30th CPP Actuarial Report due to experience over the period 2019 to 2021 as well as changes in assumptions.
- The number of contributors to the additional CPP is the same as to the base CPP, since an individual cannot contribute to the additional Plan without also contributing to the base Plan. Under the legislated first and second additional contribution rates of 2.0% and 8.0%, respectively, additional contributions are expected to increase from $9.3 billion in 2022 to $22 billion in 2030, $45 billion in 2050, and $237 billion by 2100.

- The number of beneficiaries of additional retirement benefits is expected to increase from 0.8 million in 2022 to 1.7 million in 2025, 8.9 million in 2050, and to continue increasing thereafter.
- Total additional CPP expenditures are expected to steadily grow over time as the additional Plan matures and individuals accrue benefits. Total additional CPP expenditures are projected to increase from approximately $287 million in 2022 to $2.0 billion in 2030, $29 billion in 2050, and $446 billion by 2100.

6.2 Contributions

Projected additional contributions are the product of the additional contribution rates, the number of contributors, and the average first and second additional contributory earnings. The first and second additional contribution rates for the additional CPP are set by law and are 2.0% for 2023 and thereafter and 8.0% for 2024 and thereafter. The first additional contribution rate is phased in over the period 2019 to 2023 as: 0.3%, 0.6%, 1.0%, 1.5%, and 2.0%, and the second tier of the additional Plan starts in 2024.

Table 16 presents the projected number of contributors to the additional CPP, including retirement beneficiaries who receive retirement benefits and are working (working beneficiaries), their additional contributory earnings, and additional contributions.

As all contributors to the additional Plan are contributors to the base Plan, the number of contributors to the additional Plan is linked to the same assumed labour force participation rates applied to the working-age population and the job creation rates as for the base Plan. The number of working beneficiaries who are contributors is derived from the number of retirement beneficiaries in pay.

The additional contributory earnings relating to the first tier of the additional CPP are the same as the base CPP contributory earnings (pensionable earnings between the YBE and YMPE). As such, the projected total first additional contributory earnings shown in Table 16 are the same as the projected total base CPP contributory earnings shown in Table 4.

The second additional contributory earnings relating to pensionable earnings above the YMPE up to the YAMPE are based on the assumed annual increases in wages and the assumed proportion of individuals with pensionable earnings between the YMPE and YAMPE.

As shown in Table 16, total contributions to the additional CPP are expected to be $9.3 billion in 2022 and then are projected to increase to about $13 billion in 2023 following the phase-in of the first additional contribution rate. The total additional contributions are projected to reach $18 billion by 2025, following the full phase-in of the additional CPP. Thereafter, total contributions to the additional Plan are projected to continue increasing, reaching $22 billion in 2030, $45 billion in 2050, and $237 billion by 2100.

The projected YMPE and YAMPE are also shown, which are assumed to increase according to increases in the average weekly earnings assumption, with the YAMPE equal to 107% of the YMPE

in 2024 and 114% of the YMPE from 2025 onward (rounded down to the nearest $100). The YMPE for 2023 reflects actual data up to April 2022. The YAMPE is projected to be $74,000 initially in 2024 and to then increase to $93,700 in 2030, $165,900 in 2050 and $693,300 by 2100.

After the end of the phase-in period in 2025, the first and second additional contributions to the additional CPP increase at the same rate as the first and second additional contributory earnings, respectively, throughout the projection period. This growth is reflected in the projected total additional contributions.

Table 16 Contributions - Additional CPP

Year	First Additional Contribution Rate (%)	Second Additional Contribution Rate (%)	YMPE ($)	YAMPE ($)	Number of Contributors (thousands)	First Additional Contributory Earnings ($ million)	Second Additional Contributory Earnings ($ million)	Additional Contributions ($ million)
2022	1.5	–	64,900	–	15,235	616,668	–	9,250
2023	2.0	–	66,900	–	15,534	648,785	–	12,976
2024	2.0	8.0	69,200	74,000	15,751	680,189	24,669	15,577
2025	2.0	8.0	71,200	81,100	15,959	710,485	49,554	18,174
2026	2.0	8.0	73,300	83,500	16,114	739,632	51,488	18,912
2027	2.0	8.0	75,400	85,900	16,264	769,230	53,505	19,665
2028	2.0	8.0	77,600	88,400	16,419	800,229	55,539	20,448
2029	2.0	8.0	79,900	91,000	16,566	832,186	57,535	21,247
2030	2.0	8.0	82,200	93,700	16,708	864,552	60,075	22,097
2035	2.0	8.0	94,800	108,000	17,464	1,047,401	71,771	26,690
2040	2.0	8.0	109,400	124,700	18,057	1,254,280	85,518	31,927
2045	2.0	8.0	126,200	143,800	18,686	1,499,428	101,433	38,103
2050	2.0	8.0	145,600	165,900	19,263	1,784,712	120,070	45,300
2055	2.0	8.0	168,000	191,500	19,687	2,108,096	141,425	53,476
2060	2.0	8.0	193,800	220,900	19,992	2,474,655	165,270	62,715
2065	2.0	8.0	223,600	254,900	20,289	2,903,032	193,282	73,523
2070	2.0	8.0	258,000	294,100	20,699	3,421,988	226,782	86,582
2080	2.0	8.0	343,300	391,300	21,805	4,803,930	316,670	121,412
2090	2.0	8.0	457,000	520,900	22,975	6,744,599	442,520	170,294
2100	2.0	8.0	608,200	693,300	23,973	9,379,076	614,085	236,708

6.3 Expenditures

Under the additional CPP, there are only earnings-related benefits. There are no flat-rate components to the additional disability and survivor benefits, and no additional flat-rate children's or death benefits.

The projected number of additional CPP beneficiaries by type of benefit is given in Table 17, while Table 18 presents information for male and female beneficiaries separately. The number of additional retirement beneficiaries increases over time as the number of contributors reaching age 60 (earliest retirement age) and over with at least one valid contribution to the additional CPP increases. The total number of retirement beneficiaries receiving additional retirement benefits is projected to increase from an estimated 819,000 in 2022 to 3.2 million in 2030, 8.9 million in 2050, and 15.3 million by 2100.

The total number of disability and survivor beneficiaries receiving additional benefits increases over time as well. Since eligibility to these benefits is harmonized between the base and additional CPP, all new disability and survivor beneficiaries of the base CPP are also entitled to additional benefits as long as they (in the case of disability beneficiaries) and their deceased partners (in the case of survivor beneficiaries) had made at least one contribution to the additional Plan. The total number of disability beneficiaries receiving additional benefits is projected to increase from an estimated 85,000 in 2022 to 258,000 in 2030, 546,000 in 2050, and 698,000 by 2100. The total number of survivor beneficiaries receiving additional benefits is projected to increase from about 85,000 in 2022 to 362,000 in 2030, 1.6 million in 2050, and 2.5 million by 2100.

Table 17 Beneficiaries - Additional CPP [1]
(thousands)

Year	Retirement [2],[3],[4]	Disability [5]	Survivor [4],[5]
2022	819	85	85
2023	1,088	107	111
2024	1,373	130	140
2025	1,674	153	171
2026	1,979	177	205
2027	2,274	199	240
2028	2,571	220	278
2029	2,870	239	319
2030	3,174	258	362
2035	4,737	351	628
2040	6,219	432	952
2045	7,607	500	1,296
2050	8,926	546	1,601
2055	10,125	571	1,833
2060	11,189	575	1,996
2065	12,042	571	2,120
2070	12,652	585	2,232
2080	13,551	623	2,446
2090	14,266	674	2,554
2100	15,260	698	2,545

(1) Numbers of beneficiaries by sex in Table 18 may not sum to total numbers of beneficiaries shown in Table 17 due to rounding.
(2) The number given for retirement beneficiaries includes working beneficiaries.
(3) The number given for retirement beneficiaries does not take into account that the retirement pension (base and additional benefits) can be shared between spouses.
(4) A beneficiary who receives concurrently a retirement and a survivor's benefit is counted in each category.
(5) A beneficiary who receives concurrently a disability and survivor's benefit is counted in each category.

Table 18 Beneficiaries by Sex – Additional CPP [1]
(thousands)

Year	Males			Females		
	Retirement[2],[3],[4]	Disability[5]	Survivor[4],[5]	Retirement[2],[3],[4]	Disability[5]	Survivor[4],[5]
2022	427	41	27	392	44	58
2023	566	51	36	522	55	75
2024	712	62	45	661	68	95
2025	866	73	55	809	81	116
2026	1,020	83	66	960	94	139
2027	1,168	93	77	1,106	106	163
2028	1,316	102	89	1,255	118	189
2029	1,464	111	101	1,406	129	217
2030	1,613	118	114	1,561	140	248
2035	2,351	155	191	2,386	195	437
2040	3,021	188	272	3,198	244	680
2045	3,629	217	344	3,978	284	952
2050	4,205	236	398	4,720	310	1,203
2055	4,740	246	437	5,385	325	1,396
2060	5,234	246	464	5,955	329	1,532
2065	5,636	242	488	6,407	329	1,632
2070	5,909	248	509	6,743	337	1,723
2080	6,296	265	537	7,255	358	1,909
2090	6,610	287	540	7,655	387	2,014
2100	7,090	297	536	8,170	401	2,009

(1) Numbers of beneficiaries by sex in Table 18 may not sum to total numbers of beneficiaries shown in Table 17 due to rounding.
(2) The number given for retirement beneficiaries includes working beneficiaries.
(3) The number given for retirement beneficiaries does not take into account that the retirement pension (base and additional benefits) can be shared between spouses.
(4) A beneficiary who receives concurrently a retirement and a survivor's benefit is counted in each category.
(5) A beneficiary who receives concurrently a disability and survivor's benefit is counted in each category.

Table 19 shows the amount of projected additional CPP expenditures by type. Projected additional benefit expenditures are low over the first few years of the additional Plan as additional benefits start to accrue. As higher additional benefits become payable to a greater number of beneficiaries, projected additional expenditures will increase to reach $2.0 billion in 2030, $29 billion in 2050, and $446 billion by 2100. Table 20 presents the same information but in 2022 constant dollars.

Table 19 Expenditures - Additional CPP
($ million)

Year	Retirement [1]	Disability	Survivor	Operating Expenses [2]	Total
2022	60	2	1	224	287
2023	119	5	2	252	377
2024	209	10	3	279	502
2025	325	18	5	291	640
2026	473	29	8	302	813
2027	659	44	13	313	1,030
2028	890	63	18	325	1,297
2029	1,166	86	25	337	1,615
2030	1,485	113	34	349	1,982
2031	1,853	143	45	362	2,403
2032	2,276	178	58	375	2,888
2033	2,765	217	73	389	3,444
2034	3,324	261	92	403	4,080
2035	3,951	310	114	418	4,792
2036	4,646	362	139	432	5,580
2037	5,413	420	168	447	6,448
2038	6,254	482	201	463	7,400
2039	7,178	550	240	479	8,446
2040	8,196	623	283	496	9,598
2041	9,319	701	333	513	10,866
2042	10,555	784	388	531	12,258
2043	11,913	872	451	550	13,786
2044	13,407	965	521	570	15,463
2045	15,051	1,062	601	590	17,303
2046	16,857	1,163	689	610	19,319
2047	18,836	1,267	786	632	21,521
2048	20,999	1,374	895	654	23,922
2049	23,358	1,486	1,015	677	26,535
2050	25,924	1,600	1,146	700	29,370
2051	28,713	1,715	1,291	723	32,442
2052	31,728	1,832	1,448	748	35,756
2053	34,977	1,949	1,620	772	39,318
2054	38,477	2,066	1,806	798	43,147
2055	42,250	2,180	2,008	823	47,261
2060	65,031	2,692	3,265	962	71,950
2065	92,923	3,111	5,000	1,124	102,158
2070	123,272	3,647	7,294	1,317	135,530
2075	156,308	4,349	10,202	1,555	172,414
2080	192,714	5,191	13,702	1,839	213,446
2085	232,804	6,267	17,642	2,176	258,889
2090	279,137	7,529	21,786	2,570	311,022
2095	335,014	8,842	25,964	3,029	372,848
2100	401,761	10,353	30,283	3,563	445,961

(1) Retirement expenditures include expenditures related to post-retirement benefits for working beneficiaries.

(2) Plan operating expenses exclude CPPIB operating expenses, which are accounted for separately in the investment expenses assumption.

Table 20 Expenditures – Additional CPP [1]
(millions of 2022 constant dollars)

Year	Retirement [2]	Disability	Survivor	Operating Expenses [3]	Total
2022	60	2	1	224	287
2023	116	5	2	245	366
2024	198	9	3	264	475
2025	301	17	5	270	593
2026	430	26	7	274	738
2027	587	39	12	279	917
2028	777	55	16	284	1,132
2029	998	74	21	288	1,382
2030	1,246	95	29	293	1,663
2031	1,524	118	37	298	1,977
2032	1,835	144	47	302	2,329
2033	2,186	172	58	308	2,723
2034	2,577	202	71	312	3,163
2035	3,002	236	87	318	3,642
2036	3,461	270	104	322	4,157
2037	3,954	307	123	326	4,710
2038	4,478	345	144	332	5,299
2039	5,039	386	168	336	5,930
2040	5,641	429	195	341	6,606
2041	6,288	473	225	346	7,332
2042	6,983	519	257	351	8,109
2043	7,727	566	293	357	8,942
2044	8,525	614	331	362	9,833
2045	9,383	662	375	368	10,787
2046	10,303	711	421	373	11,807
2047	11,287	759	471	379	12,895
2048	12,336	807	526	384	14,053
2049	13,453	856	585	390	15,282
2050	14,638	903	647	395	16,583
2051	15,895	949	715	400	17,959
2052	17,219	994	786	406	19,405
2053	18,610	1,037	862	411	20,920
2054	20,071	1,078	942	416	22,507
2055	21,607	1,115	1,027	421	24,170
2060	30,122	1,247	1,512	446	33,327
2065	38,984	1,305	2,098	472	42,859
2070	46,842	1,386	2,772	500	51,500
2075	53,796	1,497	3,511	535	59,339
2080	60,073	1,618	4,271	573	66,536
2085	65,729	1,769	4,981	614	73,094
2090	71,381	1,925	5,571	657	79,534
2095	77,594	2,048	6,014	702	86,357
2100	84,281	2,172	6,353	747	93,553

(1) For a given year, the value in 2022 constant dollars is equal to the corresponding value in current dollars divided by the cumulative projected increases in prices since 2022.
(2) Retirement expenditures include expenditures related to post-retirement benefits for working beneficiaries.
(3) Plan operating expenses exclude CPPIB operating expenses, which are accounted for separately in the investment expenses assumption.

6.4 Financial Projections with Legislated Additional Contribution Rates

Table 21 and Table 22 present the projected financial state of the additional CPP using the legislated first and second additional contribution rates of 2.0% and 8.0% in current dollars and in 2022 constant dollars, respectively. Historical results up to 31 December 2021 are also shown. The projected financial state of the additional CPP using the FAMCR and SAMCR of 1.97% and 7.88%, respectively is discussed in the next section 6.5.

The market value of additional CPP assets is $11 billion as at 31 December 2021. Additional CPP assets are projected to decrease in 2022 due to the market downturn observed in the first half of 2022 and assumed continued volatility for the remainder of 2022.

Under the legislated additional contribution rates, additional contributions are projected to be higher than additional expenditures up to the year 2057 inclusive. Over that period, the additional assets are therefore projected to grow rapidly, from $11 billion at the end of 2021 to $200 billion by 2030, $1.4 trillion by 2050, and $12 trillion by 2100.

In comparison with Table 11, additional CPP assets are projected to be 62% of base CPP assets by 2050, and this percentage is expected to increase to 70% by 2100.

Table 21 Historical Results and Financial Projections - Additional CPP, 2.0%, 8.0% Legislated First and Second Additional Contribution Rates

Year	First / Second Additional Contribution Rates [1] (%)	First Additional Contributory Earnings ($ million)	Second Additional Contributory Earnings ($ million)	Contributions ($ million)	Expenditures ($ million)	Net Cash Flows ($ million)	Net Investment Income [2] ($ million)	Assets at 31 Dec. ($ million)	Net Rate of Return [2] (%)	Assets/ Expenditures Ratio
Historical Results:										
2019	0.3	533,626	0	1,601	130	1,471	62	1,533	5.61	8.1
2020	0.6	532,930	0	3,198	189	3,009	370	4,912	10.84	24.5
2021	1.0	568,840	0	5,688	201	5,488	645	11,045	4.75	38.5
Projections:										
2022	1.5	616,668	0	9,250	287	8,963	(1,249)	18,758	(7.72)	49.7
2023	2.0	648,785	0	12,976	377	12,598	1,256	32,612	4.87	65.0
2024	2.0 / 8.0	680,189	24,669	15,577	502	15,076	2,042	49,730	4.98	77.8
2025	2.0 / 8.0	710,485	49,554	18,174	640	17,534	3,011	70,275	5.06	86.5
2026	2.0 / 8.0	739,632	51,488	18,912	813	18,099	4,131	92,505	5.14	89.8
2027	2.0 / 8.0	769,230	53,505	19,665	1,030	18,635	5,337	116,477	5.19	89.8
2028	2.0 / 8.0	800,229	55,539	20,448	1,297	19,151	6,601	142,229	5.19	88.0
2029	2.0 / 8.0	832,186	57,535	21,247	1,615	19,631	8,024	169,884	5.24	85.7
2030	2.0 / 8.0	864,552	60,075	22,097	1,982	20,115	9,564	199,564	5.28	83.0
2031	2.0 / 8.0	898,197	62,116	22,933	2,403	20,530	11,154	231,248	5.28	80.1
2032	2.0 / 8.0	933,295	64,289	23,809	2,888	20,921	12,944	265,113	5.32	77.0
2033	2.0 / 8.0	969,910	66,948	24,754	3,444	21,310	15,586	302,008	5.62	74.0
2034	2.0 / 8.0	1,007,917	69,114	25,687	4,080	21,608	17,673	341,289	5.62	71.2
2035	2.0 / 8.0	1,047,401	71,771	26,690	4,792	21,898	19,894	383,080	5.62	68.7
2036	2.0 / 8.0	1,085,658	74,256	27,654	5,580	22,074	22,253	427,407	5.62	66.3
2037	2.0 / 8.0	1,125,623	76,918	28,666	6,448	22,218	24,755	474,379	5.62	64.1
2038	2.0 / 8.0	1,167,224	79,614	29,714	7,400	22,313	27,403	524,096	5.62	62.0
2039	2.0 / 8.0	1,210,287	82,306	30,790	8,446	22,344	30,205	576,645	5.62	60.1
2040	2.0 / 8.0	1,254,280	85,518	31,927	9,598	22,329	33,165	632,139	5.62	58.2
2041	2.0 / 8.0	1,299,423	88,221	33,046	10,866	22,180	36,287	690,606	5.62	56.3
2042	2.0 / 8.0	1,346,635	91,652	34,265	12,258	22,007	39,577	752,190	5.62	54.6
2043	2.0 / 8.0	1,396,342	94,507	35,487	13,786	21,701	43,038	816,929	5.62	52.8
2044	2.0 / 8.0	1,446,964	98,023	36,781	15,463	21,318	46,675	884,922	5.62	51.1
2045	2.0 / 8.0	1,499,428	101,433	38,103	17,303	20,800	50,491	956,213	5.62	49.5
2046	2.0 / 8.0	1,553,431	104,868	39,458	19,319	20,139	54,490	1,030,842	5.62	47.9
2047	2.0 / 8.0	1,608,638	108,996	40,892	21,521	19,371	58,674	1,108,886	5.62	46.4
2048	2.0 / 8.0	1,666,000	112,501	42,320	23,922	18,398	63,044	1,190,329	5.62	44.9
2049	2.0 / 8.0	1,724,766	116,552	43,819	26,535	17,285	67,603	1,275,216	5.62	43.4
2050	2.0 / 8.0	1,784,712	120,070	45,300	29,370	15,930	72,349	1,363,494	5.62	42.0
2051	2.0 / 8.0	1,846,030	124,142	46,852	32,442	14,410	77,281	1,455,185	5.62	40.7
2052	2.0 / 8.0	1,909,767	128,148	48,447	35,756	12,692	82,401	1,550,278	5.62	39.4
2053	2.0 / 8.0	1,974,826	132,729	50,115	39,318	10,797	87,708	1,648,783	5.62	38.2
2054	2.0 / 8.0	2,040,986	136,795	51,763	43,147	8,617	93,199	1,750,598	5.62	37.0
2055	2.0 / 8.0	2,108,096	141,425	53,476	47,261	6,215	98,871	1,855,685	5.62	35.9
2060	2.0 / 8.0	2,474,655	165,270	62,715	71,950	(9,235)	129,839	2,428,147	5.62	31.3
2065	2.0 / 8.0	2,903,032	193,282	73,523	102,158	(28,635)	165,027	3,077,591	5.62	28.3
2070	2.0 / 8.0	3,421,988	226,782	86,582	135,530	(48,948)	205,013	3,816,454	5.62	26.8
2075	2.0 / 8.0	4,051,490	267,639	102,441	172,414	(69,973)	251,121	4,669,652	5.62	25.9
2080	2.0 / 8.0	4,803,930	316,670	121,412	213,446	(92,034)	304,991	5,667,826	5.62	25.5
2085	2.0 / 8.0	5,697,857	374,669	143,931	258,889	(114,958)	368,765	6,851,257	5.62	25.5
2090	2.0 / 8.0	6,744,599	442,520	170,294	311,022	(140,728)	445,078	8,268,331	5.62	25.6
2095	2.0 / 8.0	7,958,860	522,020	200,939	372,848	(171,909)	536,555	9,966,936	5.62	25.8
2100	2.0 / 8.0	9,379,076	614,085	236,708	445,961	(209,252)	646,104	12,001,190	5.62	26.0

(1) The legislated second additional contribution rate is applicable from the year 2024 onward.
(2) Rates of Return and Investment Income are net of all investment expenses.

Table 22 Financial Projections - Additional CPP, 2.0%, 8.0% Legislated First and Second Additional Contribution Rates (millions of 2022 constant dollars) (1)

Year	First / Second Additional Contribution Rates (2) (%)	First Additional Contributory Earnings ($ million)	Second Additional Contributory Earnings ($ million)	Contributions ($ million)	Expenditures ($ million)	Net Cash Flows ($ million)	Net Investment Income (3) ($ million)	Assets at 31 Dec. ($ million)
2022	1.5	616,668	0	9,250	287	8,963	(1,249)	18,758
2023	2.0	629,888	0	12,598	366	12,231	1,219	31,662
2024	2.0 / 8.0	644,270	23,366	14,755	475	14,280	1,934	47,104
2025	2.0 / 8.0	658,158	45,904	16,836	592	16,243	2,789	65,099
2026	2.0 / 8.0	671,724	46,761	17,175	738	16,437	3,752	84,012
2027	2.0 / 8.0	684,907	47,640	17,509	917	16,592	4,752	103,709
2028	2.0 / 8.0	698,537	48,481	17,849	1,132	16,717	5,762	124,155
2029	2.0 / 8.0	712,189	49,239	18,183	1,383	16,800	6,867	145,388
2030	2.0 / 8.0	725,380	50,404	18,540	1,663	16,877	8,025	167,439
2031	2.0 / 8.0	738,833	51,095	18,864	1,977	16,888	9,175	190,218
2032	2.0 / 8.0	752,651	51,845	19,201	2,329	16,872	10,438	213,799
2033	2.0 / 8.0	766,842	52,931	19,571	2,723	16,848	12,323	238,777
2034	2.0 / 8.0	781,266	53,573	19,911	3,163	16,749	13,699	264,543
2035	2.0 / 8.0	795,952	54,541	20,282	3,642	16,641	15,118	291,114
2036	2.0 / 8.0	808,848	55,323	20,603	4,157	16,446	16,579	318,431
2037	2.0 / 8.0	822,179	56,183	20,938	4,710	16,228	18,081	346,497
2038	2.0 / 8.0	835,848	57,011	21,278	5,299	15,978	19,624	375,305
2039	2.0 / 8.0	849,692	57,783	21,617	5,930	15,687	21,206	404,838
2040	2.0 / 8.0	863,311	58,861	21,975	6,607	15,369	22,827	435,096
2041	2.0 / 8.0	876,846	59,531	22,299	7,332	14,967	24,487	466,019
2042	2.0 / 8.0	890,887	60,634	22,668	8,110	14,559	26,183	497,623
2043	2.0 / 8.0	905,658	61,296	23,017	8,941	14,075	27,914	529,855
2044	2.0 / 8.0	920,089	62,330	23,388	9,833	13,556	29,679	562,700
2045	2.0 / 8.0	934,755	63,234	23,754	10,787	12,967	31,477	596,111
2046	2.0 / 8.0	949,432	64,094	24,116	11,808	12,309	33,303	630,034
2047	2.0 / 8.0	963,896	65,310	24,503	12,896	11,607	35,157	664,445
2048	2.0 / 8.0	978,694	66,089	24,861	14,053	10,808	37,035	699,260
2049	2.0 / 8.0	993,349	67,126	25,237	15,282	9,955	38,935	734,438
2050	2.0 / 8.0	1,007,719	67,796	25,578	16,584	8,994	40,851	769,883
2051	2.0 / 8.0	1,021,904	68,721	25,936	17,959	7,977	42,780	805,544
2052	2.0 / 8.0	1,036,457	69,548	26,293	19,405	6,888	44,720	841,357
2053	2.0 / 8.0	1,050,751	70,621	26,665	20,920	5,745	46,667	877,272
2054	2.0 / 8.0	1,064,659	71,358	27,002	22,507	4,495	48,616	913,182
2055	2.0 / 8.0	1,078,104	72,326	27,348	24,170	3,178	50,564	949,018
2060	2.0 / 8.0	1,146,263	76,553	29,050	33,327	(4,278)	60,142	1,124,720
2065	2.0 / 8.0	1,217,925	81,089	30,846	42,859	(12,013)	69,235	1,291,159
2070	2.0 / 8.0	1,300,308	86,174	32,900	51,500	(18,599)	77,902	1,450,200
2075	2.0 / 8.0	1,394,382	92,112	35,257	59,339	(24,082)	86,427	1,607,132
2080	2.0 / 8.0	1,497,486	98,713	37,847	66,536	(28,689)	95,072	1,766,781
2085	2.0 / 8.0	1,608,706	105,782	40,637	73,094	(32,457)	104,115	1,934,352
2090	2.0 / 8.0	1,724,728	113,161	43,547	79,534	(35,987)	113,815	2,114,376
2095	2.0 / 8.0	1,843,378	120,907	46,540	86,357	(39,816)	124,273	2,308,475
2100	2.0 / 8.0	1,967,536	128,822	49,657	93,553	(43,897)	135,539	2,517,602

(1) For a given year, the value in 2022 constant dollars is equal to the corresponding value in current dollars divided by the cumulative projected increases in prices since 2022.
(2) The legislated second additional contribution rate is applicable from the year 2024 onward.
(3) Investment Income is net of all investment expenses.

Chart 2 shows projected revenues and expenditures of the additional CPP for the period 2022 to 2072 on a year 2022 constant dollar basis.

Table 23 shows the sources of the revenues (contributions and investment income) required to cover the additional CPP expenditures. With the growth in the additional assets, the importance of the investment income increases rapidly. By 2080, investment income is projected to represent about 72% of revenues of the additional CPP. The importance of investment income as a source of revenues is directly related to the financing approach of the additional CPP.

A strong reliance of the additional CPP on investment income as a source of revenues results in the additional contribution rates being much more sensitive to financial market environments than is the case for the base CPP. The sensitivity of the base and additional CPP to investment experience is examined in Appendix E of this report.

Table 23 also shows the projected additional CPP expenditures as a percentage of total additional revenues. This percentage is projected to increase as the additional Plan matures from about 4% in 2022 to 10% in 2035. It continues to grow but at decreasing pace, and stabilizes at about 51% by 2086.

Chart 2 Revenues and Expenditures - Additional CPP, 2.0%/8.0% legislated contribution rates
(billions of 2022 constant dollars)

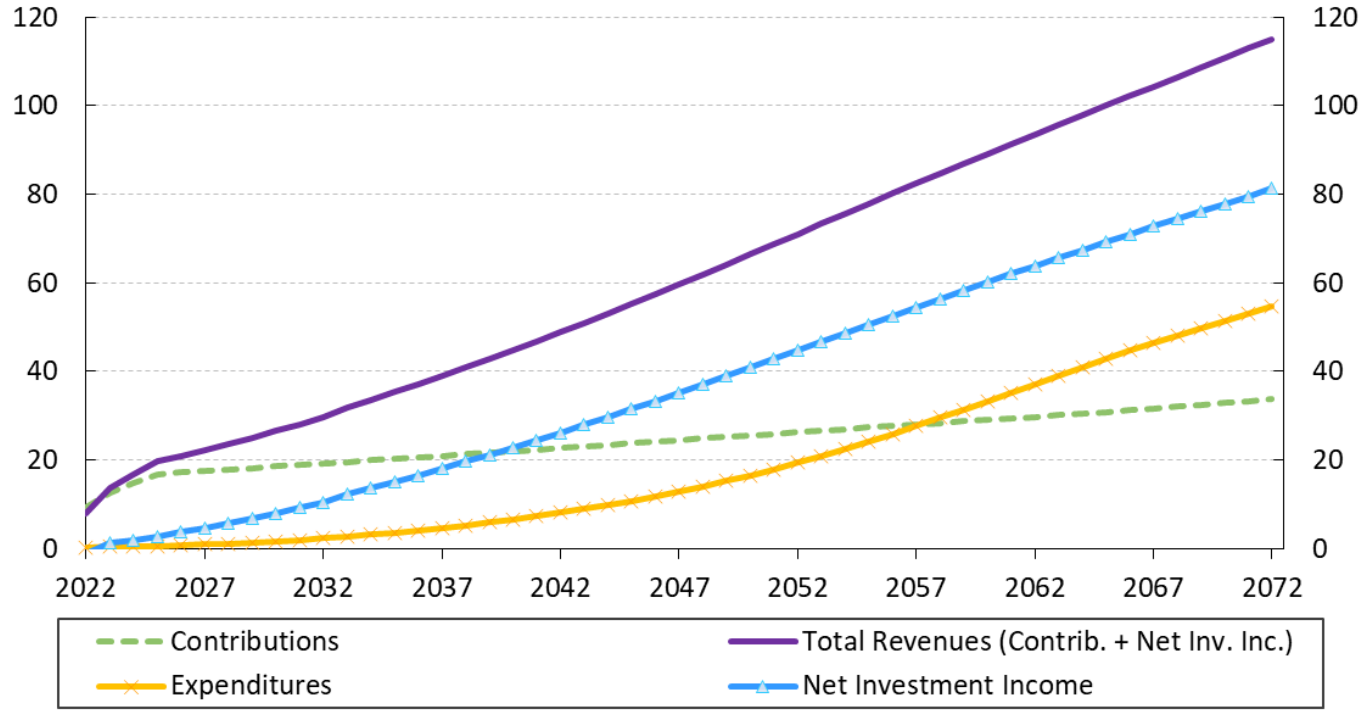


Table 23 Sources of Revenues - Additional CPP, 2.0%, 8.0% Legislated First and Second Additional Contribution Rates
($ million)

Year	Contributions	Net Investment Income [1]	Total Revenues	Net Investment Income as % of Revenues (%)	Expenditures	Expenditures as % of Revenues (%)	Net Cash Flows (Contributions less Expenditures)	% of Net Investment Income Needed to Pay Expenditures (%)
2022	9,250	(1,249)	8,001	(15.6)	287	3.6	8,963	0.0
2023	12,976	1,256	14,231	8.8	377	2.7	12,598	0.0
2024	15,577	2,042	17,619	11.6	502	2.8	15,076	0.0
2025	18,174	3,011	21,185	14.2	640	3.0	17,534	0.0
2026	18,912	4,131	23,043	17.9	813	3.5	18,099	0.0
2027	19,665	5,337	25,002	21.3	1,030	4.1	18,635	0.0
2028	20,448	6,601	27,049	24.4	1,297	4.8	19,151	0.0
2029	21,247	8,024	29,271	27.4	1,615	5.5	19,631	0.0
2030	22,097	9,564	31,661	30.2	1,982	6.3	20,115	0.0
2031	22,933	11,154	34,087	32.7	2,403	7.0	20,530	0.0
2032	23,809	12,944	36,753	35.2	2,888	7.9	20,921	0.0
2033	24,754	15,586	40,340	38.6	3,444	8.5	21,310	0.0
2034	25,687	17,673	43,360	40.8	4,080	9.4	21,608	0.0
2035	26,690	19,894	46,584	42.7	4,792	10.3	21,898	0.0
2036	27,654	22,253	49,907	44.6	5,580	11.2	22,074	0.0
2037	28,666	24,755	53,420	46.3	6,448	12.1	22,218	0.0
2038	29,714	27,403	57,117	48.0	7,400	13.0	22,313	0.0
2039	30,790	30,205	60,995	49.5	8,446	13.8	22,344	0.0
2040	31,927	33,165	65,092	51.0	9,598	14.7	22,329	0.0
2041	33,046	36,287	69,334	52.3	10,866	15.7	22,180	0.0
2042	34,265	39,577	73,842	53.6	12,258	16.6	22,007	0.0
2043	35,487	43,038	78,525	54.8	13,786	17.6	21,701	0.0
2044	36,781	46,675	83,456	55.9	15,463	18.5	21,318	0.0
2045	38,103	50,491	88,594	57.0	17,303	19.5	20,800	0.0
2046	39,458	54,490	93,948	58.0	19,319	20.6	20,139	0.0
2047	40,892	58,674	99,566	58.9	21,521	21.6	19,371	0.0
2048	42,320	63,044	105,364	59.8	23,922	22.7	18,398	0.0
2049	43,819	67,603	111,422	60.7	26,535	23.8	17,285	0.0
2050	45,300	72,349	117,648	61.5	29,370	25.0	15,930	0.0
2051	46,852	77,281	124,133	62.3	32,442	26.1	14,410	0.0
2052	48,447	82,401	130,848	63.0	35,756	27.3	12,692	0.0
2053	50,115	87,708	137,823	63.6	39,318	28.5	10,797	0.0
2054	51,763	93,199	144,962	64.3	43,147	29.8	8,617	0.0
2055	53,476	98,871	152,347	64.9	47,261	31.0	6,215	0.0
2060	62,715	129,839	192,554	67.4	71,950	37.4	(9,235)	7.1
2065	73,523	165,027	238,550	69.2	102,158	42.8	(28,635)	17.4
2070	86,582	205,013	291,596	70.3	135,530	46.5	(48,948)	23.9
2075	102,441	251,121	353,561	71.0	172,414	48.8	(69,973)	27.9
2080	121,412	304,991	426,403	71.5	213,446	50.1	(92,034)	30.2
2085	143,931	368,765	512,696	71.9	258,889	50.5	(114,958)	31.2
2090	170,294	445,078	615,371	72.3	311,022	50.5	(140,728)	31.6
2095	200,939	536,555	737,494	72.8	372,848	50.6	(171,909)	32.0
2100	236,708	646,104	882,813	73.2	445,961	50.5	(209,252)	32.4

(1) Investment Income is net of all investment expenses.

6.5 Financial Projections with Additional Minimum Contribution Rates

The results presented in Table 24 are based on the best-estimate assumptions, but use the FAMCR of 1.97% for 2025 and thereafter and SAMCR of 7.88% for 2025 and thereafter as opposed to the legislated first and second additional contribution rates of 2.0% and 8.0%, respectively. The financial projections of the additional Plan under the legislated rates were previously presented in Table 21. Under the AMCRs, the additional CPP open group assets represent 105% of its open group actuarial obligations as at 31 December 2021, and the ratio of invested assets to expenditures stabilizes at a value of 24 for the target years 2088 and 2098.

Table 25 shows the progression of the AMCRs over time under the best-estimate assumptions of this report. As shown in Table 25, if the best-estimate assumptions of this report are realized, the FAMCR and SAMCR will remain at about 1.97% and 7.88%, respectively for each of the next four reports, which are below and very close to the legislated additional contribution rates of 2.0% and 8.0%. Thus, the current legislated additional contribution rates are projected to be sufficient over subsequent reports as long as the best-estimate assumptions remain the same and additional Plan experience does not deviate materially from the assumptions.

In the event that the AMCRs, as determined under a CPP actuarial report, deviate to a certain extent from their respective legislated additional rates and the federal and provincial Ministers of Finance do not reach an agreement on how to address such deviation, certain provisions of the *Additional Canada Pension Plan Sustainability Regulations* would be activated. The deviation in the rates is quantified in the regulations with respect to both the magnitude (absolute basis points difference between the legislated rates and AMCRs) and duration of time that a deviation exists. In such case, adjustments would be made to current and future benefits and possibly to the contribution rates. In respect of this 31st CPP Actuarial Report, the AMCRs do not deviate materially from their respective legislated rates, and thus the provisions under the sustainability regulations do not apply. Therefore, in the absence of specific action by the federal and provincial governments, the legislated additional contribution rates will remain as scheduled.

Table 24 Financial Projections - Additional CPP, First and Second Additional Minimum Contribution Rates of 1.97% / 7.88%

Year	First / Second Additional Contribution Rates [1] (%)	First Additional Contributory Earnings ($ million)	Second Additional Contributory Earnings ($ million)	Contributions ($ million)	Expenditures ($ million)	Net Cash Flows ($ million)	Net Investment Income [2] ($ million)	Assets at 31 Dec. ($ million)	Assets/ Expenditures Ratio
2022	1.50	616,668	0	9,250	287	8,963	(1,249)	18,758	49.7
2023	2.00	648,785	0	12,976	377	12,598	1,256	32,612	65.0
2024	2.00 / 8.00	680,189	24,669	15,577	502	15,076	2,042	49,730	77.8
2025	1.97 / 7.88	710,485	49,554	17,901	640	17,262	3,003	69,995	86.1
2026	1.97 / 7.88	739,632	51,488	18,628	813	17,815	4,109	91,918	89.3
2027	1.97 / 7.88	769,230	53,505	19,370	1,030	18,340	5,298	115,557	89.1
2028	1.97 / 7.88	800,229	55,539	20,141	1,297	18,844	6,545	140,946	87.2
2029	1.97 / 7.88	832,186	57,535	20,928	1,615	19,312	7,948	168,206	84.9
2030	1.97 / 7.88	864,552	60,075	21,766	1,982	19,784	9,466	197,455	82.2
2031	1.97 / 7.88	898,197	62,116	22,589	2,403	20,186	11,032	228,674	79.2
2032	1.97 / 7.88	933,295	64,289	23,452	2,888	20,564	12,796	262,034	76.1
2033	1.97 / 7.88	969,910	66,948	24,383	3,444	20,938	15,401	298,374	73.1
2034	1.97 / 7.88	1,007,91	69,114	25,302	4,080	21,222	17,456	337,053	70.3
2035	1.97 / 7.88	1,047,40	71,771	26,289	4,792	21,497	19,643	378,193	67.8
2036	1.97 / 7.88	1,085,65	74,256	27,239	5,580	21,659	21,966	421,818	65.4
2037	1.97 / 7.88	1,125,62	76,918	28,236	6,448	21,788	24,427	468,032	63.2
2038	1.97 / 7.88	1,167,22	79,614	29,268	7,400	21,867	27,033	516,933	61.2
2039	1.97 / 7.88	1,210,28	82,306	30,328	8,446	21,882	29,788	568,603	59.2
2040	1.97 / 7.88	1,254,28	85,518	31,448	9,598	21,850	32,698	623,151	57.3
2041	1.97 / 7.88	1,299,42	88,221	32,550	10,866	21,684	35,767	680,602	55.5
2042	1.97 / 7.88	1,346,63	91,652	33,751	12,258	21,493	38,998	741,093	53.8
2043	1.97 / 7.88	1,396,34	94,507	34,955	13,786	21,169	42,397	804,659	52.0
2044	1.97 / 7.88	1,446,96	98,023	36,229	15,463	20,766	45,968	871,393	50.4
2045	1.97 / 7.88	1,499,42	101,433	37,532	17,303	20,229	49,713	941,335	48.7
2046	1.97 / 7.88	1,553,43	104,868	38,866	19,319	19,547	53,635	1,014,517	47.1
2047	1.97 / 7.88	1,608,63	108,996	40,279	21,521	18,758	57,737	1,091,011	45.6
2048	1.97 / 7.88	1,666,00	112,501	41,685	23,922	17,763	62,020	1,170,794	44.1
2049	1.97 / 7.88	1,724,76	116,552	43,162	26,535	16,628	66,484	1,253,906	42.7
2050	1.97 / 7.88	1,784,71	120,070	44,620	29,370	15,250	71,129	1,340,286	41.3
2051	1.97 / 7.88	1,846,03	124,142	46,149	32,442	13,707	75,955	1,429,947	40.0
2052	1.97 / 7.88	1,909,76	128,148	47,720	35,756	11,965	80,960	1,522,872	38.7
2053	1.97 / 7.88	1,974,82	132,729	49,363	39,318	10,045	86,144	1,619,060	37.5
2054	1.97 / 7.88	2,040,98	136,795	50,987	43,147	7,840	91,504	1,718,405	36.4
2055	1.97 / 7.88	2,108,09	141,425	52,674	47,261	5,413	97,037	1,820,854	35.2
2060	1.97 / 7.88	2,474,65	165,270	61,774	71,950	(10,176)	127,154	2,377,281	30.6
2065	1.97 / 7.88	2,903,03	193,282	72,420	102,158	(29,738)	161,178	3,004,773	27.7
2070	1.97 / 7.88	3,421,98	226,782	85,284	135,530	(50,246)	199,577	3,713,739	26.0
2075	1.97 / 7.88	4,051,49	267,639	100,904	172,414	(71,510)	243,531	4,526,368	25.1
2080	1.97 / 7.88	4,803,93	316,670	119,591	213,446	(93,855)	294,488	5,469,686	24.6
2085	1.97 / 7.88	5,697,85	374,669	141,772	258,889	(117,117)	354,336	6,579,194	24.5
2088	1.97 / 7.88	6,307,07	414,388	156,903	289,120	(132,217)	395,475	7,342,365	24.5
2090	1.97 / 7.88	6,744,59	442,520	167,739	311,022	(143,283)	425,372	7,896,954	24.5
2095	1.97 / 7.88	7,958,86	522,020	197,925	372,848	(174,923)	509,780	9,462,519	24.5
2098	1.97 / 7.88	8,781,99	575,494	218,354	415,281	(196,927)	567,782	10,538,204	24.5
2100	1.97 / 7.88	9,379,07	614,085	233,158	445,961	(212,803)	609,879	11,318,995	24.5

(1) The second additional minimum contribution rate is applicable from the year 2024 onward.
(2) Investment Income is net of all investment expenses.

Table 25 Progression of Additional Minimum Contribution Rates over Time

Valuation Year [1]	Target Years [2]	Target A/E Ratio [3]	Additional Minimum Contribution Rates	Years Additional Minimum Contribution Rates Applicable [4]	Assets as a % of Obligations on an Open Group Basis [5]
2021	2088 and 2098	24.5	1.97%/7.88%	2025+	105.2%
2024	2088 and 2098	24.5	1.97%/7.88%	2028+	104.9%
2027	2088 and 2098	24.5	1.97%/7.88%	2031+	104.7%
2030	2088 and 2098	24.6	1.96%/7.84%	2034+	104.1%
2033	2088 and 2098	24.6	1.96%/7.84%	2037+	104.2%

(1) Reports are prepared as at 31 December of the valuation year.

(2) Target years refer to the beginning and end of the 10-year interval that are used to determine the FAMCR and SAMCR. These rates are the lowest level rates that result in the assets/expenditures (A/E) ratio being the same in the two target years. For a given triennial review period of the Plan, the target years are 53 and 63 years after the valuation year, but occurring no earlier than 2088 and 2098. For this and all reports with valuation years before 2036, the target years are 2088 to 2098. The AMCRs must also satisfy a full funding condition as described in note (5) below.

(3) The target A/E ratio is the ratio obtained in the target years relating to the determination of the corresponding AMCRs.

(4) The legislated first additional contribution rate applies to the current triennial review period 2022-2024. More generally, the legislated first and second additional contribution rates apply for each triennial review period following a valuation year.

(5) The AMCRs must satisfy the condition that the present value of projected additional expenditures equals the projected additional assets and present value of projected additional contributions. In other words, the total assets must equal 100% of the obligations of the additional Plan. As shown, this condition is projected to be met over successive valuations, under the best-estimate assumptions of this report.

7 Reconciliation with Previous Triennial Report

7.1 Base CPP

7.1.1 Introduction

The results presented in this report differ from those previously projected for a variety of reasons. Differences between the actual experience for 2019 through 2021 and that projected in the 30th CPP Actuarial Report are addressed in section 7.1.2 below. Since historical results provide the starting point for the projections shown in this report, these historical differences between actual and projected experience have an effect on the projections. The impact of experience since the last triennial valuation of the base Plan (that is, the experience update from the period 2019-2021) and changes in the assumptions and methodology on the base CPP minimum contribution rate are addressed in section 7.1.3. Detailed reconciliations of the projected minimum contribution rate is presented in Appendix D.

7.1.2 Experience Update – 31 December 2018 to 31 December 2021

The major components of the change in the base CPP assets from 31 December 2018 to 31 December 2021 are summarized in Table 26.

Contributions during the period 2019 to 2021 were not materially different than expected.

Expenditures during the period were $3.4 billion lower than expected. The difference between actual and expected expenditures is mainly due to retirement benefits (lower take-up of retirement benefits at age 60 than expected), disability benefits (lower disability incidence rates than expected), and survivor benefits. The details by type of expenditure are given in Table 27.

Due to the strong investment performance over the period (actual average annual nominal rate of return of 12.7% compared to the anticipated 5.2%), investment income on base CPP assets was $103 billion higher than expected.

The resulting base CPP assets as at 31 December 2021 are about $106 billion higher than projected under the 30th CPP Actuarial Report.

Table 26 Change in Assets - 31 December 2018 to 31 December 2021 - Base CPP [1]
(cost accrual basis, $ million)

	Actual	Expected [2]	Difference: Actual – Expected
Assets at 31 December 2018	371,700	371,700	-
+ Contributions	160,534	161,101	(567)
- Expenditures	153,211	156,565	(3,354)
+ Investment Income	164,701	61,801	102,900
Change in Assets	172,024	66,337	105,687
Assets at 31 December 2021	543,725	438,037	105,687

(1) Components may not sum to totals due to rounding.
(2) Expected contributions, expenditures, and investment income shown are as per the projections of the 30th CPP Actuarial Report as at 31 December 2018.

Table 27 Summary of Expenditures – 2019 to 2021 – Base CPP [1]
($ million)

	Actual[2]	Expected [3]	Difference Actual – Expected
Retirement	121,016	123,434	(2,418)
Disability	13,083	13,491	(408)
Survivors	14,334	14,703	(369)
Children	1,588	1,664	(76)
Death	1,251	1,224	27
Operating Expenses	1,939	2,049	(110)
Total Expenditures	153,211	156,565	(3,354)

(1) Components may not sum to totals due to rounding.
(2) The actual amounts for benefit expenditures include an adjustment for total overpayments of $310 million.
(3) Expected expenditures shown are as per the projections of the 30th CPP Actuarial Report as at 31 December 2018.

7.1.3 Changes in the Minimum Contribution Rate

Table 28 presents the main elements of change in the base Plan MCR since the 30th CPP Actuarial Report and shows an overall decrease in the rate.

Experience over the period 2019 to 2021 was better than anticipated overall. The main contributing factor for this was better than expected investment experience, which lowers the MCR by 0.35 percentage points. Changes made to the demographic assumptions also act to lower the MCR. However, these reductions in the MCR are partially offset by changes made to benefit, economic and investment assumptions.

The impacts on the MCR resulting from changes in assumptions include the subsequent event disclosed in section 2.3. Overall, changes to the assumptions to reflect the subsequent event resulted in an increase in the MCR of 0.31 percentage points. A large portion of this increase is due to reductions in the 2022 assumed nominal rate of return. The reduction in MCR of 0.35 percentage points due to 2019-2021 investment experience is therefore partially offset by lower assumed returns in 2022.

A more detailed reconciliation of changes in the MCR is provided in Table 107 in Appendix D of this report.

Table 28 Reconciliation of Changes in Minimum Contribution Rate [1]
(% of base CPP contributory earnings)

	Steady-State Rate	Full Funding Rates [2]		MCR	
		2025-2033	2034+	2025-2033	2034+
30th CPP Actuarial Report - After Rounding	**9.71**	**0.04**	**0.01**	**9.75**	**9.72**
30th CPP Actuarial Report - Before Rounding	**9.708**	**0.035**	**0.007**	**9.743**	**9.715**
Improvements in Methodology	0.048	(0.001)	(0.001)	0.046	0.046
Experience (2019 to 2021)	(0.544)	(0.005)	(0.001)	(0.550)	(0.545)
Changes in Demographic Assumptions	(0.121)	0.002	0.001	(0.119)	(0.120)
Changes in Benefit Assumptions	0.016	0.003	0.002	0.019	0.018
Changes in Economic Assumptions	0.064	0.001	0.001	0.066	0.065
Changes in Investment Assumptions	0.373	0.001	0.000	0.373	0.373
Changes in Other Assumptions	(0.009)	0.001	0.000	(0.008)	(0.009)
Change in Funding Target from 2031-2081 to 2034-2084	(0.009)	(0.002)	0.000	(0.011)	(0.008)
Rate before Rounding	**9.526**	**0.035**	**0.009**	**9.560**	**9.535**
Rounded Rate, in Accordance with the Calculation of Contribution Rates Regulations, 2021	**9.53**	**0.03**	**0.01**	**9.56**	**9.54**
31st CPP Actuarial Report	**9.53**	**0.03**	**0.01**	**9.56**	**9.54**

(1) Components may not sum to totals due to rounding.
(2) Under the *Budget Implementation Act, 2018, No. 1*, amendments to the CPP statute took effect 1 January 2019. The full funding rates in respect of the amendments were determined for the 30th CPP Actuarial Report.

7.2 Additional CPP

7.2.1 Introduction

The results presented in this report differ from those previously projected for a variety of reasons. Differences between the actual experience for 2019 through 2021 and that projected in the 30th CPP Actuarial Report are addressed in section 7.2.2 below. Since historical results provide the starting point for the projections shown in this report, these historical differences between actual and projected experience over the period 2019-2021 have an effect on the projections. The impact of experience since the previous triennial valuation of the additional Plan and changes in the assumptions and methodology on the additional CPP first and second additional minimum contribution rates are addressed in section 7.2.3. Detailed reconciliations of the additional minimum contribution rates are presented in Appendix D.

7.2.2 Experience Update – 1 January 2019 to 31 December 2021

The major components of the change in the additional CPP assets from the start of the additional Plan on 1 January 2019 to 31 December 2021 are summarized in Table 29.

Contributions during the period 2019 to 2021 were not materially different than expected.

As the additional Plan started only recently, administrative processes regarding benefits are yet to be finalized. As such, only partial experience data regarding benefit expenditures were available at the time this CPP Actuarial Report was prepared. Operating expenses over the period 2019 to 2021 were $256 million higher than expected.

Due to the strong investment performance over the period (actual average annual nominal rate of return of 7.1% compared to the anticipated 2.6%), investment income on the additional CPP assets was $657 million higher than expected.

The resulting additional CPP assets as at 31 December 2021, are $459 million higher than projected under the 30th CPP Actuarial Report.

Table 29 Change in Assets - 1 January 2019 to 31 December 2021 - Additional CPP [1]
(cost accrual basis, $ million)

	Actual	Expected [2]	Difference: Actual – Expected
Assets at 1 January 2019	0	0	-
+ Contributions	10,487	10,451	36
- Expenditures	520	286	234
+ Investment Income	1,078	421	657
Change in Assets	11,045	10,586	459
Assets at 31 December 2021	11,045	10,586	459

(1) Components may not sum to totals due to rounding.
(2) Expected contributions, expenditures, and investment income shown are as per the projections of the 30th CPP Actuarial Report as at 31 December 2018.

7.2.3 Changes in the Additional Minimum Contribution Rates

Table 30 presents the main elements of change in the first and second additional minimum contribution rates (FAMCR, SAMCR) since the 30th CPP Actuarial Report and shows an overall decrease in the rates.

Economic, and investment experience both acted to lower the AMCRs. Changes made to the demographic, economic, and investments assumptions also acted to lower the AMCRs. However, these reductions in the rates are partially offset by changes in other assumptions (e.g. operating expenses). The net result of all changes since the 30th CPP Actuarial Report is a decrease in the FAMCR of 0.01 percentage points and corresponding decrease in the SAMCR of 0.04 percentage points.

The impacts on the AMCRs resulting from changes in assumptions include the subsequent event disclosed in section 2.3. Overall, changes to the assumptions to reflect the subsequent event resulted in decreases of less than 0.005 percentage points and 0.02 percentage points in the FAMCR and SAMCR, respectively.

A more detailed reconciliation of changes in the AMCRs is provided in Table 108 in Appendix D of this report.

Table 30 Reconciliation of Changes in Additional Minimum Contribution Rates [1]
(% of additional CPP contributory earnings)

	First Additional Minimum Contribution Rate	Second Additional Minimum Contribution Rate
30th CPP Actuarial Report - After Rounding	**1.98**	**7.92**
30th CPP Actuarial Report - Before Rounding	**1.977**	**7.907**
Improvements in Methodology	0.027	0.108
Experience (2019 to 2021)	(0.006)	(0.025)
Changes in Demographic Assumptions	(0.010)	(0.038)
Changes in Benefit Assumptions	0.004	0.014
Changes in Economic Assumptions	(0.025)	(0.099)
Changes in Investment Assumptions	(0.016)	(0.062)
Changes in Other Assumptions	0.019	0.075
Rate before Rounding	**1.970**	**7.879**
Rounded Rates, in Accordance with the Calculation of Contribution Rates Regulations, 2021	**1.97**	**7.88**
31st CPP Actuarial Report	**1.97**	**7.88**

(1) Components may not sum to totals due to rounding.
(2) Under the *Budget Implementation Act, 2019, No. 1*, the application for a CPP retirement pension is waived upon reaching age 70. As the amendment is not a benefit improvement, the full funding provision was not invoked.

8 Actuarial Opinion

In our opinion, considering that this 31st Actuarial Report on the Canada Pension Plan as at 31 December 2021 was prepared pursuant to the *Canada Pension Plan*:

- the data on which this report is based are sufficient and reliable for the purposes of this report;
- the assumptions used are, individually and in aggregate, reasonable and appropriate for the purposes of this report; and
- the methods employed are appropriate for the purposes of this report.

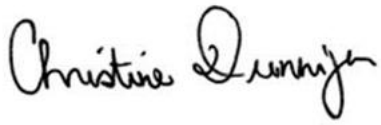
Based on the results of this valuation, we hereby certify that:

- the minimum contribution rate required to finance the base CPP is 9.56% for years 2025 to 2033 and 9.54% for the year 2034 and thereafter.
- the additional minimum contribution rates that result in projected contributions being sufficient, along with projected investment income, to fully pay projected expenditures of the additional CPP are determined to be:
  - first additional minimum contribution rate: 1.97% for the year 2025 and thereafter, and
  - second additional minimum contribution rate: 7.88% for the year 2025 and thereafter.
- the insufficient rates provisions of the *Canada Pension Plan* and the provisions under the *Additional Canada Pension Plan Sustainability Regulations* do not apply. Therefore, in the absence of specific action by the federal and provincial governments, the legislated contribution rates will remain for both the base CPP and the additional CPP.

This report has been prepared, and our opinions given, in accordance with accepted actuarial practice in Canada, in particular, the General Standards and the Practice-Specific Standards for Social Security Programs of the Standards of Practice of the Canadian Institute of Actuaries.

As of the date of the signing of this report, we have not learned of any events, other than the events already accounted for in section 2.3 of this report, that would have a material impact on the financial states of the base or additional CPP as at 31 December 2021.

Assia Billig, FCIA, FSA
Chief Actuary



Christine Dunnigan, FCIA, FSA
Senior Actuary

Michel Montambeault, FCIA, FSA
Senior Actuary

Ottawa, Canada
14 November 2022

Appendix A – Summary of Plan Provisions

A.1 Introduction

The *Canada Pension Plan* came into force on 1 January 1966. Since its inception, the CPP has been amended a number of times. The amendments include an enhancement of the CPP (the additional CPP) such that, effective 1 January 2019, the CPP consists of two components: the base CPP and additional CPP.

The most recent amendments to the *Canada Pension Plan* are the following:

The *Budget Implementation Act, 2019, No. 1*, which received Royal Assent on 21 June 2019, amends the CPP statute such that the application for a CPP retirement pension is waived upon reaching age 70, effective 1 January 2020. This amendment was considered to be a subsequent event for the purpose of the 30th CPP Actuarial Report since the amendment became known to the Chief Actuary after the valuation date but before the report date. The amendment was taken into account for the 30th CPP Actuarial Report since it was determined to have a material impact on the financial state of the CPP.

Regulations regarding the CPP contribution rates and financial sustainability of the additional Plan, specifically the *Calculation of Contribution Rates Regulations, 2021* and the *Additional Canada Pension Plan Sustainability Regulations*, which both received formal provincial approval. These Regulations were originally introduced in 2018 and were taken into account for the 30th CPP Actuarial Report. Both Regulations became effective 1 February 2021.

The *Budget Implementation Act, 2022, No. 1*, which received Royal Assent on 23 June 2022, contains technical amendments regarding eligibility for the base CPP post-retirement disability benefit and determination of the additional CPP drop-in provisions under the CPP statute.[1] The amendments reflect the original intent of the given benefit and provisions and were thus included in the projections of previous CPP actuarial reports.

This 31st CPP Actuarial Report takes into account all the above listed amendments and Regulations.

This appendix presents a summary of the provisions of the Plan inclusive of all amendments. The legislation shall prevail if there is a discrepancy between it and this summary.

A.2 Participation

The CPP includes virtually all members of the labour force in Canada, including both employees and self-employed persons between the ages of 18 and 70 with employment earnings, other than those covered by the Québec Pension Plan (QPP). The main exceptions are persons with annual earnings lower than $3,500 (the Year's Basic Exemption, defined below), members of certain religious groups, and other persons who qualify under excepted employment. It should be noted

[1] Amendments are pending provincial approval.

that the CPP covers all members of the Canadian Forces and the Royal Canadian Mounted Police, including those residing in the province of Québec. The persons to whom a CPP disability benefit is payable are not required to contribute.

A.3 Definitions

A.3.1 Base and Additional CPP

The base CPP or base Plan refers to that part of the CPP other than the part relating to the additional CPP. Prior to 1 January 2019, the CPP consisted only of the base Plan.

The additional CPP or additional Plan refers to the enhancement to the CPP introduced in *An Act to Amend the Canada Pension Plan, the Canada Pension Plan Investment Board Act and the Income Tax Act*. The additional CPP was implemented as of 1 January 2019. The additional CPP has two (first and second) parts or tiers, and the corresponding first and second additional contribution rates and pensionable earnings on which contributions are made will be phased in over the seven-year period 2019 to 2025, as described below.

Since 1 January 2019, the CPP comprises the base and additional Plans.

A.3.2 Year's Maximum Pensionable Earnings (YMPE) and Year's Additional Maximum Pensionable Earnings (YAMPE)

The YMPE for a calendar year is the limit to which employment and self-employment earnings are subject to contributions and first additional contributions for purposes of the base Plan and additional Plan, respectively. The YMPE increases each year to the extent warranted by the percentage increase, as at 30 June of the preceding year, in the 12-month average of the average weekly earnings of the Industrial Aggregate (as published by Statistics Canada). If the amount so calculated is not a multiple of $100, the next lower multiple of $100 is used. The YMPE is set at $64,900 in 2022.

The YAMPE for a calendar year is the limit to which employment and self-employment earnings are subject to second additional contributions above the YMPE for the purposes of the additional Plan. The YAMPE will be introduced in the year 2024. The YAMPE will first be set at 107% of the YMPE in 2024, and then at 114% of the YMPE in 2025 and thereafter. The YAMPE is thus set to increase in tandem with the YMPE after 2025. If the YAMPE so calculated is not a multiple of $100, the next lower multiple of $100 is used.

In this report, the YMPE and YAMPE in the year 2025 are projected to be $71,200 and $81,100, respectively.

A.3.3 Year's Basic Exemption (YBE)

The YBE for a calendar year is the minimum employment earnings required to participate in the Plan. As well, contributions are waived on earnings up to the YBE. The YBE is $3,500 in 2022.

A.3.4 Contributory Period and Additional Contributory Periods of the CPP

The contributory period is in respect of the base CPP and is the number of months from attainment of age 18 or from 1 January 1966, if later, to the earliest of the month in which the contributor dies, the month before the one in which the retirement pension commences and the month before the one in which the contributor reaches 70 years of age, less the number of months during which the contributor received a CPP or QPP disability benefit (including the three-month waiting period), or during which the contributor had at least one eligible child under seven years of age and had earnings for that year lower than the YBE. The contributory period excludes periods on or after 1 January 2012 during which beneficiaries contribute while in receipt of a retirement pension.

The first additional contributory period in respect of the additional CPP is the number of months from attainment of age 18 or from 1 January 2019, if later, to the earliest of the month in which the contributor dies, the month before the one in which the retirement pension commences and the month before the one in which the contributor reaches 70 years of age.

The second additional contributory period in respect of the additional CPP is the number of months from attainment of age 18 or from 1 January 2024, if later, to the earliest of the month in which the contributor dies, the month before the one in which the retirement pension commences and the month before the one in which the contributor reaches 70 years of age.

A.3.5 Pension Index

The Pension Index for a given calendar year is equal to the Consumer Price Index averaged over the 12-month period ending with October of the preceding year; however, the Pension Index of a given year may not be less than the previous year's Pension Index.

A.4 Contribution Rate and Additional Contribution Rates of the CPP

In respect of the base CPP, from 1966 to 1986, the annual contribution rate applicable to contributory earnings was 1.8% for employees (and the same amount for their employers) and 3.6% in respect of self-employed earnings. This combined employee-employer contribution rate of 3.6% was subject to an annual increase of 0.2 percentage points from 1987 to 1996, attaining 5.6% in the last year of that period. From 1997 to 2003, the combined employee-employer contribution rate for the base CPP then increased in steps to reach a rate of 9.9% by 2003, with no subsequent increases scheduled thereafter.

The first additional contribution rate of the additional CPP applies to earnings between the YBE and the YMPE. The first additional combined employee-employer contribution rate is being phased in over the 5-year period 2019 to 2023 and will be equal to 2.0% from the year 2023 onward. The first additional contribution rate during the phase-in period from 2019 to 2023 is shown in Table 31.

The second additional contribution rate of the additional CPP applies to earnings between the YMPE and YAMPE and will be applied starting in the year 2024. The second additional combined employee-employer contribution rate is equal to 8.0% for the year 2024 and thereafter.

Employees and employers pay equal shares of the base and additional contribution rates of the CPP, and the self-employed pay the full rates.

Table 31 shows the legislated contribution rates for the CPP.

Table 31 Legislated Contribution Rates
(self-employed and combined employer-employee) (%)

	Pensionable Earnings above YBE up to YMPE		Pensionable Earnings above YMPE up to YAMPE
Year	Base Contribution Rate	First Additional Contribution Rate	Second Additional Contribution Rate
2003-2018	9.9	–	–
2019	9.9	0.3	–
2020	9.9	0.6	–
2021	9.9	1.0	–
2022	9.9	1.5	–
2023	9.9	2.0	–
2024+	9.9	2.0	8.0

The CPP statute gives the federal and provincial ministers of finance the authority to make changes to the Plan's contribution rates through regulation, in connection with a triennial review. However, year-over-year rate increases cannot exceed 0.2 percentage points; beyond that, legislation is required.

For the base Plan, if a triennial CPP actuarial report projects a minimum contribution rate in excess of the scheduled (legislated) rate and the finance ministers do not make a recommendation to either increase the legislated rate or maintain it, the insufficient rates provisions of the *Canada Pension Plan* would apply. The base CPP contribution rate would then be increased in stages and a possible temporary freeze on inflation adjustments to benefits in pay would apply.

For the additional Plan, if a triennial CPP actuarial report projects that the additional minimum contribution rates deviate to a certain extent from their respective legislated additional rates and the finance ministers do not agree on how to address the deviation, then sustainability Regulations in respect of the additional Plan would provide the actions to take: changes to benefits and possibly the additional contributions rates. The sustainability Regulations – the *Additional Canada Pension Plan Sustainability Regulations*, became effective 1 February 2021.

A.5 Retirement Pension

A.5.1 Eligibility Requirements

A person aged 60 or over becomes eligible for a base CPP retirement pension provided contributions have been made during at least one calendar year. Further, an individual must apply for a retirement pension in order to receive it. However, since 1 January 2020, the requirement to apply is waived for an eligible person if he or she is aged 70 or older and is in receipt of another benefit from the CPP, OAS program, or a provincial plan and/or had an income tax return filed in respect of the year before the year in which granting the waiver is considered.

Prior to 2012, a work cessation test applied in order for a retirement pension to become payable before age 65. This test required individuals who applied to take their CPP retirement benefit early (i.e. before age 65) to either stop working or materially reduce their earnings both in the month immediately preceding and the month of benefit take-up. In the month following the start of pension payment, an individual could return to work and/or earn more without affecting the eligibility for or amount of the benefit. However, no further contributions to the CPP were allowed once benefits started being paid. There was no work cessation test for those aged 65 or older.

Since 1 January 2012, the work cessation test no longer applies, and individuals younger than 65 who choose to work in Canada outside of Québec while receiving a CPP or QPP retirement pension are required, along with their employers, to contribute to the CPP. Working beneficiaries aged 65 or older are given the option of continuing to contribute to the Plan; however, employers of those opting to do so are also required to contribute. The contributions from working beneficiaries are applied toward providing post-retirement benefits from the base and additional CPP and do not affect eligibility for other CPP benefits, except the post-retirement disability benefit. Upon attaining age 70, contributions are no longer permitted under the Plan.

The eligibility requirements for the additional retirement benefit are those of the base CPP. That is, a contributor is deemed to be eligible for the additional CPP retirement benefit if they are eligible for the base CPP retirement benefit.

A.5.2 Amount of Pension

The initial amount of the monthly retirement pension payable to a contributor under the CPP is equal to the sum of their retirement benefits payable under the base and additional Plans.

Base CPP

The initial monthly retirement pension payable under the base Plan is based on the contributor's entire history of pensionable earnings during the contributory period. The retirement pension under the base Plan is equal to 25% of the average of the YMPE for the year of retirement and the four previous years, referred to as the Maximum Pensionable Earnings Average (MPEA), adjusted to take into account the contributor's pensionable earnings. For this purpose, the

contributor's pensionable earnings for any given month are indexed by the ratio of the MPEA for the year of retirement to the YMPE for the year to which the given month belongs.

Some periods with low pensionable earnings may be excluded from the calculation of benefits by reason of pensions commencing after age 65, disability, child-rearing for a child less than seven years of age, and the general drop-out provision.

The general drop-out provision allows for a number of years with low or zero earnings to be dropped from the calculation of the retirement benefit. For example, for someone who started their retirement benefit at age 65 in 2022, the provision allows for 17% of the number of months with the lowest earnings (up to a maximum of about eight years) to be dropped from the calculation of the benefit. The general drop-out percentage was 15% from 1966 to 2011, 16% in 2012 and 2013, and has been 17% since 2014. As a result, the maximum number of years of low or zero earnings that may be dropped from the calculation of the retirement benefit for those contributors who take their benefit at age 65 has increased from about seven to eight years. The actual drop-out percentage that applies is based on the year of benefit take-up. The increase in the general drop-out provision increases the retirement pension, as well as the CPP disability and survivor pensions, since the determination of these benefits depends on the retirement pension.

The maximum retirement benefit payable under the base CPP at age 65 in 2022 is $1,243.75 per month or $14,925 per year.

Additional CPP

The calculation of the additional CPP retirement benefit is based on the first and second additional monthly pensionable earnings. The first additional monthly pensionable earnings are equal to the total of the highest 480 months or the total number of months, if lower, in the first additional contributory period of monthly adjusted pensionable earnings up to the YMPE divided by 480. Similarly, the second additional monthly pensionable earnings are equal to the total of the highest 480 or total number of months, if lower, in the second additional contributory period of monthly adjusted pensionable earnings between the YMPE and the YAMPE divided by 480. These calculations provide for a monthly accrual of 1/480 of the total additional retirement benefit.

The additional monthly retirement benefit is calculated as the sum of 8.33% of the first additional monthly pensionable earnings and 33.33% of the second additional monthly pensionable earnings.

The pensionable earnings used for the calculation of additional retirement benefits are adjusted to the date of retirement in the same way as for the base CPP, that is, indexing by the ratio of the MPEA to the YMPE as described above. Further, to account for the lower first additional contribution rates during the first four years of the phase-in period (from 2019 to 2022), the first additional monthly pensionable earnings are multiplied by 0.15 in 2019, 0.30 in 2020, 0.50 in 2021, and 0.75 in 2022.

Unlike the base CPP, there are no drop-out provisions for the additional Plan. However, there are "drop-in" provisions for the additional CPP to protect the additional benefits from periods of low pensionable earnings resulting from disability or child-rearing for a child less than seven years of age.

Specifically, for individuals who become disabled after 1 January 2019, an imputed income will be assigned to those disability periods of low or zero earnings for the purpose of calculating the additional CPP retirement (and survivor) benefits. The drop-in amount will be equal to 70 per cent of an individual's average earnings in the six years prior to the onset of the disability.

The disability drop-in amount is calculated based on months of earnings after 2018 and prior to the onset of disability. If, however, there are fewer than 72 months (6 years) of such earnings, then the drop-in will be calculated based on the actual number of earnings months after 2018, prior to the onset of disability.

For parents of children under the age of seven on or after 1 January 2019, an imputed income will be assigned to child-rearing periods of low or zero earnings on or after 1 January 2019 for the purpose of calculating additional CPP benefits. The drop-in amount is equal to the parent's average earnings during the five years prior to the birth or adoption of the child if that amount is higher than their actual earnings during the period the child was younger than age seven.

The child-rearing drop-in amount is calculated based on months of earnings after 2018 and prior to birth or adoption of a child. If, however, there are fewer than 60 such months (5 years), then the drop-in is calculated based on the actual number of earnings months, but not lower than 36. If there are less than 36 such months of earnings, the drop-in will be calculated using imputed earnings of 40% of the YMPE for the number of months missing from the minimum of 36.

Additional CPP retirement benefits will initially be low in the early years of the additional Plan due to the lower accrual rates during the phase-in period and few years of contributions. Contributions made over time to the additional CPP allow individuals to accrue partial additional benefits. Full additional retirement benefits are accrued after about 40 years of making contributions.

The maximum additional retirement benefit at age 65 in January 2022 is $9.84 per month or $118.08 per year, and is projected to increase over time. Additional CPP retirement benefits are initially low in the early years of the additional Plan due to the lower accrual rates during the phase-in period and few years of contributions.

The projected maximum additional retirement benefits are shown in Table 32. An individual, with pensionable earnings at or above the YAMPE, who contributed to the additional Plan for at least 40 years starting in the year 2025 or later, would receive the maximum additional retirement benefit payable of $647 per month or $7,759 per year, in 2022 wage-adjusted dollars[1]. Table 32 accounts for the phase-in period of the additional Plan from 2019 to 2025. The maximum

[1] For a given year, the value in 2022 wage-adjusted dollars is equal to the corresponding value in current dollars divided by the cumulative projected increase in nominal wage since 2022.

additional CPP retirement benefit represents an increase of 52% over the maximum base CPP retirement pension.

Table 32 Projected Maximum Additional CPP Retirement Benefit

Pensionable Earnings at or above YMPE before 2024, YAMPE thereafter
All amounts in 2022 wage-adjusted dollars
Maximum Basic CPP Retirement Benefit in 2022: $14,925 per year ($1,243.75 per month)

Start Retirement Pension at Age 65 on January 1	Number of Years of Contributions to Additional CPP [1]	Additional CPP Retirement Benefit	
Year		Monthly	Annual
2024	5	$28	$336
2029	10	$106	$1,271
2044	25	$348	$4,180
2065	46 [2]	$647	$7,759

(1) All years starting from 2019 to year before retirement.
(2) 40 years of contributions at the maximum.

A.5.3 Adjustment for Early or Postponed Retirement Benefit

The CPP retirement pension is subject to an actuarial adjustment that depends on the year and contributor's age at commencement of the pension. As the initial monthly retirement pension is the sum of the retirement benefits under the base and additional Plans, the actuarial adjustment is applied to each component's benefit.

The retirement pension is permanently adjusted downward or upward by a factor for each month respectively before or after age 65 and the age when the pension commences or, if earlier, age 70. Prior to 2011, the adjustment factor for both pre-65 and post-65 pension take-up was 0.5% per month. Starting in 2011, the adjustment factors were changed. For contributors who take their retirement benefit early (before age 65), the adjustment factor gradually increased to 0.6% per month over the five-year period 2012 to 2016. For those who take their benefit after age 65, the factor gradually increased to 0.7% per month over the three-year period 2011 to 2013. Table 33 shows the legislated pension adjustment factors for the CPP.

Table 33 Legislated Pension Adjustment Factors
(percentages)

Effective date	Pre-65 Downward Monthly Adjustment Factor	Post-65 Upward Monthly Adjustment Factor
Pre-2011	0.50	0.50
1 January 2011	0.50	0.57
1 January 2012	0.52	0.64
1 January 2013	0.54	0.70
1 January 2014	0.56	0.70
1 January 2015	0.58	0.70
1 January 2016	0.60	0.70

The downward pension adjustment factor of 0.6% per month, applicable for the year 2016 and thereafter, results in a pension that is reduced by 36% for pension take-up at age 60. The upward

factor of 0.7% per month, applicable for 2013 and thereafter, results in a pension increased by 42% for pension take-up at age 70.

In accordance with subsection 115(1.11) of the *Canada Pension Plan*, the Chief Actuary shall calculate the pension adjustment factors and specify them in every third triennial CPP actuarial report prepared, starting with the Actuarial Report on the Canada Pension Plan as at 31 December 2015. The Chief Actuary may also, if deems it necessary, specify the factors in any supplemental CPP actuarial report after 2015.

In accordance with the legislation, the first CPP actuarial report to specify the pension adjustment factors was the 27th CPP Actuarial Report as at 31 December 2015, which was tabled in the House of Commons on 27 September 2016. The methodology used to calculate the factors is described in the study: "Canada Pension Plan Actuarial Adjustment Factors as specified in the 27th Actuarial Report on the Canada Pension as at 31 December 2015 – Actuarial Study No. 18", which was published by the OCA in April 2017. The pension adjustment factors are reviewed with each triennial actuarial valuation. In accordance with the CPP statute, the factors are specified in every third triennial actuarial report or more frequently if deemed necessary by the Chief Actuary. The pension adjustment factors will next be specified in the CPP Actuarial Report as at 31 December 2024.

A.5.4 Working Beneficiaries – Post-Retirement Benefit

Prior to 2012, those who received a CPP retirement pension and then returned to work (i.e. working beneficiaries) did not pay contributions and therefore did not continue to build their CPP pension. Commencing 1 January 2012, individuals under the age of 65 who receive either a CPP or QPP retirement pension and continue to work in Canada outside of Québec are required, along with their employers, to contribute to the CPP. Working beneficiaries aged 65 to 69 are not required to contribute, but are given the option to do so. Employers of those working beneficiaries opting to contribute are also required to contribute.

The contributions paid by working beneficiaries provide for a post-retirement benefit. The total post-retirement benefit is equal to the sum of the benefits earned during retirement under the base and additional Plans.

The post-retirement benefit is earned at a rate of 1/40 of the maximum retirement pension per year of post-retirement contributions and is adjusted for the applicable earnings level and age of the contributor.

For both the base and additional CPP, contributions paid by working beneficiaries toward accruing the post-retirement benefit do not affect eligibility for other CPP benefits, except the post-retirement disability benefit described below. Pensionable earnings and additional pensionable earnings of working beneficiaries do not qualify for credit splitting.

A post-retirement benefit becomes payable the year following the year in which contributions are made, and multiple post-retirement benefits may accumulate over time. The total pension

payable resulting from the combination of the retirement pension and post-retirement benefit may be greater than the maximum CPP or QPP pension payable. As for the CPP retirement pension, the post-retirement benefit is payable for a beneficiary's lifetime.

The maximum base and additional CPP post-retirement benefits at age 65 in January 2022 for a working beneficiary who started their retirement pension at age 64 are, respectively, $31.09 and $5.17 per month for a total post-retirement benefit of $36.26 per month or $453.12 per year.

A.6 Disability Pension

A.6.1 Eligibility Requirements

A person is considered disabled if he or she is suffering from a severe and prolonged mental or physical disability. A disability is considered severe if by reason of it the person is regularly incapable of pursuing any substantially gainful occupation; a disability is considered prolonged if it is likely to be long-continuing and of indefinite duration or likely to result in death.

A person who becomes disabled prior to age 65 and is not receiving a CPP retirement pension is eligible for a disability pension provided that contributions have been made, at the time of disablement, for at least four of the previous six calendar years, counting years included wholly or partly in the contributory period. Contributions must be on earnings that are not less than 10% of the YMPE rounded, if necessary, to the next lower multiple of $100. Since 2008, contributors with 25 or more years of contributions to the Plan can meet the eligibility requirement with contributions in three of the last six years.

The eligibility requirements for the additional disability pension are those of the base CPP. That is, a contributor is deemed to be eligible for the additional CPP disability pension if they are eligible for the base CPP disability pension.

A.6.2 Amount of Pension

The initial amount of the monthly disability pension payable is the sum of the disability benefits payable under the base and additional Plans.

The initial base CPP monthly disability pension is the sum of a flat-rate portion payable ($524.64 per month in 2022) depending only on the year in which the benefit is payable and an earnings-related portion equal to 75% of the base CPP retirement pension that would be payable at the onset of disability if the contributory period ended on that date and no actuarial adjustment applied.

The initial amount of the additional CPP monthly disability pension is strictly earnings-related and is equal to 75% of the additional retirement pension that would be payable at the onset of disability if the first and second additional contributory periods ended on that date and no actuarial adjustment applied.

The automatic conversion of the CPP disability pension into a retirement pension at age 65 is determined by base and additional pensionable earnings at the time of disablement, price-indexed to age 65. In other words, the indexing from the time of disablement to age 65, which determines the initial rate of the CPP retirement pension, is in line with increases in prices rather than wages.

The maximum base and additional monthly CPP disability pensions payable in January 2022 are, respectively, $1,457.45 and $7.38, for a total of $1,464.83 per month or $17,577.96 for the year.

The additional CPP disability benefits are initially low in the early years of the additional Plan due to the lower accrual rates during the phase-in period and few years of contributions. The projected maximum additional CPP disability benefits, in 2022 wage-adjusted dollars, are shown in Table 34. The table accounts for the phase-in period of the additional Plan from 2019 to 2025. The maximum additional disability benefit payable is $5,819 per year or $485 per month, in 2022 wage-adjusted dollars.

Table 34 Projected Maximum Additional CPP Disability Benefit

Pre-Disability Pensionable Earnings at or above YMPE before 2024, YAMPE thereafter
All amounts in 2022 wage-adjusted dollars

As at January 1	Number of Years of Contributions to Additional CPP [1]	Additional CPP Disability Benefit	
Year		Monthly	Annual
2024	5	$21	$252
2029	10	$79	$953
2044	25	$261	$3,135
2065+	46 [2]	$485	$5,819

(1) All years starting from 2019 to year before disability.
(2) 40 years of contributions at the maximum.

A.6.3 Post-Retirement Disability Benefit (Base CPP only)

Prior to 2019, base CPP retirement beneficiaries who were deemed disabled after the start of their retirement pension could not receive the CPP disability pension, even if they were still under age 65 and otherwise met eligibility requirements. Commencing 1 January 2019, a post-retirement disability benefit equal to the flat-rate portion of the disability pension ($524.64 per month in 2022) is payable under the base CPP to retirement beneficiaries who are deemed disabled while under age 65. Contributions paid by working beneficiaries toward post-retirement benefits are used in determining eligibility for the post-retirement disability benefit. Eligible disabled retirement beneficiaries receive the post-retirement disability benefit in addition to their retirement pension, and the dependent children of disabled retirees receive children's benefits.

The post-retirement disability benefit pertains only to the base Plan. There is no additional post-retirement disability benefit payable under the additional Plan.

A.7 Survivor's Pension

A.7.1 Eligibility Requirements

A person who was married to a contributor or was a common-law partner of a contributor at the time of the contributor's death is considered to be a survivor of the deceased contributor. The survivor is eligible for a survivor's pension if the following conditions are met as at the date of the contributor's death:

- The deceased contributor must have made contributions during the lesser of: (i) ten calendar years, or (ii) one-third of the total number of years included wholly or partly in their contributory period, but not for less than three years.
- If the survivor is the separated spouse of the deceased contributor, there must be no cohabiting common-law partner of the contributor at the time of death. If the survivor is the common-law partner of the deceased contributor, the couple must have cohabited for not less than one year immediately before the death of the contributor. If the common-law partner is of the same sex as the deceased contributor, the death must have occurred on or after 17 April 1985.
- Prior to 2019, the surviving spouse or common-law partner must have had dependent children, been disabled, or been at least 35 years of age. As of 1 January 2019, these conditions no longer apply.

The eligibility requirements for the additional survivor's pension are those of the base CPP. That is, a person is eligible for an additional CPP survivor's pension if they are eligible for the base CPP survivor's pension.

A.7.2 Amount of Pension

The initial amount of the monthly survivor's pension payable under the CPP is equal to the sum of the survivor's benefits payable under the base and additional Plans.

Prior to 2019, survivors who were not disabled and did not have dependent children had their survivor's pension reduced by 10 per cent for each year they were under the age of 45 when their spouse or common-law partner died. This reduction lasted until age 65, when the survivor's pension was then recalculated. This meant that survivors under the age of 35 who were not disabled and did not have dependent children did not receive a survivor's pension until age 65.

As of 1 January 2019, reductions are no longer applied to the survivor's pension for survivors under age 45 who are neither disabled nor have dependent children. A surviving spouse and common-law partner of any CPP contributor who has made sufficient contributions will receive an unreduced survivor's pension.

The amount of the pension changes depending on whether the survivor is younger or older than age 65 as described below. Additional survivor's benefits regardless of age will initially be low in

the early years of the additional Plan due to the lower accrual rates during the phase-in period and few years of additional contributions previously made by the deceased contributor.

A.7.2.1 New Survivor under Age 65

The initial monthly survivor's pension payable until the surviving spouse or common-law partner attains age 65 is the sum of a base CPP flat-rate benefit and base and additional CPP earnings-related benefits. There is no additional CPP flat-rate benefit.

The base CPP flat-rate survivor's benefit depends only on the year in which the survivor's benefit is payable ($204.69 per month in 2022).

The earnings-related benefits payable under the base and additional CPP depend initially only on the contributor's record of pensionable and additional pensionable earnings, respectively as at the date of death. The initial earnings-related survivor's benefit is equal to 37.5% of either the retirement pension of the deceased contributor if they had been receiving a pension, or the retirement pension that would have been payable to the deceased contributor if the contributory and additional contributory periods had ended at the time of death, with no actuarial adjustment in either case.

The maximum base and additional monthly CPP earnings-related survivor's benefit for new survivors under age 65 are, respectively, $466.41 and $3.69 in January 2022. In total, including the base CPP flat-rate amount, the maximum CPP survivor's pension payable in January 2022 for new survivors under age 65 is $674.79 per month or $8,097.48 for the year.

Additional CPP survivor benefits are initially low in the early years of the additional Plan due to the lower accrual rates during the phase-in period and few years of contributions. The projected maximum additional CPP survivor's benefits, in 2022 wage-adjusted dollars, are shown in Table 35. The table accounts for the phase-in period of the additional Plan from 2019 to 2025. The maximum additional survivor's benefit payable for survivors younger than age 65 is $2,910 per year or $243 per month, in 2022 wage-adjusted dollars.

Table 35 Projected Maximum Additional CPP Survivor's Benefit, Survivor under Age 65
Prior Earnings of Deceased Contributor at or above YMPE before 2024, YAMPE thereafter
All amounts in 2022 wage-adjusted dollars

As at January 1	Number of Years of Prior Contributions by Deceased Contributor to Additional CPP [1]	Additional CPP Survivor's Benefit	
Year		Monthly	Annual
2024	5	$11	$126
2029	10	$40	$477
2044	25	$131	$1,568
2065+	46 [2]	$243	$2,910

(1) All years starting from 2019.
(2) 40 years of contributions at the maximum.

A.7.2.2 Survivor Age 65 or Over

At age 65, or upon becoming widowed at a later age, an eligible surviving spouse or common-law partner is entitled to a monthly survivor's benefit equal to 60% of either the retirement pension of the deceased contributor if they had been receiving a pension, or the retirement pension that would have been payable to the deceased contributor if the contributory and additional contributory periods had ended at the time of death, with no actuarial adjustment in either case.

The maximum base and additional monthly CPP survivor's pensions payable in January 2022 for new survivors aged 65 or older are, respectively, $746.25 and $5.90, for a total of $752.15 per month or $9,025.80 for the year.

As for survivors benefits payable to survivors younger than 65, survivor benefits for those age 65 and older are initially low in the early years of the additional Plan due to the lower accrual rates during the phase-in period and few years of contributions. The projected additional CPP survivor's benefits, in 2022 wage-adjusted dollars, are shown in Table 36. The table accounts for the phase-in period of the additional Plan from 2019 to 2025. The maximum additional survivor's benefit payable for survivors aged 65 or older is $4,655 per year or $388 per month, in 2022 wage-adjusted dollars.

Table 36 Projected Maximum Additional CPP Survivor's Benefit, Survivor Age 65 or Over
Prior Earnings of Deceased Contributor at or above YMPE before 2024, YAMPE thereafter
All amounts in 2022 wage-adjusted dollars

As at January 1	Number of Years of Prior Contributions by Deceased Contributor to Additional CPP [1]	Additional CPP Survivor's Benefit	
Year		Monthly	Annual
2024	5	$17	$201
2029	10	$64	$762
2044	25	$209	$2,508
2065+	46 [2]	$388	$4,655

(1) All years starting from 2019.
(2) 40 years of contributions at the maximum.

A.8 Death Benefit (Base CPP only)

A lump sum benefit is payable to the estate of a deceased contributor if the eligibility rules for the survivor's benefit are met. Prior to 2019, the amount of the death benefit was equal to six times the monthly amount of the CPP retirement pension accrued or payable in the year of death, adjusted to exclude any actuarial adjustments, and subject to a maximum of ten percent of the YMPE for the year of death prior to 1998, and $2,500 thereafter. As of 1 January 2019, the death benefit equals the flat-rate amount of $2,500.

The death benefit pertains only to the base CPP. There is no additional CPP death benefit.

A.9 Child's Benefits (Base CPP only)

Each child under age 18 and each full-time student aged 18 to 25 who is dependent on a contributor eligible for a CPP disability benefit (the disability pension or post-retirement disability benefit) or who was dependent on a deceased contributor who satisfied the requirements for a survivor's pension is entitled to a flat-rate monthly benefit ($264.53 in 2022). Furthermore a child may receive more than one child's benefit simultaneously.

The child's benefits pertain only to the base CPP. There are no additional CPP child's benefits.

A.10 Combined Benefits

The combined benefits rules of the CPP regarding the simultaneous payment of disability and survivor's pensions or retirement and survivor's pensions are complex and involve calculations and comparisons of various amounts.

For combined benefits under the base CPP, if there are two flat-rate components, then the beneficiary receives the larger one. For the earnings-related components, the beneficiary receives the larger one and 60% of the smaller one.

As well, the total combined earnings-related component is limited to the maximum retirement pension at age 65 for combined survivor-retirement benefits and to the maximum disability pension for combined survivor-disability benefits. In the case of combined survivor-retirement benefits where the retirement pension is taken early (before age 65), the final retirement amount is actuarially adjusted.

The combined benefits under the additional CPP follow the same rules as for the base CPP, except that there are no flat rate benefits payable, and the limits on the earnings-related amounts do not apply.

A.11 Inflation Adjustments

All monthly CPP benefits are indexed annually in accordance with inflation, as measured by the Pension Index. Benefits are multiplied on 1 January of each calendar year by the ratio of the Pension Index applicable for that calendar year to the Pension Index for the preceding year. As the Pension Index for a year is at least equal to the value of the previous year's Pension Index, benefits are either held constant or increased from one year to the next.

A.12 Credit Splitting

Pensionable and additional pensionable earnings may be split between separated or divorced couples (legal spouses or common-law partners) for each month the couple lived together. Pensionable earnings (of the base CPP) are used to establish eligibility for CPP benefits, and both pensionable and additional pensionable earnings are used to calculate the amounts of benefits.

Contributors may obtain a credit split even if they have remarried. However, pensionable and additional pensionable earnings cannot be split for any year in which the total earnings of the former couple do not exceed twice the YBE. Credit splitting also does not apply for any period of cohabitation during which a former spouse or common-law partner received a CPP retirement pension.

A.13 Pension Sharing

Couples (legal spouses or common-law partners) in an ongoing relationship may voluntarily (at the request of one of them) share their CPP retirement pensions corresponding to the number of years during which they cohabited. This applies provided both spouses have reached the minimum age requirement to receive a retirement pension. Sharing is possible even if only one of the spouses participated in the Plan. Pension sharing ceases upon separation, divorce, or death.

Appendix B – Data, Assumptions and Methodology

B.1 Introduction and Context

This section describes the data, assumptions, and methodology that underlie the financial projections in the Results sections of this report.

Future cash flows for the base and additional Plans are projected over a long period of time, i.e. over more than 75 years, and depend on assumptions such as those regarding fertility, mortality, migration, labour force participation, job creation, unemployment, inflation, employment earnings, and investment returns. These assumptions form the basis for the projections of future income and expenditures of both components of the CPP.

Over the years, the cumulative difference between revenues from contributions and investment income and the expenditures of the base and additional CPP generates the respective accumulated assets. The ratio of the end-of-year assets to the following year's expenditures (the A/E ratio) is then calculated for each component of the Plan.

For the base CPP, the A/E ratio is used to determine the steady-state contribution rate, which is the lowest contribution rate that, in the long term, would generally stabilize the A/E ratio. The steady-state contribution rate is determined in this way before the consideration of any full funding requirement for increased or new benefits. The full funding rate for increased or new benefits is determined independently of the steady-state rate. It is added to the steady-state rate to produce the minimum contribution rate.

For the additional CPP, the A/E ratio combined with a funding ratio of at least 100% on an open-group basis are used to determine the first and second additional minimum contribution rates together with any permanent full funding requirement for increased or new benefits. Temporary increases in the additional minimum contribution rates to fully amortize any past costs resulting from increased or new benefits would be determined separately.

Although the demographic, economic, and investment assumptions represent the Chief Actuary's best estimates, the resulting future financial states of the base and additional CPP presented in this report should be interpreted with caution. This information is not intended to be predictions, but rather projections of the future financial states of the base and additional CPP.

The future revenues and expenditures of the CPP depend on many economic factors. It is important to define the individual economic assumptions in the context of a long-term overall economic perspective. For this report, it is assumed that, despite the current uncertain outlook for major economies, a moderate and sustainable growth in the Canadian economy will persist throughout the projection period.

The actuarial examination of the CPP involves the projection of its revenues and expenditures over a long period of time. Although best judgment is used regarding future economic trends, it is

nonetheless difficult to anticipate all economic changes that may occur during the projection period. There will always be some degree of uncertainty.

The COVID-19 pandemic affected the labour markets deeply during 2020 and 2021 because of sanitary measures and lockdowns. Significant job losses and elevated unemployment rates were also observed. However, by the end 2021, main labour market measures had rebounded to pre-pandemic levels in most sectors of the economy. Short-term uncertainty due to the pandemic exists with other variables such as mortality, migration and wages.

The financial market performed well through 2021 after an initial pandemic-related decline at the end of fiscal year 2019-2020. However, there have been significant disruptions in the financial markets in 2022, which are likely attributable to the escalation of the conflict in Ukraine. In addition, the uncertainty surrounding high inflation due to the demand and supply shocks caused by the pandemic, has been exacerbated by the conflict in Ukraine. Given the significant effects on the financial projections for the CPP, the escalation of the conflict in Ukraine is considered a subsequent event that was taken into account for the purpose of this 31st CPP Actuarial Report.

Furthermore, the projected aging of the population combined with the continued retirement of the baby boom generation over the next few decades will certainly create significant social and economic changes. It is possible that the evolution of the working-age population, especially the active population, will be quite different from what has been historically observed and what has been assumed for the purpose of this report.

Other factors that add to the uncertainty include the timing and pace of transition to a green economy, the pace of technological advances and innovation as well as worldwide policies on protectionism vs. globalization.

As all these events evolve, the economic, demographic and investment environments continue to be subject to sustained volatility and unpredictability. The OCA will continue to monitor current and emerging trends and will adjust assumptions as needed in future reports.

B.2 Data

Table 37 lists the sources of data used for this report categorized by major assumptions. The most recent years of data are also listed.

Table 37 Data Sources

Major Assumptions	Source of Data	Last Experience Year
Population [1]		
Fertility	Statistics Canada, Institut de la statistique du Québec	2020
Migration	Statistics Canada	2021
Mortality	Statistics Canada Life Tables	2020 [1]
Initial population	Statistics Canada	2021
Economic		
CPI	Statistics Canada	2022 [2]
Real Wage Increases	Statistics Canada	2022 [3]
	Records of Earnings file from ESDC	2020
Labour Force (participation, employment, and unemployment rates)	Statistics Canada	2021
Total Earnings and Contributory Earnings	Records of Earnings file from ESDC	2020
Contributions	ESDC	2020
	Canada Revenue Agency	2020
Benefits	Administrative data from ESDC	2021
Assets and Investment	CPPIB	2022 [4]
	Canadian Institute of Actuaries' Report on Canadian Economic Statistics 1924-2021	2021
Operating Expenses	ESDC and CPPIB	2021

(1) Revisions to Mortality Life Tables from 1980 to 2019, as well as new Life Tables for 2020, published by Statistics Canada in January 2022 were taken into account.
(2) Inflation figures published by Statistics Canada up to May 2022 were taken into account.
(3) For the purpose of projecting the YMPE for 2023, data up to April 2022 were taken into account.
(4) CPPIB financial results up to the first quarter of Fiscal Year 2022-2023 (as at June 30, 2022) were taken into account.

In addition to the data sources listed above, other data and reference sources were consulted for the development of the assumptions used in this report, such as mortality data from the United Kingdom and United States and various economic forecasts.

B.3 Demographic Assumptions

Both the historical and projected populations of Canada less Québec are required for the calculation of future CPP contributions and benefits of the relevant cohorts of contributors and beneficiaries.

The populations of Canada and Québec as at 1 July 2021 are used as a starting point. The populations are then projected by age and sex from one year to the next by adding births and net migrants and subtracting deaths. Applying the fertility, migration, and mortality assumptions to the starting population develops the annual numbers of births, net migrants, and deaths. The relevant population for the CPP, which is the population of Canada less Québec, is obtained by subtracting the projected population of Québec from the projected population of Canada.

The population covered by the CPP pertains to Canada less Québec, but includes all members of the Canadian Forces (CF) and the Royal Canadian Mounted Police (RCMP). The approach used above to determine the CPP population does not make an explicit allowance for the members of

the CF or RCMP residing in Québec or outside Canada. However, provision for this group is made implicitly through the development of the number of people with earnings and the proportion of contributors as described in section B.5 of this appendix.

B.3.1 Initial Population as at 1 July 2021

The starting point for the demographic projections is based on the most recent Statistics Canada population estimates as at 1 July 2021 for Canada and Québec, by age and sex. The estimates are based on the 2016 Census. These estimates are adjusted by ungrouping ages 100 and older into individual ages using the observed distribution of Old Age Security program beneficiaries by age for ages 100 and older.

B.3.2 Fertility Rates

There are two definitions for the fertility rate: the total fertility rate and the cohort fertility rate. The total fertility rate corresponds to the average number of children born in a given calendar year. Specifically, it is the sum of the fertility rates by age group for women aged 15 to 49 in a given calendar year. In comparison, the cohort fertility rate is the average number of children born to a woman in her lifetime, for women born in a specific year. It gives an idea of trends and variations between different generations over time.

The total fertility rate in Canada has declined significantly since the baby boom period, when the rate peaked at nearly 4.0 per woman in the late 1950s. The baby bust period that followed in the mid-1960s initiated a decline in total fertility rates, resulting in a then-record low of 1.6 children per woman by the mid-1980s. The total fertility rate rose slightly in the early 1990s, but then generally declined further to a level of 1.5 by the late 1990s. Starting in the 2000s, Canada was one of many industrialized countries that saw their total fertility rates increase. By 2008, the total fertility rate for Canada had reached 1.68. However, in some industrialized countries, including Canada, the total fertility rate has decreased since 2008, which could be attributable to the 2008 economic downturn, continued economic uncertainty, as well as other factors.

The total fertility rate for Canada was 1.47 in 2019 and 1.40 in 2020. The significant decrease in 2020 could be due to the high level of uncertainty and much lower immigration caused by the COVID-19 pandemic.

Similar to Canada, the total fertility rate in Québec fell from a high of 4.0 per woman in the 1950s; however, the rate for Québec fell to a greater degree, reaching 1.4 by the mid-1980s. The rate for Québec then recovered somewhat in the early 1990s to over 1.6 and subsequently declined to below 1.5 by the late 1990s. The fertility rate for Québec increased with the introduction of the Québec Childcare Centres in 1997 and with the introduction of the Québec Parentale Insurance Plan (QPIP) in 2006. There was a significant increase in the rate after the year 2000, with the rate reaching 1.74 by 2008. In 2006, the rate for Québec exceeded Canada's level for the first time since 1958. However, similar to Canada's fertility rate, the fertility rate for Québec has been decreasing in recent years. The total fertility rate for Québec was 1.57 in 2019 and 1.52 in 2020.

Fertility rates are affected by many factors, including social attitudes, reproductive technologies, as well as economic and environmental conditions. Although there have been periods of growth in the total fertility rates in recent decades, it is unlikely that the rates will return to historical levels in the absence of significant societal changes. It is assumed for this report that the continued economic uncertainty and the COVID-19 pandemic have caused a temporary downward effect on total fertility rates, with couples choosing to postpone having any or more children until conditions improve. These effects were taken into consideration along with historical trends in age-specific fertility rates over the last 15 years. Given the uncertainty surrounding the effect of the COVID-19 pandemic on fertility rates in the year 2020, the data for that year were excluded from the analysis for purposes of setting the fertility rates for years 2021 and beyond. The historical data considered are therefore from the 15-year period ending in 2019.

In 2021, the Government of Canada announced that it would work with provinces and territories to establish a Canada-Wide Early Learning and Child Care Plan[1]. The fertility rate assumptions for this 31st CPP Actuarial Report take into account the proposed plan. Consistent with what was experienced in Québec with the introduction of the QPIP, the plan could lead to an increase in fertility rates for certain age groups and hence was considered in setting the assumptions for this report. The effect on the fertility rates is assumed to occur over the first several years following the adoption of the system before leveling out.

To determine the ultimate total fertility rate for Canada, the historical fertility rate of each age group was studied and projected independently. Based on historical analysis and the factors mentioned above, it is assumed that the total fertility rate from 2029 onward for Canada will be 1.54 children per woman, which is lower than the ultimate rate of 1.62 assumed for the 30th CPP Actuarial Report.

For Québec, the assumption was set by analyzing both the historical fertility rate as well as the difference between Canada's and Québec's fertility rates for each age group. The introduction of the Canada-Wide Early Learning and Child Care Plan is expected to reduce this difference. It is therefore assumed that the difference in the rates will decrease until 2029 and remain stable thereafter. As a result, the total fertility rate from 2029 onward for Québec is assumed to be 1.55 children per woman, which is lower than the assumed ultimate rate of 1.65 in the 30th CPP Actuarial Report.

Although the historical total fertility rates, based on age-group rates, are used to set the assumptions for the future, it is nonetheless useful and informative to consider the historical progression of the cohort fertility rates. Over time, the assumed age-group rates lead to cohort fertility rates which converge to the total fertility rate assumption, as shown for Canada in Table 38.

The cohort fertility rates in both Canada and Québec have declined over time. For females born in 1940, who reached the end of their childbearing years (turned age 49) in 1989, the cohort rates

[1] All provinces and territories have subsequently signed a Canada-Wide Early Learning and Child Care Plan (CWELCC) agreement with the federal Government.

were 2.69 and 2.34 for Canada and Québec, respectively. However, for females reaching the end of their childbearing years in 2019 (born in 1970), the Canada and Québec cohort fertility rates were 1.78 and 1.74, respectively.

Table 38 Cohort Fertility Rates by Age and Year of Birth
(Canada)

Year of Birth of Woman [1]	Annual Fertility Rates by Age and Year of Birth (per 1,000 women)							Cohort Fertility Rate per Woman [2]
	15-19	20-24	25-29	30-34	35-39	40-44	45-49	
1940	59.7	231.6	152.6	70.5	20.3	3.1	0.1	2.69
1945	54.7	161.4	130.4	65.7	19.9	3.3	0.1	2.18
1950	45.0	118.9	126.2	67.6	23.3	4.2	0.2	1.93
1955	37.4	103.7	121.1	73.6	29.0	5.2	0.2	1.85
1960	31.3	91.3	117.5	86.1	32.6	6.2	0.4	1.83
1965	26.0	76.8	121.2	84.9	36.4	7.9	0.5	1.77
1970	22.7	76.5	104.7	91.3	48.5	10.6	0.8	1.78
1975	25.6	64.6	97.9	106.1	53.4	11.7	0.9	1.80
1980	20.0	54.2	101.9	107.7	57.1	13.6	1.0	1.78
1985	14.9	52.6	96.3	108.0	61.0	15.6	1.0	1.75
1990	13.9	44.6	87.2	108.0	69.7	16.5	1.0	1.70
1995	12.1	37.1	78.7	115.4	73.2	16.5	1.0	1.67
2000	7.8	28.5	75.6	118.3	73.2	16.5	1.0	1.60
2005	5.7	23.1	74.5	118.3	73.2	16.5	1.0	1.56
2006	5.5	22.0	74.5	118.3	73.2	16.5	1.0	1.55
2007	5.3	20.9	74.5	118.3	73.2	16.5	1.0	1.55
2008	5.2	20.9	74.5	118.3	73.2	16.5	1.0	1.55
2009	5.0	20.9	74.5	118.3	73.2	16.5	1.0	1.55
2010	4.8	20.9	74.5	118.3	73.2	16.5	1.0	1.55
2011	4.7	20.9	74.5	118.3	73.2	16.5	1.0	1.54
2012+	4.5	20.9	74.5	118.3	73.2	16.5	1.0	1.54

(1) Years of birth correspond to the midpoint of each age group. For example, in the first row of the table, 1940 is the year of birth for those aged 17, 22, 27, etc.
(2) Fertility rates below and to the right of the stepwise line are projected.

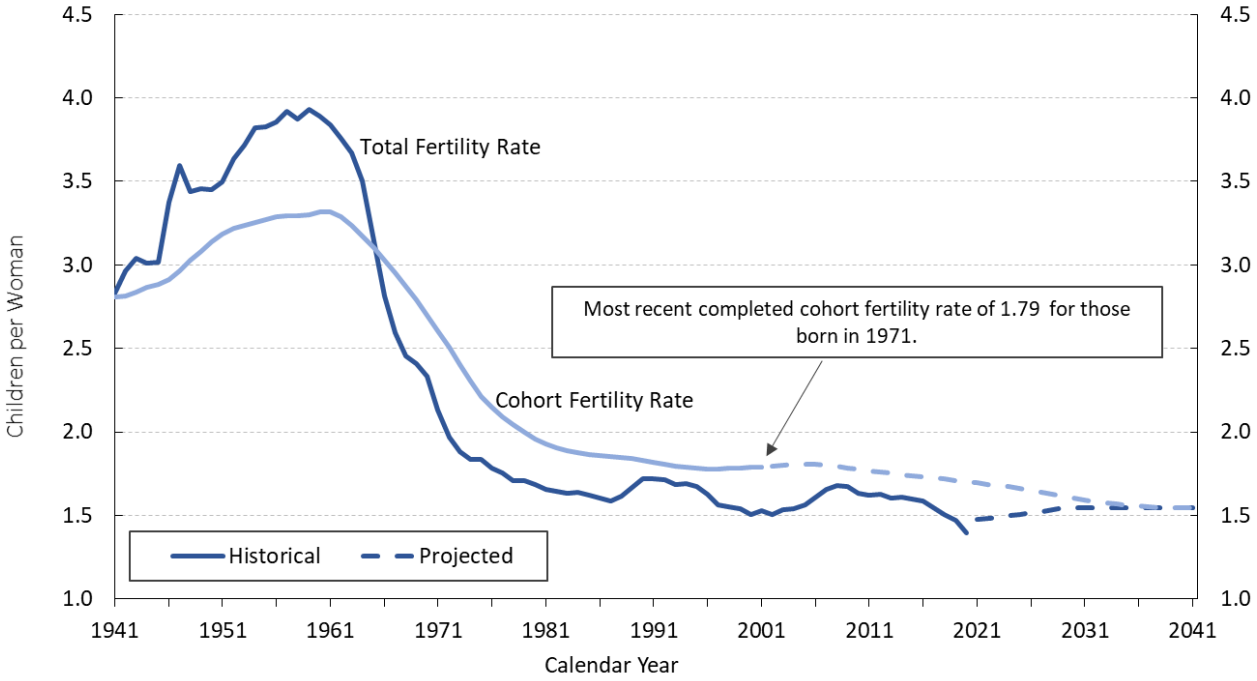
Table 39 below shows the assumed fertility rates of each age group and the resulting assumed total fertility rates by calendar year.

Table 39 Fertility Rates for Canada

Year	Annual Fertility Rates by Age Group (per 1,000 women)							Total
	15-19	20-24	25-29	30-34	35-39	40-44	45-49	
2022	5.7	28.5	78.7	108.0	61.0	13.6	0.9	1.48
2023	5.5	27.4	78.0	109.5	62.8	14.0	0.9	1.49
2024	5.3	26.3	77.4	110.9	64.5	14.4	0.9	1.50
2025	5.2	25.3	76.8	112.4	66.3	14.8	0.9	1.51
2026	5.0	24.2	76.2	113.9	68.0	15.2	0.9	1.52
2027	4.8	23.1	75.6	115.4	69.7	15.6	1.0	1.53
2028	4.7	22.0	75.0	116.8	71.4	16.1	1.0	1.53
2029+	4.5	20.9	74.5	118.3	73.2	16.5	1.0	1.54

Chart 3 shows the historical and projected total and cohort fertility rates for Canada.

Chart 3 Historical and Projected Total and Cohort Fertility Rates for Canada(1)



(1) Cohort fertility rates are based on the age of a woman being 30 in a given calendar year. For instance, the cohort fertility rate for the year 2016 pertains to women born in 1986.

Finally, in accordance with the average experience over the last 10, 20, and 30 years, the assumed ratio of male to female newborns is 1.053, which is the same as for the 30th CPP Actuarial Report.

B.3.3 Mortality

For this report, the mortality rate projections start from the year 2019 mortality rates of Statistics Canada (2019 Canada Life Tables or 2019 CLT). According to Statistics Canada, life expectancies at birth in 2019 without any assumed future improvements in mortality (i.e. reductions in mortality) for males and females in Canada were 80.3 and 84.4 years, respectively, compared to 80.8 and 84.6 years projected under the 30th CPP Actuarial Report. At age 65 in 2019, life expectancies were 19.6 and 22.4 years according to Statistics Canada, compared to 20.0 and 22.6 years projected under the 30th CPP Actuarial Report for males and females, respectively.

Although Statistics Canada's 2020 CLT were published in January 2022, they were not used as the starting point for mortality rates nor for developing mortality improvement rates beyond 2020 given that they reflect significant increases related to COVID-19 deaths. However, 2020 mortality rates and mortality improvement rates reflect Statistics Canada's 2020 CLT. In 2020, life

expectancy at birth (without future mortality improvements) stood at 79.5 for males and 84.0 for females, a decrease from 2019 of 0.7 and 0.4 for males and females respectively.

The average annual mortality improvement rates experienced in Canada over the 15-year period from 2004 to 2019 by age and sex were used as the basis for projecting annual mortality improvement rates from 2021 onward. Improvement rates by age and sex for years 2021 to 2039 were determined by cubic interpolation between:

- the improvement rates of year 2019 and
- the assumed ultimate improvement rates described below in respect of the period 2039 and thereafter.

For the year 2039 and thereafter for Canada, the assumed ultimate annual rates of mortality improvement vary by age only and not by sex or calendar year. The assumed ultimate mortality improvement rates are derived using a combination of backward- and forward-looking approaches. The analysis of the Canadian experience over the period from 1921 to 2019 was combined with an analysis of the possible drivers of future mortality improvements. Mortality improvement rates for males at most ages are currently higher than those for females but are assumed to decrease to the same level as female rates from 2039 onward. The mortality improvement rates for Québec are assumed to be the same as for Canada from 2021 onward.

The ultimate rate for both sexes for ages 0 to 89 is set at 0.8% per year from 2039 onward for Canada and Québec. For ages above 89, the ultimate improvement rate is set to reduce from 0.5% for the age group 90-94 to 0.2% for those aged 95 and older.

Once the projected mortality rates were calculated using the assumed mortality improvement rates, additional factors were then applied to the mortality rates for both Canada and Québec in order to reflect the additional increase in mortality rates due to the COVID-19 pandemic as well as the impact of the opioid crisis.

For 2021, COVID-19 mortality adjustment factors by age group were determined using data on the number of COVID-19 deaths from both Health Canada and Statistics Canada. Due to the uncertainty of the effects of COVID-19 on mortality, these adjustement factors were phased out over the two year period 2022-2023. The pandemic is therefore assumed to have a residual effect on mortality in 2022, followed by an assumed full recovery and reversion to the projected unadjusted mortality rates for years 2023 and onward.

Over the last decade, Canada has been faced with an important increase in accidental drug poisoning deaths and the COVID-19 pandemic has exacerbated the issue. Opioid overdose is a relatively new cause of death, and it is a subset of accidental drug poisoning deaths. It is more prevalent in the 25 to 49 age group and among men. In order to reflect the impact of the pandemic on the opioid-related deaths, opioid-related mortality adjustment factors were derived using data from both Health Canada and Statistics Canada. These mortality adjustment factors apply only to the year 2021 (they are assumed to be 0 for years 2022 and beyond). It is further

assumed that, over the next decade, the opioid crisis in Canada will subside, due to several government initiatives to increase awareness and reduce opioid supply. Projected mortality rates of those age groups affected by the opioid crisis are assumed to revert back to normal levels, leading to a period of high growth in mortality improvement rates.

Table 40 shows the total adjustment factors, i.e. taking into account the assumed increase in COVID-19 deaths and in opioid-related deaths resulting from the pandemic, that were applied to the mortality rates for the period 2021-2022. For reference purpose, the table also shows the actual increases in mortality rates for 2020. Table 41 shows the total adjustments by age, which amount to increases in mortality rates of 6.0% in 2020, 5.5% in 2021, and 2.0% in 2022.

Table 40 Percentage Increase in Mortality Rates
(2020 Historical, 2021-2022 Adjustment Factors)

Age Group	2020	2021	2022
0-19	1.0	1.0	0.0
20-29	12.0	12.0	0.0
30-39	13.0	13.0	1.0
40-49	8.0	8.0	1.0
50-59	5.0	5.0	1.0
60-69	5.0	3.0	1.0
70-79	4.0	4.0	2.0
80+	7.0	6.0	2.0
Total	6.0	5.5	2.0

Table 41 shows historical (2019 and 2020),the resulting initial adjusted (2021-2022), intermediate (2023-2038) and ultimate (2039+) assumed annual mortality improvement rates for Canada. The mortality improvement rates shown for 2023-2038 represents the average rates over this period.

Table 41 Assumed Annual Mortality Improvement Rates for Canada
(percentages)

	Males						Females					
Age	2019	2020	2021	2022	2023-2038 (1)	2039+	2019	2020	2021	2022	2023-2038 (1)	2039+
0	1.2	4.3	(3.1)	2.1	1.0	0.8	1.2	(2.6)	3.9	2.2	1.0	0.8
1-19	2.4	(1.4)	4.9	3.3	1.5	0.8	0.9	7.3	(7.8)	1.8	0.8	0.8
20-39	(0.6)	(21.5)	6.7	10.7	1.3	0.8	(1.0)	(18.3)	3.8	10.5	1.2	0.8
40-64	1.3	(13.4)	9.1	5.7	1.1	0.8	1.4	(5.8)	2.7	5.8	1.1	0.8
65-74	1.8	(3.3)	3.3	3.6	1.3	0.8	1.3	(2.9)	2.0	3.2	1.1	0.8
75-84	1.8	(2.0)	0.6	4.5	1.3	0.8	1.1	(2.9)	0.3	3.9	1.1	0.8
85-89	1.9	(2.9)	0.9	5.5	1.4	0.8	1.6	(3.5)	0.7	5.2	1.2	0.8
90-94	1.4	(4.3)	1.3	5.2	1.1	0.5	1.3	(4.0)	0.7	5.0	1.0	0.5
95+	0.6	(1.6)	(2.8)	4.1	0.5	0.2	0.6	(2.8)	(1.4)	4.2	0.5	0.2

(1) The mortality improvement rates shown for 2023-2038 represent average rates over these periods.

The resulting projected mortality rates in Table 42 indicate a continuous decrease in mortality rates over the long term. For example, the mortality rate at age 65 for males is expected to decrease from about 10 deaths per thousand people in 2022 to 6 deaths per thousand people by 2075. The gap in mortality rates between males and females at most ages is also expected to decrease over the projection period.

Table 42 Mortality Rates for Canada
(annual deaths per 1,000 people)

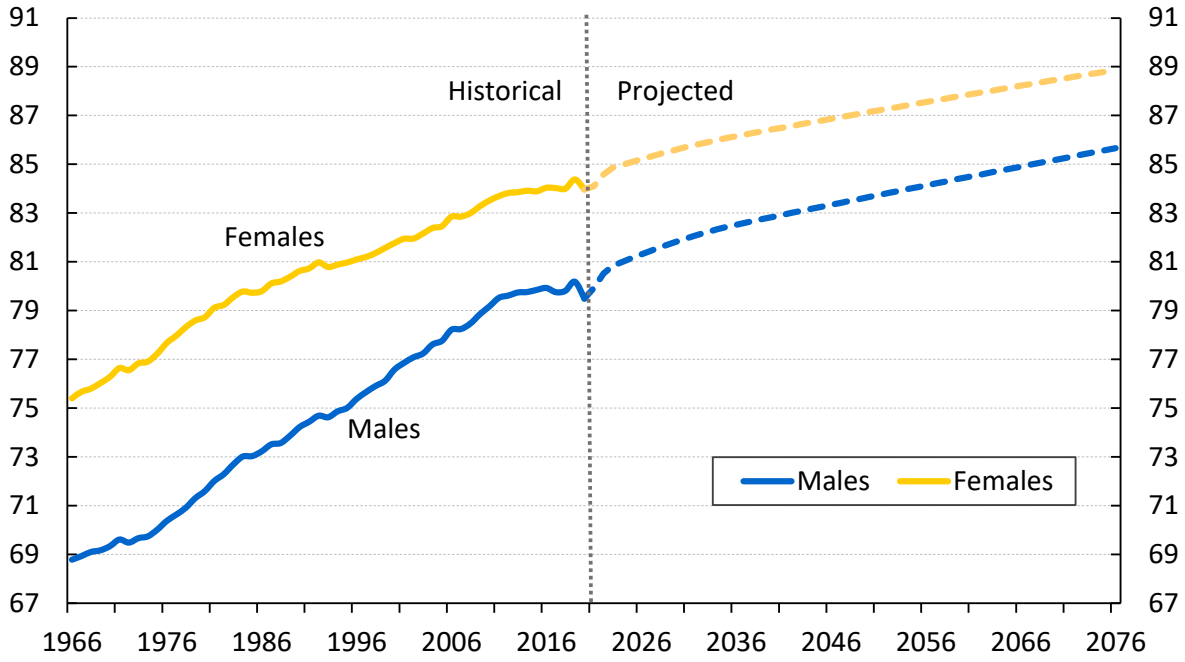
	Males				Females			
Age	2022	2025	2050	2075	2022	2025	2050	2075
0	4.71	4.56	3.67	3.00	3.74	3.61	2.90	2.37
10	0.07	0.07	0.05	0.04	0.07	0.07	0.06	0.05
20	0.60	0.56	0.43	0.35	0.29	0.28	0.22	0.18
30	1.05	1.03	0.77	0.63	0.49	0.49	0.37	0.30
40	1.40	1.36	1.12	0.92	0.79	0.76	0.62	0.51
50	2.77	2.63	2.09	1.71	1.76	1.68	1.34	1.10
60	6.54	6.15	4.80	3.93	4.15	3.92	3.09	2.53
65	10.43	9.84	7.75	6.34	6.68	6.36	5.06	4.14
70	16.96	15.81	12.40	10.14	11.12	10.49	8.38	6.86
75	27.85	26.03	20.49	16.76	18.86	17.89	14.43	11.80
80	46.45	43.46	34.27	28.04	32.71	31.07	25.11	20.55
85	77.88	72.27	56.24	46.01	57.47	54.06	43.01	35.19
90	135.60	127.09	104.10	89.11	104.95	98.79	81.50	69.76
100	336.40	323.16	295.32	275.48	292.54	280.40	255.29	238.14

Chart 4 and Chart 5 show the historical and projected life expectancies at birth and age 65, respectively since the Plan's inception in 1966, based on each given year's mortality rates (i.e. without future mortality improvements). Table 43 shows the projected Canadian life expectancies at various ages for the specified calendar years, also based on each given year's mortality rates (without future improvements). Table 44 is similar to Table 43, the only difference being that it takes into account the assumed mortality improvements after the specified calendar years (with future improvements).

Given the continuing trend in increased longevity, Table 44 is considered to be more realistic than Table 43, especially for the older ages. At the same time, the extended length of the projection period increases the uncertainty of the results presented in Table 44 for younger ages.

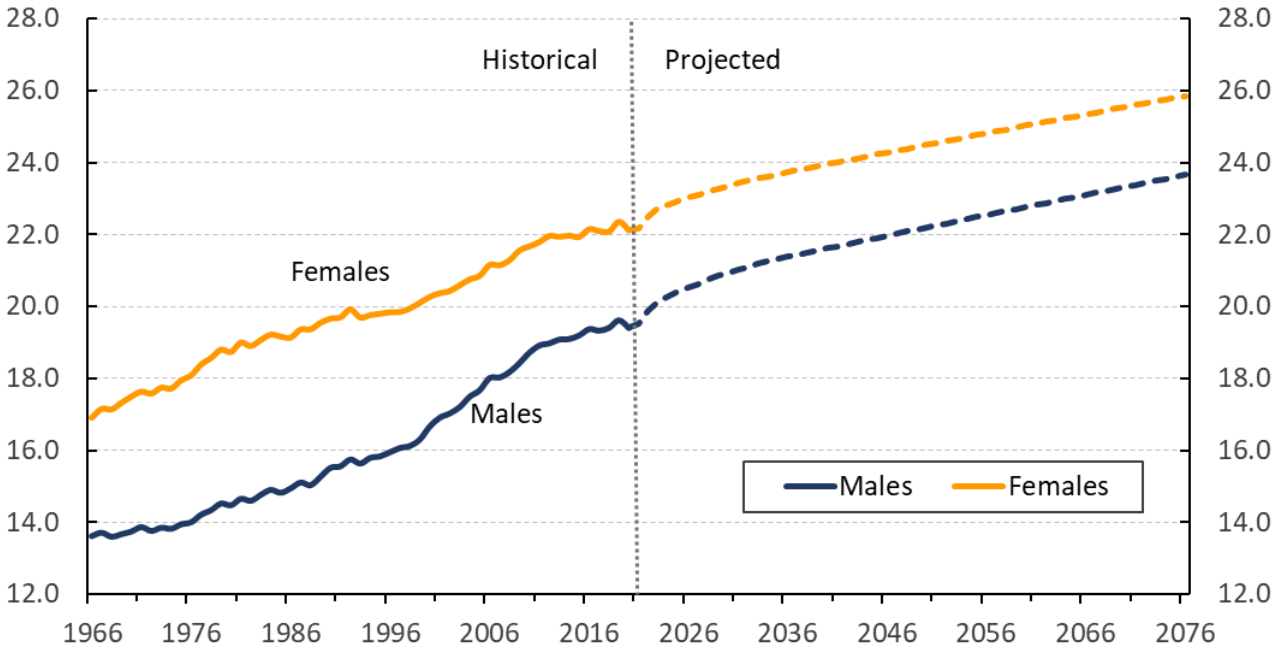
From 2022 to 2075, Canadian life expectancy at age 65 (with assumed future mortality improvements) is projected to grow from 21.3 to 24.5 years for males and from 23.8 to 26.7 years for females, as shown in Table 44.

Chart 4 Life Expectancies at Birth for Canada, without mortality improvements after the year shown(1)



(1) These are calendar year life expectancies based on the mortality rates of the given attained year.

Chart 5 Life Expectancies at Age 65 for Canada, without mortality improvements after the year shown(1)



(1) These are calendar year life expectancies based on the mortality rates of the given attained year.

Table 43 Life Expectancies for Canada, without mortality improvements after the year shown (1)

	Males				Females			
Age	2022	2025	2050	2075	2022	2025	2050	2075
0	80.5	81.2	83.7	85.6	84.6	85.1	87.1	88.8
10	71.0	71.6	74.0	75.9	75.0	75.5	77.5	79.1
20	61.1	61.7	64.1	66.0	65.1	65.6	67.5	69.1
30	51.6	52.2	54.5	56.3	55.3	55.8	57.7	59.3
40	42.2	42.8	44.9	46.7	45.6	46.1	47.9	49.5
50	32.9	33.5	35.5	37.2	36.1	36.6	38.3	39.8
60	24.0	24.6	26.5	28.0	26.9	27.3	29.0	30.4
65	19.9	20.4	22.2	23.6	22.5	22.9	24.5	25.8
70	16.0	16.5	18.1	19.4	18.3	18.7	20.2	21.4
75	12.5	12.9	14.4	15.5	14.5	14.8	16.1	17.2
80	9.4	9.8	11.0	11.9	11.0	11.3	12.4	13.4
85	6.8	7.1	8.0	8.7	8.0	8.2	9.1	9.9
90	4.6	4.9	5.5	5.9	5.5	5.7	6.3	6.8
100	2.2	2.3	2.5	2.6	2.5	2.6	2.8	3.0

(1) These are calendar year life expectancies based on the mortality rates of the given attained year.

Table 44 Life Expectancies for Canada, with mortality improvements after the year shown (1)

	Males				Females			
Age	2022	2025	2050	2075	2022	2025	2050	2075
0	86.7	86.9	88.7	90.4	90.0	90.2	91.7	93.1
10	76.4	76.6	78.4	80.1	79.8	80.0	81.5	82.9
20	65.8	66.0	67.9	69.5	69.2	69.4	71.0	72.4
30	55.5	55.7	57.5	59.2	58.8	59.0	60.6	62.0
40	45.3	45.5	47.3	49.0	48.5	48.7	50.2	51.7
50	35.3	35.6	37.3	38.9	38.3	38.5	40.0	41.4
60	25.8	26.0	27.6	29.1	28.5	28.7	30.1	31.5
65	21.3	21.5	23.1	24.5	23.8	24.0	25.4	26.7
70	17.2	17.4	18.8	20.1	19.4	19.6	20.8	22.1
75	13.4	13.6	14.8	16.0	15.3	15.4	16.6	17.7
80	10.0	10.2	11.2	12.2	11.6	11.7	12.7	13.7
85	7.1	7.3	8.1	8.9	8.3	8.5	9.3	10.0
90	4.8	5.0	5.5	6.0	5.7	5.8	6.4	6.8
100	2.2	2.3	2.5	2.6	2.6	2.6	2.8	3.0

(1) These are cohort life expectancies that take into account assumed future improvements in mortality of the general population and therefore differ from calendar year life expectancies, which are based on the mortality rates of the given attained year.

B.3.4 Net Migration

The net migration rate refers to the net effect relative to the population of the number of immigrants less the number of total (net) emigrants, plus the net increase in the number of non-permanent residents.

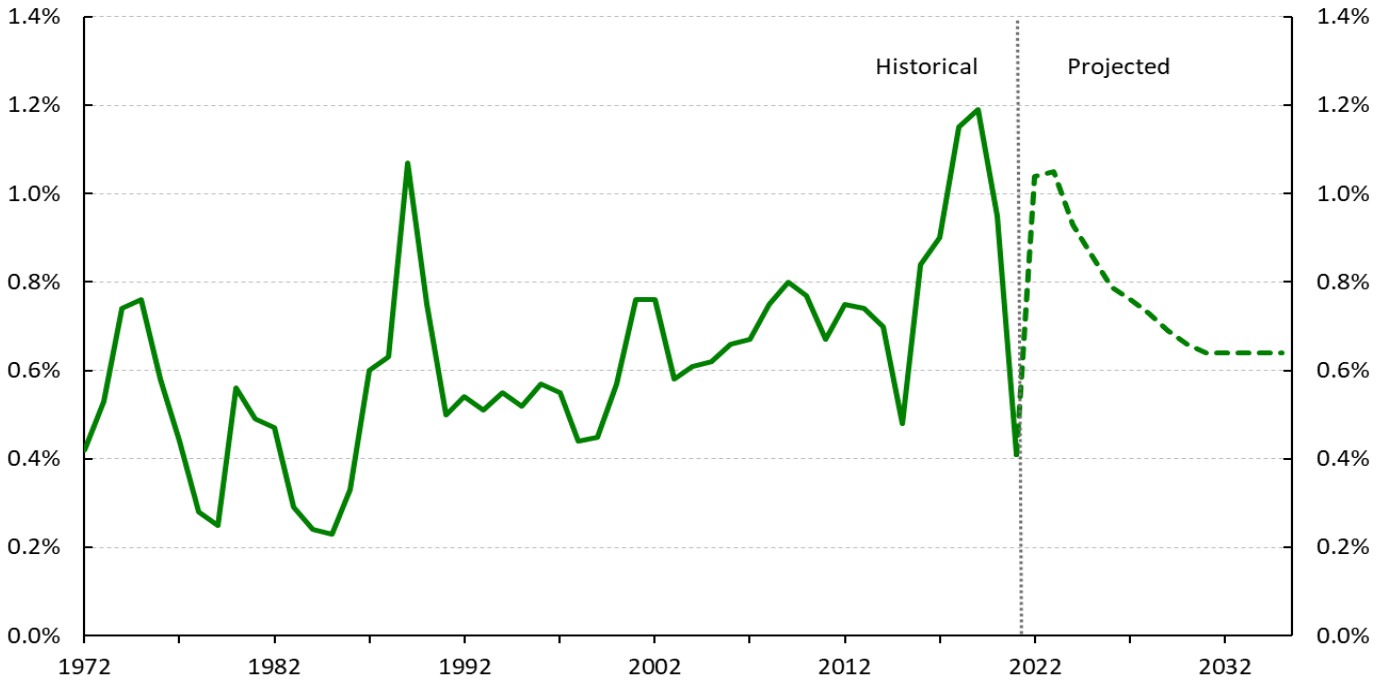
Immigration and emigration are generally recognized as being volatile parameters of future population growth since they are subject to a variety of demographic, economic, social, and political factors. During the period from 1972 to 2021, annual immigration to Canada varied between 84,000 and 323,000, annual emigration from Canada fluctuated between 35,000 and 95,000, and the annual number of returning Canadians fluctuated between 8,000 and 55,000. The 2020 and 2021 data are especially volatile compared to historical experience due to the COVID-19 pandemic, and they were thus excluded from our analysis in setting the net migration rate assumption. The net migration rate for year ending June 2021 stands at 0.41% of the population, well below pre-pandemic levels. In the 2020 Annual Report to Parliament, the Government of Canada released details on its Immigration Levels Plan for 2021-2023. The target numbers of new permanent residents are set at 401,000 in 2021, 411,000 in 2023 and 421,000 in 2023.

Over the same period, the annual net increase in the number of non-permanent residents fluctuated between -71,000 and 169,000. In the most recent years, the number of international students and temporary workers with permits under the International Mobility Program have grown substantially. They represent the two largest groups of non-permanent residents, accounting for more than half of non-permanent residents.

The number of temporary workers is assumed to stabilize in future as the aging of the labour force and related labour shortages subside. It is also expected that the number of foreign students will stabilize over the next five years. Therefore, the annual net increase in the number of non-permanent residents is projected to fall gradually to reach zero in 2026 and to remain at that level thereafter.

The actual 2021 net migration rate of 0.41% is assumed to increase to 1.04% of the Canadian population in 2022, 1.05% in 2023, and 0.93% in 2024. From 2025 to 2031, the net migration rate is assumed to decrease gradually to reach an ultimate level of 0.64%, which corresponds to the average rate experienced over the ten-year period 2010-2019, excluding the net increase in non-permanent residents during that period. The assumed short-term net migration rate is higher than the ultimate rate of 0.64% due to the federal government's short-term targets and the assumed gradual decrease to zero for the net increase in the number of non-permanent residents from 2022 through 2026. Chart 6 shows the net migration experience since 1972 and the projected rates.

Chart 6 Net Migration Rate (Canada)



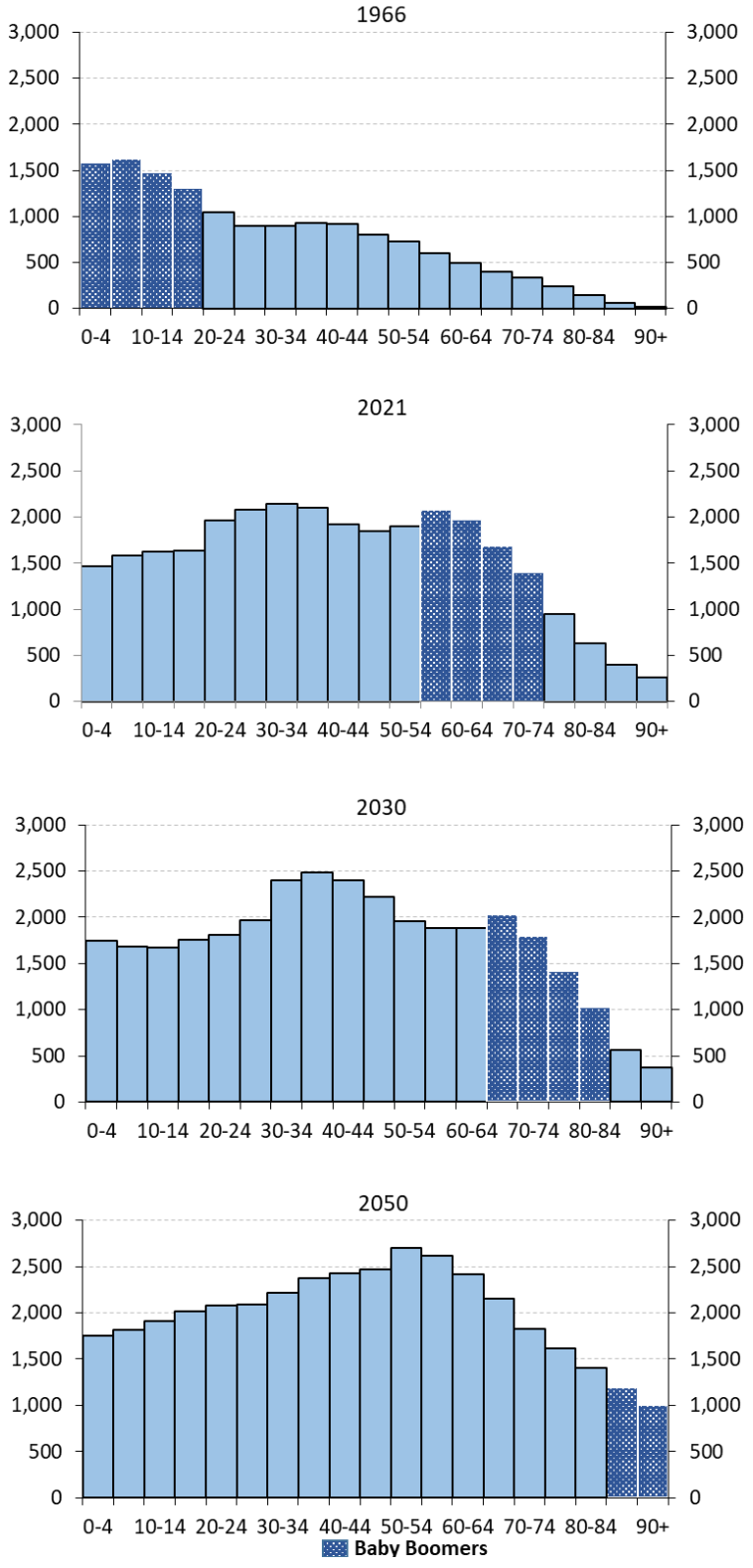
To project Québec's population, the same migration components of immigration, total emigration and net increase in non-permanent residents are considered. An additional component consisting of the net interprovincial migration for Québec is also included. It is assumed that the 2021 net migration rate of 0.16% for Québec will increase gradually to reach an ultimate level of 0.43% in 2031, assuming a decline in the net increase of non-permanent residents to zero by 2026. The ultimate net migration rate for Québec of 0.43% corresponds to the average experience over the last 10 years ending in 2019, excluding the net increase in non-permanent residents.

For both Canada and Québec, the distributions of immigrants, total emigrants, and non-permanent residents by age and sex used for the demographic projections were derived from Statistics Canada data averaged over the period 2010 to 2019.

B.3.5 Projected Population and its Characteristics

The historical and projected evolution of the Canada less Québec population age distribution since the inception of the Plan is shown in Chart 7. One can easily observe that the triangular shape of the 1960s has become more rectangular over time. This is projected to continue and indicates an aging population. The chart also reveals that the number of people aged 85 and over is expected to increase dramatically over the coming decades.

Chart 7 Age Distribution of the Population of Canada less Québec
(thousands)



The population of Canada as at 1 July 2021 is 38.2 million, while the population of Canada less Québec is 29.6 million. Table 45 and Table 46 present the projected populations of Canada and Canada less Québec as at 1 July for selected age groups and years, while Chart 8 shows the evolution of the population of Canada less Québec, split by ages groups 0 to 19, 20 to 64, and 65 and above, from 1975 to 2100. Table 47 shows the variations in the relative proportions of various age groups for Canada less Québec throughout the projection period.

The proportion of people aged 65 and over for Canada less Québec is expected to be 18.4% of the total population in 2022 and to increase significantly thereafter to 28.4% by 2100. The number of people aged 65 and older as a proportion of the number of people aged 20 to 64 also increases significantly over the same period, from a projected 30.4% in 2022 to 53.7% by 2100. This proportion affects the ratio of benefits to contributions under the CPP.

Table 45 Population of Canada by Age
(thousands)

Year	0-17	18-69	70+	0-19	20-64	65+	Total
2022	7,297	26,401	5,037	8,115	23,273	7,347	38,735
2023	7,391	26,616	5,240	8,226	23,400	7,621	39,247
2024	7,469	26,791	5,456	8,319	23,504	7,893	39,716
2025	7,531	26,947	5,682	8,399	23,591	8,169	40,160
2026	7,578	27,093	5,908	8,467	23,667	8,445	40,579
2027	7,626	27,222	6,139	8,528	23,748	8,711	40,987
2028	7,674	27,334	6,374	8,580	23,821	8,981	41,382
2029	7,728	27,428	6,606	8,631	23,892	9,239	41,762
2030	7,775	27,508	6,841	8,678	23,973	9,474	42,124
2035	7,976	27,870	7,913	8,886	24,608	10,264	43,758
2040	8,204	28,505	8,465	9,100	25,289	10,784	45,173
2045	8,263	29,383	8,766	9,246	25,947	11,219	46,412
2050	8,268	30,240	9,035	9,271	26,516	11,755	47,543
2055	8,343	30,837	9,460	9,335	26,911	12,394	48,640
2060	8,505	31,243	10,043	9,498	27,088	13,204	49,790
2065	8,713	31,486	10,818	9,720	27,279	14,018	51,017
2070	8,923	31,773	11,566	9,947	27,781	14,534	52,262
2080	9,227	33,063	12,295	10,314	28,877	15,395	54,586
2090	9,509	34,487	12,777	10,626	30,146	16,000	56,773
2100	9,917	35,754	13,541	11,068	31,153	16,991	59,212

Table 46 Population of Canada less Québec by Age
(thousands)

Year	0-17	18-69	70+	0-19	20-64	65+	Total
2022	5,684	20,605	3,785	6,335	18,203	5,536	30,074
2023	5,763	20,814	3,942	6,429	18,344	5,746	30,519
2024	5,835	20,994	4,108	6,510	18,471	5,957	30,937
2025	5,895	21,156	4,283	6,581	18,579	6,173	31,333
2026	5,944	21,307	4,458	6,644	18,674	6,390	31,708
2027	5,996	21,442	4,636	6,705	18,768	6,600	32,073
2028	6,049	21,560	4,817	6,759	18,851	6,815	32,426
2029	6,107	21,662	4,996	6,814	18,929	7,022	32,764
2030	6,159	21,748	5,180	6,866	19,012	7,209	33,087
2035	6,387	22,135	6,036	7,105	19,580	7,873	34,557
2040	6,619	22,722	6,513	7,328	20,191	8,335	35,854
2045	6,679	23,529	6,800	7,474	20,836	8,699	37,008
2050	6,676	24,375	7,027	7,494	21,402	9,182	38,078
2055	6,741	24,974	7,413	7,548	21,797	9,783	39,128
2060	6,901	25,373	7,956	7,706	22,020	10,504	40,229
2065	7,116	25,647	8,635	7,932	22,211	11,255	41,398
2070	7,332	25,930	9,320	8,167	22,665	11,750	42,581
2080	7,632	27,165	10,001	8,531	23,763	12,505	44,799
2090	7,900	28,591	10,403	8,829	25,021	13,045	46,894
2100	8,307	29,828	11,094	9,267	25,996	13,966	49,228

Chart 8 Population of Canada less Québec
(millions)

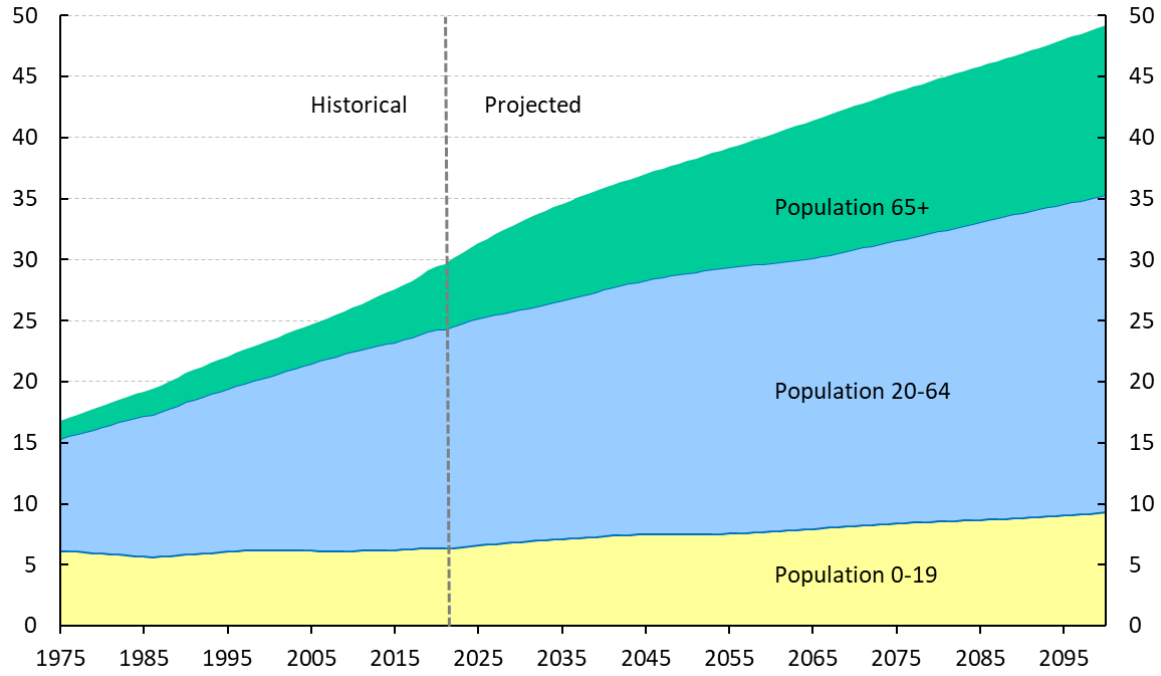


Table 47 Analysis of Population of Canada less Québec by Age

Year	% of Total Population (1)			% of Total Population (1)			Age 65 + as % of Age
	0-17	18-69	70+	0-19	20-64	65+	20-64
2022	18.9	68.5	12.6	21.1	60.5	18.4	30.4
2023	18.9	68.2	12.9	21.1	60.1	18.8	31.3
2024	18.9	67.9	13.3	21.0	59.7	19.3	32.2
2025	18.8	67.5	13.7	21.0	59.3	19.7	33.2
2026	18.7	67.2	14.1	21.0	58.9	20.2	34.2
2027	18.7	66.9	14.5	20.9	58.5	20.6	35.2
2028	18.7	66.5	14.9	20.8	58.1	21.0	36.2
2029	18.6	66.1	15.2	20.8	57.8	21.4	37.1
2030	18.6	65.7	15.7	20.8	57.5	21.8	37.9
2035	18.5	64.1	17.5	20.6	56.7	22.8	40.2
2040	18.5	63.4	18.2	20.4	56.3	23.2	41.3
2045	18.0	63.6	18.4	20.2	56.3	23.5	41.7
2050	17.5	64.0	18.5	19.7	56.2	24.1	42.9
2055	17.2	63.8	18.9	19.3	55.7	25.0	44.9
2060	17.2	63.1	19.8	19.2	54.7	26.1	47.7
2065	17.2	62.0	20.9	19.2	53.7	27.2	50.7
2070	17.2	60.9	21.9	19.2	53.2	27.6	51.8
2080	17.0	60.6	22.3	19.0	53.0	27.9	52.6
2090	16.8	61.0	22.2	18.8	53.4	27.8	52.1
2100	16.9	60.6	22.5	18.8	52.8	28.4	53.7

(1) Sum of components may not equal to 100% due to rounding

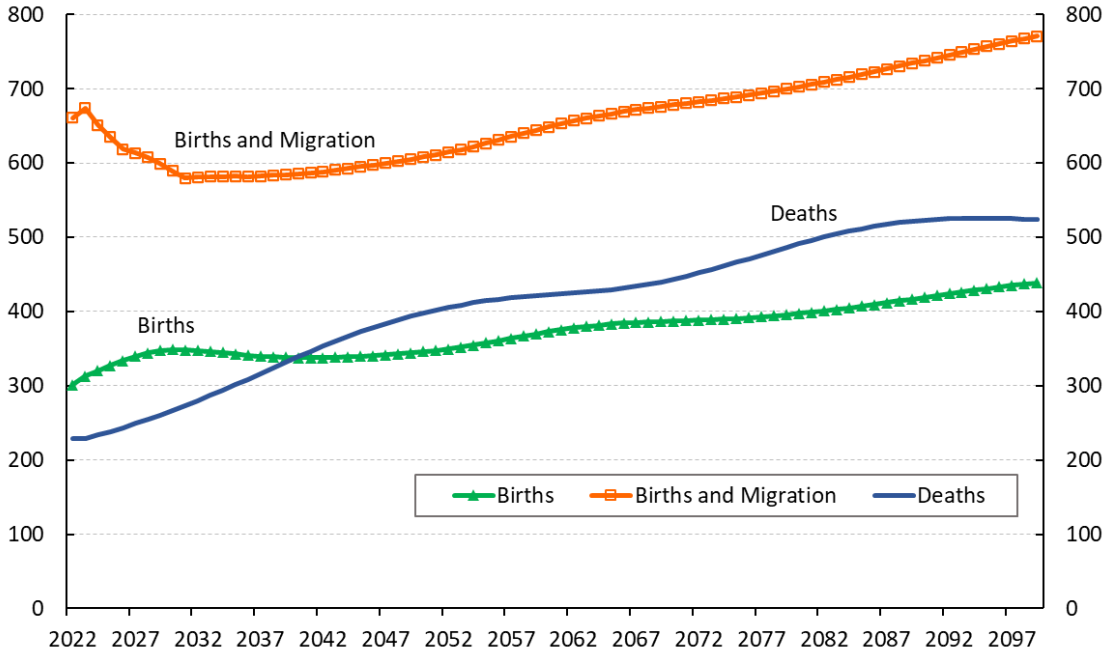
Table 48 shows the projected components of population growth, which is defined as the projected number of births plus net migrants less the projected number of deaths, for Canada less Québec from 2022 to 2100, and Chart 9 presents these figures graphically. For Canada less Québec, the number of births is projected to exceed deaths until 2039. Thereafter, all population growth is expected to come from migration.

In 2022, the population of Canada less Québec is projected to grow by about 1.5%. The annual growth is projected to slow to about 1.0% by 2030, 0.6% by 2045 and around 0.5% by 2075. The population of Canada less Québec is expected to reach 49.2 million by 2100.

Table 48 Births, Net Migrants, and Deaths for Canada less Québec
(thousands)

Year	Population 1st July	Births	Net Migrants	Deaths	Change in Population	Annual Percentage Change		
						20-64	65+	Total
						(%)	(%)	(%)
2022	30,074	301	359	228	432	1.1	3.8	1.5
2023	30,519	313	361	229	445	0.8	3.8	1.5
2024	30,937	320	330	233	417	0.7	3.7	1.4
2025	31,333	327	308	238	397	0.6	3.6	1.3
2026	31,708	334	285	244	375	0.5	3.5	1.2
2027	32,073	339	274	249	365	0.5	3.3	1.1
2028	32,426	344	263	255	353	0.4	3.3	1.1
2029	32,764	348	252	261	339	0.4	3.0	1.0
2030	33,087	349	241	267	323	0.4	2.7	1.0
2035	34,557	343	239	301	281	0.6	1.6	0.8
2040	35,854	338	248	339	246	0.6	1.0	0.7
2045	37,008	340	255	373	222	0.6	0.9	0.6
2050	38,078	346	262	398	210	0.5	1.2	0.6
2055	39,128	358	269	414	212	0.3	1.4	0.5
2060	40,229	373	276	422	226	0.1	1.5	0.6
2065	41,398	383	283	429	237	0.2	1.4	0.6
2070	42,581	387	291	444	235	0.5	0.7	0.6
2080	44,799	397	305	491	211	0.5	0.5	0.5
2090	46,894	419	319	523	215	0.4	0.6	0.5
2100	49,228	441	334	524	250	0.4	0.7	0.5

Chart 9 Projected Components of Population Growth for Canada less Québec (thousands)



B.4 Economic Assumptions

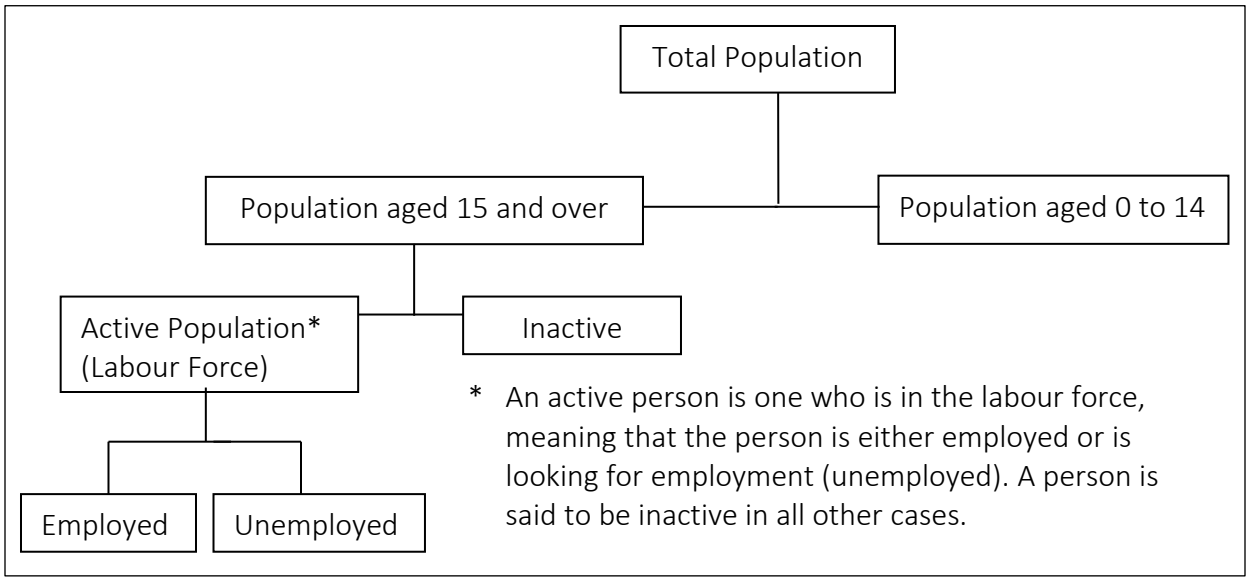
The list of assumptions required to project the various economic indices, as well as CPP contributions and expenditures is quite extensive. The following sections cover the more important assumptions.

The economic outlook rests on the assumed evolution of the labour market, that is, labour force participation, employment, unemployment, inflation, and the increase in average employment earnings. Rates of return on CPP assets reflect the financial markets and are part of the investment assumptions described in section B.6 of this appendix. All of these factors must be considered together and form part of an overall economic perspective.

B.4.1 Labour Market

Chart 10 shows the main components of the labour market that are used to determine the number of earners and contributors by age, sex, and calendar year.

Chart 10 Components of the Labour Market



The number of earners is based on the number of employed and is defined as the number of persons who had earnings during a given calendar year. The earners become contributors if they have earnings during the year above the Year's Basic Exemption (YBE) and they are between the ages of 18 and 70.

The proportion of earners and contributors assumptions (described in this section and section B.5.1) rely on the projected active population of this report. The projected effect of working beneficiaries is reflected in all these assumptions.

B.4.1.1 Active Population (Canada)

Table 49 to Table 51 provide projections of the active and employed populations and associated labour force participation, employment, and unemployment rates for Canada.

Table 49 Active and Employed Populations (Canada, ages 15 and over)
(thousands)

	Population [1]			Active Population			Employed		
Year	Males	Females	Total	Males	Females	Total	Males	Females	Total
2022	15,661	16,048	31,709	10,908	9,741	20,649	10,211	9,199	19,410
2023	15,879	16,274	32,153	11,025	9,860	20,885	10,356	9,339	19,695
2024	16,079	16,482	32,561	11,129	9,967	21,096	10,443	9,431	19,873
2025	16,265	16,679	32,944	11,225	10,069	21,294	10,521	9,517	20,038
2026	16,435	16,862	33,297	11,313	10,166	21,479	10,592	9,598	20,190
2027	16,601	17,039	33,640	11,400	10,264	21,663	10,661	9,681	20,342
2028	16,761	17,210	33,971	11,481	10,358	21,839	10,738	9,770	20,507
2029	16,913	17,374	34,287	11,560	10,449	22,009	10,812	9,855	20,667
2030	17,059	17,529	34,588	11,636	10,538	22,174	10,883	9,938	20,821
2035	17,695	18,219	35,914	12,031	11,002	23,033	11,252	10,376	21,628
2040	18,287	18,860	37,147	12,356	11,291	23,647	11,556	10,649	22,205
2045	18,873	19,484	38,358	12,681	11,575	24,256	11,859	10,918	22,776
2050	19,401	20,046	39,447	12,952	11,815	24,767	12,111	11,145	23,256
2055	19,875	20,539	40,414	13,139	11,993	25,132	12,286	11,313	23,599
2060	20,348	21,019	41,367	13,286	12,142	25,428	12,424	11,453	23,877
2065	20,836	21,516	42,352	13,451	12,307	25,758	12,579	11,608	24,187
2070	21,333	22,031	43,364	13,681	12,516	26,196	12,794	11,804	24,599
2080	22,316	23,077	45,393	14,263	13,027	27,290	13,338	12,286	25,625
2090	23,224	24,047	47,271	14,849	13,552	28,401	13,886	12,783	26,669
2100	24,227	25,052	49,279	15,402	14,039	29,440	14,404	13,240	27,644

(1) Adjusted to the basis used by Statistics Canada in its Labour Force Survey.

Table 50 Labour Force Participation, Employment, and Unemployment Rates (Canada, ages 15 and over)
(percentages)

	Labour Force Participation Rate			Employment Rate			Unemployment Rate		
Year	Males	Females	Total	Males	Females	Total	Males	Females	Total
2022	69.7	60.7	65.1	65.2	57.3	61.2	6.4	5.6	6.0
2023	69.4	60.6	65.0	65.2	57.4	61.3	6.1	5.3	5.7
2024	69.2	60.5	64.8	64.9	57.2	61.0	6.2	5.4	5.8
2025	69.0	60.4	64.6	64.7	57.1	60.8	6.3	5.5	5.9
2026	68.8	60.3	64.5	64.4	56.9	60.6	6.4	5.6	6.0
2027	68.7	60.2	64.4	64.2	56.8	60.5	6.5	5.7	6.1
2028	68.5	60.2	64.3	64.1	56.8	60.4	6.5	5.7	6.1
2029	68.4	60.1	64.2	63.9	56.7	60.3	6.5	5.7	6.1
2030	68.2	60.1	64.1	63.8	56.7	60.2	6.5	5.7	6.1
2035	68.0	60.4	64.1	63.6	57.0	60.2	6.5	5.7	6.1
2040	67.6	59.9	63.7	63.2	56.5	59.8	6.5	5.7	6.1
2045	67.2	59.4	63.2	62.8	56.0	59.4	6.5	5.7	6.1
2050	66.8	58.9	62.8	62.4	55.6	59.0	6.5	5.7	6.1
2055	66.1	58.4	62.2	61.8	55.1	58.4	6.5	5.7	6.1
2060	65.3	57.8	61.5	61.1	54.5	57.7	6.5	5.7	6.1
2065	64.6	57.2	60.8	60.4	54.0	57.1	6.5	5.7	6.1
2070	64.1	56.8	60.4	60.0	53.6	56.7	6.5	5.7	6.1
2080	63.9	56.4	60.1	59.8	53.2	56.5	6.5	5.7	6.1
2090	63.9	56.4	60.1	59.8	53.2	56.4	6.5	5.7	6.1
2100	63.6	56.0	59.7	59.5	52.9	56.1	6.5	5.7	6.1

Table 51 Labour Force Participation Rates (Canada)
(percentages)

	Males				Females			
Age Group	2022	2025	2035	2050	2022	2025	2035	2050
15-19	48.7	49.4	52.0	52.0	51.2	51.8	54.0	54.0
20-24	77.1	77.7	80.0	80.0	75.2	75.9	78.0	78.0
25-29	88.8	89.6	92.0	92.0	84.4	85.5	89.0	89.0
30-34	92.4	92.8	94.0	94.0	84.1	84.8	87.0	87.0
35-39	93.4	93.6	94.0	94.0	83.3	84.4	88.0	88.0
40-44	92.8	93.1	94.0	94.0	85.0	85.9	89.0	89.0
45-49	92.3	92.5	93.0	93.0	85.0	86.0	89.0	89.0
50-54	90.0	90.3	91.0	91.0	83.3	84.2	87.0	87.0
55-59	82.4	82.7	84.0	84.0	72.3	73.1	76.0	76.0
60-64	64.8	65.1	66.0	66.0	51.3	51.7	53.0	53.0
65-69	34.0	34.4	36.0	36.0	21.7	22.3	24.0	24.0
70 and Over	11.4	11.7	13.0	13.0	4.5	4.7	5.5	5.5
55-69	61.7	60.9	62.6	63.7	49.4	48.8	51.5	52.3
55 and Over	43.0	41.2	37.9	39.7	31.4	30.0	27.7	28.7
18-69	80.8	81.1	83.2	82.2	72.6	73.2	76.8	75.9
15 and Over	69.7	69.0	68.0	66.8	60.7	60.4	60.4	58.9

Several trends are taken into account in developing the above assumptions. Some of these trends are discussed below.

Male-Female Labour Force Participation Gap

The overall labour force participation rates in Canada (the active population expressed as a proportion of the population aged 15 and over) from 1976 to 2021 clearly show a narrowing of the gap between male and female rates. Although the increase in participation rates of females aged 18 to 69 has slowed down since the mid-2000s, the increase was significant over the previous decades. It has also been observed that participation rates for those aged 55 and older have increased significantly over the last decade for both men and women.

In 1976, overall male labour force participation (ages 15 and over) was about 78% compared to only 46% for females, which represents a gap of 32%. This gap has narrowed to 9.0% in 2021 (participation rates of 69.6% for males, 60.6% for females), slightly higher than its pre-pandemic level of 8.8% in 2018 and 2019. It is assumed that females will continue to narrow the gap in participation rates but at a slower pace, with the gap gradually reducing to about 7.6% by 2035 (68.0% for males vs. 60.4% for females). A part of this reduction comes from the expected impact on the female labour force due to the Early Learning and Child Care Plan initiative announced by the federal Government in 2021. This is in line with the observed historical impact on the province of Quebec's female labour force following the implementation of their childcare system in 1997.

Population Aging

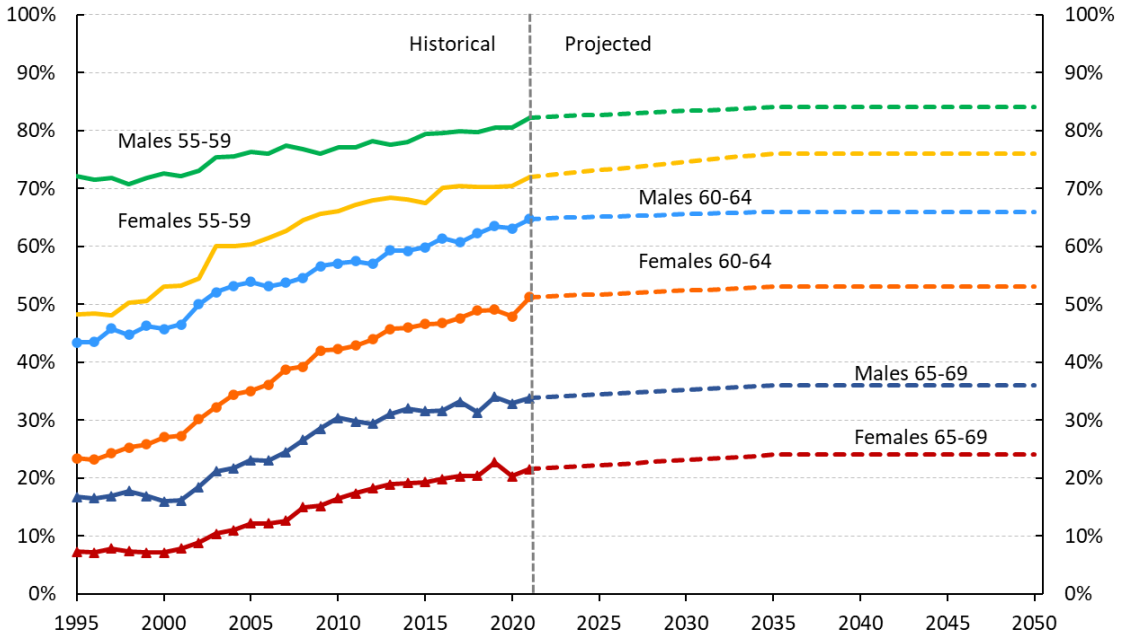
Given that participation rates start to decline mostly after age 50, the aging of the population will exert downward pressure on the overall labour force participation rate in Canada. If current participation rates by age and sex were to apply throughout the projection period, the effect of population aging alone would cause the overall participation rate from Table 50 to fall from 65.1% in 2021 to 60.3% in 2050, instead of 62.8% as projected under the best-estimate assumptions.

An assumption underlying the future overall participation rate is an increase in participation rates for age groups 55 and over as a result of an expected continued trend toward longer working lives. Continued trends in making work more accessible to older workers (such as wage subsidies for hiring older workers and flexible work arrangements), the removal of the work cessation test to receive the CPP retirement pension prior to age 65, the projected continued increases in life expectancy, and possible insufficient retirement savings are assumed to encourage older workers to delay their retirement and exit the labour force at a later age.

The participation rates for those aged 55 to 59 are assumed to increase from 82.4% to 84.0% for males and from 72.3% to 76.0% for females over the period 2021 to 2050. Over the same period, the participation rates for those aged 60 to 64 are assumed to increase from 64.8% to 66.0% and from 51.3% to 53.0% for males and females, respectively, and the participation rates for those aged 65 to 69 are assumed to increase from 34.0% to 36.0% and from 21.7% to 24.0% for males and females, respectively.

Chart 11 shows the historical and projected participation rates for the three age groups 55 to 59, 60 to 64, and 65 to 69.

Chart 11 Labour Force Participation Rates (Canada)



Labour Shortages

Despite the assumed future increase in participation rates of women and older workers, as well as an assumed continued reliance on skilled immigrant workers, it is still expected that there will be continued labour shortages in the future as the working-age population expands at a slower pace and as baby boomers continue to retire and exit the labour force. The participation rates for all age groups are expected to increase due to the attractive employment opportunities resulting from labour shortages.

Based on the foregoing, the participation rates of both men and women are expected to increase over the projection period from their 2021 levels for all age groups. Nonetheless, these increases in participation rates are not sufficient to offset the decrease in the overall participation rate (ages 15 and over) due to the demographic shift from population aging.

For the purpose of projecting the participation rates, the projection period has been divided into two periods: 2022 to 2035 and from 2035 onward. From 2022 to 2035, the projected participation rates are based on the expected impact of the above-mentioned factors through time for each age group and sex. From 2035 onward, the participation rates are held constant. This long-term assumption combined with a slow growth in the working-age population, results in a rate of growth of approximately 0.4% for the Canadian active population (that is, the labour force) after 2035.

B.4.1.2 Employment (Canada)

In Canada, the annual job creation rate (i.e. the change in the number of persons employed) has been on average about 1.5% since 1976. However, this rate has varied over the years. It is assumed that the job creation rate will be 2.9% in 2022 and 1.5% in 2023, corresponding to an assumed decrease in unemployment rate from 7.5% in 2021 (actual) to 6.0% in 2022 and 5.7% in 2023. These rates are based on the recent experience and various economic forecasts, and reflect the expected labour market recovery from the COVID-19 pandemic. It is further assumed that over the 2024-2027 period, the job creation rate will be slightly lower than the labour force growth rate, so that the unemployment rate will slowly increase from 5.7% in 2023 to 6.1% by 2027.

Over the long term, the job creation rate is projected to be the same as the labour force growth of 0.4%. This reflects the ultimate assumption for the unemployment rate of 6.1% for years 2027 and thereafter.

Table 52 shows the projected number of employed persons and the employment rate for those aged 18 to 69, in Canada.

Table 52 Employment of Population (Canada, ages 18 to 69)

	Population		Employed		Employment Rate	
Year	Males	Females	Males	Females	Males	Females
	(thousands)		(thousands)		(%)	
2022	13,241	13,161	9,768	8,874	73.8	67.4
2023	13,347	13,269	9,890	8,998	74.1	67.8
2024	13,433	13,358	9,957	9,077	74.1	68.0
2025	13,508	13,439	10,017	9,152	74.2	68.1
2026	13,578	13,516	10,071	9,224	74.2	68.2
2027	13,640	13,583	10,123	9,298	74.2	68.5
2028	13,692	13,642	10,182	9,378	74.4	68.7
2029	13,737	13,691	10,239	9,454	74.5	69.1
2030	13,776	13,733	10,293	9,528	74.7	69.4
2035	13,950	13,919	10,579	9,923	75.8	71.3
2040	14,264	14,241	10,843	10,174	76.0	71.4
2045	14,711	14,672	11,115	10,416	75.6	71.0
2050	15,144	15,096	11,353	10,633	75.0	70.4
2055	15,433	15,404	11,506	10,793	74.6	70.1
2060	15,616	15,627	11,605	10,918	74.3	69.9
2065	15,708	15,778	11,708	11,051	74.5	70.0
2070	15,828	15,945	11,872	11,225	75.0	70.4
2080	16,491	16,572	12,363	11,670	75.0	70.4
2090	17,211	17,276	12,879	12,144	74.8	70.3
2100	17,841	17,913	13,342	12,574	74.8	70.2

B.4.1.3 Labour Market (Canada less Québec)

Given that the CPP covers labour force in all provinces except Québec, labour market assumptions were developed for Québec, and the results for Canada less Québec were derived. Table 53 and Table 54 show the projected active population, number of employed, and labour force participation rates for Canada less Québec.

Table 53 Active and Employed Populations (Canada less Québec, ages 15 and over)
(thousands)

	Population [1]			Active Population			Employed		
Year	Males	Females	Total	Males	Females	Total	Males	Females	Total
2022	12,101	12,471	24,572	8,491	7,601	16,092	7,933	7,157	15,090
2023	12,287	12,668	24,955	8,600	7,714	16,314	8,064	7,288	15,353
2024	12,460	12,852	25,312	8,699	7,819	16,519	8,154	7,383	15,537
2025	12,621	13,026	25,647	8,791	7,919	16,710	8,236	7,472	15,708
2026	12,769	13,186	25,955	8,876	8,012	16,888	8,310	7,556	15,866
2027	12,911	13,342	26,253	8,957	8,105	17,062	8,382	7,639	16,021
2028	13,048	13,491	26,539	9,033	8,192	17,225	8,453	7,722	16,175
2029	13,178	13,633	26,811	9,105	8,277	17,382	8,521	7,801	16,322
2030	13,303	13,768	27,071	9,175	8,358	17,533	8,586	7,877	16,463
2035	13,857	14,378	28,235	9,527	8,781	18,308	8,916	8,275	17,191
2040	14,391	14,958	29,349	9,829	9,052	18,881	9,198	8,531	17,729
2045	14,936	15,540	30,476	10,142	9,325	19,466	9,489	8,790	18,279
2050	15,440	16,079	31,519	10,412	9,564	19,976	9,741	9,016	18,757
2055	15,894	16,557	32,452	10,606	9,745	20,351	9,923	9,187	19,110
2060	16,339	17,015	33,354	10,759	9,893	20,652	10,066	9,326	19,392
2065	16,796	17,482	34,278	10,921	10,051	20,972	10,218	9,475	19,693
2070	17,263	17,966	35,229	11,138	10,252	21,391	10,422	9,664	20,086
2080	18,201	18,961	37,162	11,709	10,761	22,470	10,955	10,144	21,099
2090	19,073	19,893	38,966	12,285	11,282	23,567	11,494	10,635	22,129
2100	20,024	20,849	40,873	12,819	11,754	24,573	11,994	11,080	23,074

(1) Adjusted to the basis used by Statistics Canada in its Labour Force Survey.

Table 54 Labour Force Participation Rates (Canada less Québec)
(percentages)

	Males				Females			
Age Group	2022	2025	2035	2050	2022	2025	2035	2050
15-19	46.7	47.7	51.5	51.5	49.3	50.2	53.5	53.5
20-24	76.8	77.3	79.2	79.3	74.2	74.9	77.2	77.3
25-29	88.8	89.5	92.0	92.0	83.9	85.0	88.7	88.8
30-34	92.4	92.8	94.0	94.0	83.8	84.5	86.8	86.8
35-39	93.5	93.6	94.0	94.0	82.2	83.5	87.5	87.5
40-44	92.6	92.9	94.0	94.0	84.0	85.2	88.8	88.8
45-49	92.3	92.4	93.0	93.0	84.3	85.3	88.8	88.8
50-54	90.1	90.4	91.0	91.0	82.3	83.3	86.7	86.8
55-59	82.3	82.7	84.0	84.0	72.0	73.1	76.6	76.5
60-64	65.9	66.1	66.9	66.7	53.0	53.4	54.6	54.4
65-69	35.9	36.4	37.7	37.6	23.2	23.8	25.6	25.5
70 and Over	12.0	12.4	13.6	13.6	5.1	5.3	6.0	5.9
55-69	62.8	62.0	63.4	64.5	50.5	50.1	52.7	53.5
55 and Over	44.1	42.3	38.7	40.9	32.5	31.2	28.7	29.8
18-69	81.1	81.4	83.5	82.4	72.4	73.2	77.1	76.0
15 and Over	70.2	69.7	68.8	67.4	60.9	60.8	61.1	59.5

B.4.1.4 Number of Earners (Canada less Québec)

The number of earners for any given year, namely anyone who had employment earnings during the year, is always more than the employed population and sometimes even close to the labour force because it includes all individuals who had earnings at any time during the year, whereas the employed population only indicates the average number of employed in any given year.

The projected number of earners is obtained by a regression based on a highly correlated historical relationship between the number of employed persons and the number of earners over the period 1976 to 2019. Table 55 shows the projected average number of employed persons and the projected number and proportion of earners (relative to the population) aged 18 to 69, for Canada less Québec. The projected number and proportion of earners shown in Table 55 pertain to all earners, including those who are CPP retirement beneficiaries. The effect of CPP retirement beneficiaries with earnings, that is, working beneficiaries, is discussed more in detail in section B.7.6 of this appendix.

Table 55 Employment of Population (Canada less Québec, ages 18 to 69)

Year	Population		Employed		Earners		Proportion of Earners (earners as % of population)	
	Males	Females	Males	Females	Males	Females	Males	Females
	(thousands)		(thousands)		(thousands)		(%)	
2022	10,301	10,304	7,591	6,900	8,475	7,853	82.3	76.2
2023	10,404	10,411	7,705	7,019	8,627	8,004	82.9	76.9
2024	10,492	10,502	7,779	7,104	8,733	8,117	83.2	77.3
2025	10,570	10,586	7,846	7,184	8,830	8,223	83.5	77.7
2026	10,641	10,665	7,907	7,260	8,894	8,307	83.6	77.9
2027	10,706	10,735	7,965	7,335	8,955	8,390	83.6	78.2
2028	10,762	10,798	8,021	7,411	9,016	8,473	83.8	78.5
2029	10,811	10,851	8,075	7,483	9,073	8,552	83.9	78.8
2030	10,852	10,896	8,126	7,551	9,125	8,626	84.1	79.2
2035	11,038	11,096	8,385	7,912	9,392	9,015	85.1	81.2
2040	11,327	11,395	8,631	8,146	9,655	9,272	85.2	81.4
2045	11,740	11,789	8,891	8,379	9,962	9,548	84.9	81.0
2050	12,169	12,206	9,131	8,595	10,253	9,812	84.3	80.4
2055	12,460	12,514	9,292	8,758	10,451	10,010	83.9	80.0
2060	12,642	12,731	9,401	8,884	10,578	10,158	83.7	79.8
2065	12,756	12,891	9,506	9,013	10,686	10,298	83.8	79.9
2070	12,878	13,052	9,662	9,180	10,847	10,478	84.2	80.3
2080	13,510	13,655	10,143	9,623	11,385	10,980	84.3	80.4
2090	14,227	14,363	10,655	10,095	11,966	11,525	84.1	80.2
2100	14,841	14,987	11,104	10,513	12,467	12,001	84.0	80.1

B.4.2 Annual Increase in Prices (Inflation Rate)

The increase in prices (inflation rate) assumption is needed to determine the Pension Index for any given calendar year. It is also used in the determination of the annual nominal increase in average employment earnings, the YMPE, YAMPE, and the nominal rates of return on investments.

Price increases, as measured by changes in the CPI, tend to fluctuate from year to year. Since the mid-1950s, the trend was generally upward through the early 1980s and then generally downward until the introduction of the inflation-control targets in the early 1990s, at which point inflation began to stabilize. The average annual increases in the CPI over the 50, 20 and 10-year periods ending in 2021 were 3.9%, 1.9% and 1.7%, respectively.

On December 13, 2021, the Bank of Canada and the Government renewed their commitment to keep inflation between 1% and 3% with a target at the mid-point of 2% until the end of 2026[1]. They further noted that the Bank will use the flexibility of the 1% to 3% control range to actively

[1] https://www.bankofcanada.ca/2021/12/joint-statement-of-the-government-of-canada-and-the-bank-of-canada-on-the-renewal-of-the-monetary-policy-framework/

seek the maximum sustainable level of employment to an extent that is consistent with keeping medium-term inflation expectations at 2%.

Despite the mid-point target of 2%, the CPI tends to fluctuate from year to year. The COVID-19 pandemic had an impact on the CPI. In 2020, the CPI rose by only 0.7% as a result of a decline in consumer spending stemming from various pandemic-related measures and restrictions. However, as the pandemic evolved and restrictions were lifted, consumer demand increased and supply issues arose. As a result, the increase in CPI was 3.4% in 2021, the fastest pace since 1991. The uncertainty surrounding high inflation due to the demand and supply shocks caused by the pandemic has been exacerbated by the escalation of the conflict in Ukraine. This report considers the escalation of the conflict in Ukraine a subsequent event.

Due to the economic instability caused by the COVID-19 pandemic, the global impacts of the war in Ukraine, and related supply chain issues, inflation is expected to be higher than the 2% target up until 2025. Increase in prices are assumed to be 6.9% in 2022, 3.0% in 2023, 2.5% in 2024, 2.25% in 2025 and 2.0% for 2026 and thereafter. These assumed price increases are based on short-term forecasts from various economists as well as on the expectation that the Bank of Canada and federal Government will continue to renew the inflation target at 2.0% and that the Bank of Canada will be successful in keeping inflation at its mid-point target in the long term.

B.4.3 Real Wage Increases

Two wage measure are used in this report: the average annual earnings (AAE) and the average weekly earnings (AWE). The assumed increase in AAE is used to project the total employment earnings of CPP contributors, while the assumed increase in the AWE is used to project the increase in the YMPE from one year to the next. The average difference between both measures has been relatively small over the period 1966 to 2019. However, they tend to grow at different paces in times of economic expansions and slowdowns.

B.4.3.1 Long-Term Real Wage Increases

Over the long term, increases in the real AAE and real AWE are assumed to be the same and are referred to as real wage increases in this report. The real wage increase can be measured using the difference between the increases in the nominal average wage and the CPI. In this case, the nominal average wage is defined as the ratio of the total nominal earnings to total civilian employment in the Canadian economy as a whole.

The relationship between real wages and the labour markets and overall economy is complex. In general, real wages are subject to downward pressure as the demand for workers decreases. On the other hand, one could expect upward pressure on wages if the size of the labour force fails to keep pace with a growing economy.

The real wage increase is related to the growth in total labour productivity plus the growth of various factors, as shown in Table 56. Data for year 2020 were not taken into account due to variability in data related to the pandemic.

Table 56 Real Wage Increase and Related Components [1]

	1961-2019 Average	1990-2019 Average	2000-2019 Average	Ultimate Assumption
Labour Productivity Growth	1.61%	1.19%	0.93%	1.05%
+ Compensation Ratio Growth	(0.08)%	(0.15)%	0.01%	0.00%
+ Earnings Ratio Growth	(0.17)%	(0.16)%	(0.11)%	(0.05)%
+ Average Hours Worked Growth	(0.33)%	(0.17)%	(0.29)%	(0.10)%
+ Price Differential Growth	0.05%	(0.06)%	0.04%	0.00%
Real Wage Increase	1.07%	0.65%	0.57%	0.90%

(1) Components may not sum to totals due to rounding.

Labour productivity in the above table is defined as the ratio of the real Gross Domestic Product (GDP) to total hours worked in the Canadian economy. As shown in Table 56, growth in labour productivity has decreased since the 1960s. However, long-term productivity is expected to increase as a result of labour shortages and continued technological advancements. At the same time, increasing labour force participation rates of older workers and a reliance on immigration for future labour force growth are expected to moderate labour shortages and the associated impact on productivity.

In addition, labour productivity could be affected by the timing and pace of Canada's transition to a green economy. There is a substantial uncertainty surrounding the effect of this transition on the composition of Canada's economy as it potentially moves away from carbon-intensive sectors over the next decades.

Based on the foregoing, a labour productivity growth of 1.05% is assumed for the long term.

The compensation ratio is the ratio of the total compensation received by workers to the nominal GDP, thereby reflecting the extent to which changes in productivity are shared between capital and labour. This ratio decreased on average by 0.08% per year over the 58-year period ending in 2019. It is assumed that there will be no change in the compensation ratio over the long term.

The earnings ratio is the ratio of total workers' earnings to total compensation. Changes in the earnings ratio reflect changes in the compensation structure offered to employees. The historical decline in the earnings ratio of 0.17% per year from 1961 to 2019 has been primarily due to the faster growth in supplementary labour income, such as employer contributions to pension plans, health benefit plans, the CPP, and the Employment Insurance program, compared to earnings. Given that a significant portion of the historical decrease in the earnings ratio can be explained by the increase in CPP contributions resulting from the increase in the contribution rate from 3.6% in 1986 to 9.9% in 2003, the earnings ratio is not expected to decline as fast as it has in the past. However, as a result of the aging of the population, it is expected that the cost of pension plans and health programs will continue to increase in the future and exert downward pressure on the earnings ratio. Based on the foregoing, it is assumed that the long-term earnings ratio will decline by 0.05% per year.

The average hours worked is defined as the ratio of total hours worked to total employment in the Canadian economy. There was a decrease in the average hours worked between 1961 and 2019. In the future, the assumed steady increases in productivity and the higher participation rates of older workers, who generally work fewer hours, could continue to apply negative pressure on the average hours worked. It is assumed that in the long term, the average hours worked will decline by 0.10% per year.

Finally, the price differential or "labour's terms of trade" is the ratio of the GDP deflator (defined as the ratio of nominal to real GDP) to the CPI. Including this ratio is necessary because labour productivity is expressed in real terms by using real GDP, while current dollar earnings are converted to real earnings using the CPI. The average annual growth in the price differential was 0.05% between 1961 and 2019. it is assumed that the price differential will remain stable without change over the long term.

The result of the foregoing discussion is that the real wage is assumed to increase by 0.9% per year over the long term.

B.4.3.2 Short-Term Real Wage Increases

Although the real AAE and real AWE are assumed to grow at the same pace in the long term, they tend to grow at different paces in times of economic expansions and slowdowns.

In times of economic slowdown, the AWE increases at a faster pace than the AAE and the reverse occurs in times of economic expansion. This is because during economic slowdowns, individuals with lower earnings lose their jobs, which tends to increase the AWE (proportionally higher earners remain in the labour force and people work less weeks during the year). The reverse holds true in times of economic expansion, i.e., low earners get rehired and people work more weeks during the year.

Based on information up to the end of June 2022, the real AAE is projected to decrease by 2.4% in 2022 and by 0.1% in 2023. Real AAE are then projected to increase, with an ultimate real increase of 0.9% reached in 2026. The negative real AAE growth in the early years of the projection is a result of assumed wage dynamics in periods of high inflation stemming from the COVID-19 pandemic and exarcerbated by the escalation of the conflict in Ukraine, which is considered a subsequent event. The ultimate real AAE increase assumption is developed taking into account historical trends, labour productivity, labour shortages, and other contributing factors. The ultimate real AAE increase assumption combined with the ultimate price increase assumption results in an assumed nominal annual increase of 2.9% in 2026 and thereafter.

Real AWE are projected to decrease by 3.3% in 2022 and by 0.1% in 2023. In the following years, and consistent with the historical long-term relationship between the real change in the AWE and AAE, AWE increase, with an ultimate real increase of 0.9% reached in 2026, equal to the same ultimate real increase in AAE that year.

B.4.3.3 Summary

Table 57 shows the assumptions regarding the annual increases in prices, real AAE, and real AWE.

Table 57 Inflation, Real AAE and AWE Increases
(percentages)

Year	Price Increases	Real Increases Average Annual Earnings (AAE)	Real Increases Average Weekly Earnings (AWE), (YMPE)
2022	6.90	(2.40)	(3.30)
2023	3.00	(0.10)	(0.10)
2024	2.50	0.40	0.40
2025	2.25	0.65	0.65
2026+	2.00	0.90	0.90

B.4.4 Average Annual Earnings, Total Earnings, and Pensionable Earnings

Average annual earnings are projected by taking into account past and expected structural demographic and labour market changes as well as the narrowing of the gap between average female and male employment earnings. As part of these projections, the average annual earnings of working beneficiaries are also taken into account. The ratio of female to male average employment earnings stood at about 48% in 1966 and was 79% in 2019. This ratio is projected to increase to 87% by 2050. Table 58 shows the projected average annual earnings by age group and sex for selected years.

Table 58 Average Annual Earnings (Canada less Québec, ages 18 to 69)
(dollars)

	Males			Females		
Age Group	2022	2025	2050	2022	2025	2050
20-24	28,844	31,372	62,089	23,168	25,359	51,816
25-29	47,880	51,694	102,162	39,661	43,200	90,330
30-34	59,805	64,383	126,451	45,928	50,186	106,976
35-39	65,016	69,986	137,292	50,383	55,078	117,484
40-44	67,857	73,083	143,502	54,550	59,584	126,144
45-49	69,087	74,447	145,975	55,927	61,068	128,915
50-54	67,653	73,043	143,178	55,028	60,018	126,401
55-59	62,875	67,512	132,685	50,474	55,487	116,963
60-64	54,073	58,429	114,042	41,524	45,987	98,623
65-69	38,633	42,872	84,567	28,459	31,126	68,963
All Ages	55,850	60,553	119,711	44,606	48,953	104,580

Total earnings are the product of average earnings and the number of earners. Table 59 shows the projected average earnings and number of earners for each sex, the resulting total earnings, and the annual percentage increase in total earnings for Canada less Québec. The significant increase in total earnings of 8.3% in 2022 results from projected higher employment and high nominal wage growth following the first two years of the COVID-19 pandemic. The annual

increase in total earnings is set to reach an ultimate value of about 3.4%. This nominal increase comprises an ultimate inflation rate of 2.0%, real wage growth of 0.9%, and employed population growth for the age group 18 to 69 of 0.5%.

Table 59 Total Earnings (Canada less Québec, ages 18 to 69)

Year	Average Annual Earnings		Earners		Total Earnings	Annual Increase in Total Earnings
	Males	Females	Males	Females		
	($)	($)	(thousands)	(thousands)	($ million)	(%)
2022	55,850	44,606	8,475	7,853	823,656	8.3
2023	57,374	46,011	8,627	8,004	863,211	4.8
2024	58,945	47,456	8,733	8,117	899,943	4.3
2025	60,553	48,953	8,830	8,223	937,262	4.1
2026	62,212	50,494	8,894	8,307	972,783	3.8
2027	63,917	52,084	8,955	8,390	1,009,361	3.8
2028	65,669	53,722	9,016	8,473	1,047,268	3.8
2029	67,466	55,413	9,073	8,552	1,085,983	3.7
2030	69,313	57,154	9,125	8,626	1,125,534	3.6
2035	79,367	66,667	9,392	9,015	1,346,437	3.6
2040	90,949	77,553	9,655	9,272	1,597,232	3.5
2045	104,305	90,100	9,962	9,548	1,899,381	3.5
2050	119,711	104,580	10,253	9,812	2,253,547	3.4
2055	137,533	121,256	10,451	10,010	2,651,238	3.2
2060	158,118	140,483	10,578	10,158	3,099,531	3.1
2065	181,895	162,645	10,686	10,298	3,618,653	3.1
2070	209,339	188,185	10,847	10,478	4,242,605	3.3
2080	277,903	251,176	11,385	10,980	5,921,931	3.4
2090	369,452	334,704	11,966	11,525	8,278,334	3.4
2100	491,216	445,970	12,467	12,001	11,475,969	3.3

The average pensionable earnings by age, sex, and calendar year correspond to the average portion of individual employment earnings below the YMPE for a cohort of earners earning more than the YBE. The average pensionable earnings are determined using average annual earnings and distributions of earners and earnings. For the additional CPP, the same methodology as mentioned above applies, but the average portion of individual employment earnings used goes up to the YAMPE.

In 2022, the YMPE and YBE are respectively $64,900 and $3,500. The YAMPE is set at 107% of the YMPE in 2024 ($74,000 as projected in this report), and at 114% of the YMPE in 2025 ($81,100 as projected in this report) and thereafter, as per the CPP statute. The YMPE and the YAMPE are increased annually based on the average industrial aggregate wage in Canada as published by Statistics Canada. The projected average pensionable earnings by age and sex for selected years up to the YMPE and YAMPE are shown in Table 60 and Table 61, respectively.

Table 60 Average Pensionable Earnings up to YMPE (Canada less Québec)
(dollars)

	Males			Females		
Age Group	2022	2025	2050	2022	2025	2050
20-24	29,672	32,146	61,826	24,879	27,052	53,076
25-29	42,933	46,564	91,715	38,227	41,557	83,955
30-34	48,749	52,971	105,071	41,568	45,322	92,381
35-39	50,739	55,196	109,847	43,698	47,691	97,328
40-44	51,731	56,322	112,346	45,704	49,903	101,766
45-49	52,044	56,672	113,058	46,430	50,705	103,435
50-54	51,566	56,175	111,864	46,138	50,354	102,521
55-59	49,421	53,694	106,313	43,811	47,955	97,087
60-64	46,072	49,989	97,482	39,815	43,619	87,908
65-69	41,908	45,652	88,625	34,830	37,657	76,391
All Ages	46,121	50,309	99,541	40,334	44,114	89,768
YMPE	64,900	71,200	145,600	64,900	71,200	145,600
All Ages / YMPE	0.71	0.71	0.68	0.62	0.62	0.62

Table 61 Average Pensionable Earnings up to YAMPE (Canada less Québec)
(dollars)

	Males			Females		
Age Group	2022	2025	2050	2022	2025	2050
20-24	-	32,811	63,004	-	27,326	53,617
25-29	-	48,987	96,221	-	43,125	87,277
30-34	-	56,841	112,417	-	47,718	97,577
35-39	-	59,704	118,505	-	50,581	103,520
40-44	-	61,169	121,733	-	53,158	108,648
45-49	-	61,636	122,679	-	54,042	110,474
50-54	-	60,979	121,133	-	53,554	109,274
55-59	-	57,987	114,547	-	50,776	103,039
60-64	-	53,792	104,659	-	45,919	92,781
65-69	-	49,196	95,407	-	39,525	80,336
All Ages	-	54,027	106,730	-	46,508	94,919
YAMPE	-	81,100	165,900	-	81,100	165,900
All Ages / YAMPE	-	0.67	0.64	-	0.57	0.57

The ratios of average pensionable earnings for males and females as a percentage of the YMPE and the YAMPE are slowly decreasing over time. This is due to the freezing of the YBE which has the effect that, over time, fewer and fewer workers are exempt from participating in the CPP. This, in turn, has the effect of increasing the number of earners with low earnings participating in the Plan. The ratio reduces over time for males mainly due to this YBE effect. The ratio also reduces for females, but to a smaller extent and thus is relatively stable as the YBE effect is mostly offset by the increase in their average pensionable earnings.

B.5 Contributions

Contributions are determined by multiplying together the number of contributors, average contributory earnings, and the contribution rate. Contributions are determined separately for the base and additional Plans to account for the different contributory earnings (as of 2024) and different contribution rates of the two components of the CPP. The number of contributors is the same since a contributor to the additional Plan is necessarily a contributor to the base Plan.

B.5.1 Proportion of Contributors

In order to be considered a contributor to the CPP in any given calendar year, one must have employment earnings exceeding the YBE. Accordingly, the proportion of contributors (in respect of the population[1]) is determined by multiplying the proportion of the population who are earners by the proportion of earners earning more than the YBE. This last proportion is determined for each age, sex, and calendar year by expressing the YBE as a percentage of average employment earnings and using distributions of earners and their earnings. The proportion of contributors is adjusted to reflect working beneficiaries. Table 62 presents the proportion of contributors by selected age groups and years for males and females.

Table 62 Proportion of Contributors to the CPP, by Age Group
(percentages)

	Males			Females		
Age Group	2022	2025	2050	2022	2025	2050
20-24	79.2	82.0	85.1	77.3	79.9	84.3
25-29	87.0	87.7	92.5	83.4	84.6	91.2
30-34	89.0	90.3	92.4	82.0	83.5	88.2
35-39	88.0	90.1	91.8	79.5	82.0	87.6
40-44	88.2	88.1	89.9	80.1	81.9	87.3
45-49	85.9	87.7	89.4	79.9	82.1	87.3
50-54	84.2	85.3	86.9	79.0	81.0	86.0
55-59	77.2	79.6	81.7	69.7	71.9	76.7
60-64	61.5	63.5	66.8	51.0	52.4	56.5
65-69	28.9	30.4	33.4	19.5	20.6	23.6
All Ages	77.4	78.8	81.1	70.5	72.1	76.9

B.5.2 Average Contributory Earnings

Average contributory earnings, which include contributory earnings of working beneficiaries, are determined for each age, sex, and year by subtracting the YBE from the average pensionable earnings shown in Table 60 and Table 61. The resulting average contributory earnings by age group and sex for selected years up to the YMPE and YAMPE are shown in Table 63 and Table 64, respectively.

[1] Population of Canada less that of Québec

Table 63 Average Contributory Earnings for Pensionable Earnings up to YMPE
(dollars)

	Males			Females		
Age Group	2022	2025	2050	2022	2025	2050
20-24	26,172	28,646	58,326	21,379	23,552	49,576
25-29	39,433	43,064	88,215	34,727	38,057	80,455
30-34	45,249	49,471	101,571	38,068	41,822	88,881
35-39	47,239	51,696	106,347	40,198	44,191	93,828
40-44	48,231	52,822	108,846	42,204	46,403	98,266
45-49	48,544	53,172	109,558	42,930	47,205	99,935
50-54	48,066	52,675	108,364	42,638	46,854	99,021
55-59	45,921	50,194	102,813	40,311	44,455	93,587
60-64	42,572	46,489	93,982	36,315	40,119	84,408
65-69	38,408	42,152	85,125	31,330	34,157	72,891
All Ages	42,621	46,809	96,041	36,834	40,614	86,268
YMPE	64,900	71,200	145,600	64,900	71,200	145,600

Table 64 Average Contributory Earnings for Pensionable Earnings up to YAMPE
(dollars)

	Males			Females		
Age Group	2022	2025	2050	2022	2025	2050
20-24	–	29,311	59,504	–	23,826	50,117
25-29	–	45,487	92,721	–	39,625	83,777
30-34	–	53,341	108,917	–	44,218	94,077
35-39	–	56,204	115,005	–	47,081	100,020
40-44	–	57,669	118,233	–	49,658	105,148
45-49	–	58,136	119,179	–	50,542	106,974
50-54	–	57,479	117,633	–	50,054	105,774
55-59	–	54,487	111,047	–	47,276	99,539
60-64	–	50,292	101,159	–	42,419	89,281
65-69	–	45,696	91,907	–	36,025	76,836
All Ages	–	50,527	103,230	–	43,008	91,419
YAMPE	–	81,100	165,900	–	81,100	165,900

B.5.3 Total Contributory Earnings

Contributory earnings for each given age, sex, and year are calculated as the product of the proportion of contributors, average contributory earnings, and the corresponding population. Total contributory earnings for each year are obtained by summing contributory earnings for each age and sex in that year.

Total contributory earnings are then adjusted upward to take into account the non-refundable portion of employer contributions arising generally in respect of (1) employees with multiple employers during a given year, and (2) employees earning less than the YBE during a given year, including those who only work part of a year. The amount of non-refundable employer

contributions increases total CPP contributions, which translates into higher underlying contributory earnings. As such, contributory earnings are adjusted only for the purpose of determining the correct amount of contributions, and not for the determination of benefits.

The records of earnings from Service Canada, statistics on contributors from the "The CPP & OAS Stats Book 2021", published by ESDC, and information from the Canada Revenue Agency on base CPP contribution refunds were used to project the adjustment to contributory earnings up to the YMPE and YAMPE. The adjustment for earnings up to the YMPE is projected to be 1.54% in 2022 and decrease to 1.49% over the projection period to account for the YBE being frozen at $3,500. The adjustment for earnings up to YAMPE is projected to be 1.50% in 2024 and decrease to 1.43% over the projection period also to account for the YBE being frozen at $3,500.

Annual contributions are equal to the product of adjusted contributory earnings and the contribution rates set by law. For the base Plan, the legislated contribution has been 9.9% since 2003. For the additional Plan, the legislated first additional contribution rate is 2.0% as of 2023 (phased in starting in 2019) and the legislated second additional contribution rate is 8.0% as of 2024. Table 65 and Table 66 present information on the total adjusted contributory earnings for pensionable earnings up to the YMPE and YAMPE, respectively. The significant increase in total adjusted contributory earnings of 9.4% in 2022 represents the projected higher employment and high nominal wage growth following the first two years of the COVID-19 pandemic.

Table 65 Total Adjusted Contributory Earnings for Pensionable Earnings up to YMPE

Year	Unadjusted Average Contributory Earnings		YMPE	Contributors		Total Adjusted Contributory Earnings	Annual Increase in Total Adjusted Contributory Earnings
	Males	Females		Males	Females		
	($)	($)	($)	(thousands)	(thousands)	($ million)	(%)
2022	42,621	36,834	64,900	7,975	7,261	616,668	9.4
2023	43,956	38,040	66,900	8,124	7,410	648,785	5.2
2024	45,435	39,357	69,200	8,229	7,522	680,189	4.8
2025	46,809	40,614	71,200	8,328	7,632	710,485	4.5
2026	48,237	41,915	73,300	8,394	7,720	739,632	4.1
2027	49,671	43,237	75,400	8,458	7,806	769,230	4.0
2028	51,155	44,604	77,600	8,524	7,895	800,229	4.0
2029	52,691	46,023	79,900	8,586	7,980	832,186	4.0
2030	54,237	47,461	82,200	8,646	8,062	864,552	3.9
2035	62,655	55,306	94,800	8,963	8,501	1,047,401	3.9
2040	72,359	64,290	109,400	9,256	8,801	1,254,280	3.6
2045	83,366	74,508	126,200	9,579	9,107	1,499,428	3.6
2050	96,041	86,268	145,600	9,872	9,390	1,784,712	3.5
2055	110,817	99,919	168,000	10,076	9,610	2,108,096	3.3
2060	127,943	115,699	193,800	10,212	9,780	2,474,655	3.2
2065	147,760	133,916	223,600	10,342	9,947	2,903,032	3.2
2070	170,574	154,910	258,000	10,539	10,160	3,421,988	3.4
2080	227,074	206,683	343,300	11,106	10,699	4,803,930	3.5
2090	302,482	275,498	457,000	11,705	11,270	6,744,599	3.4
2100	403,048	367,285	608,200	12,213	11,760	9,379,076	3.3

Table 66 Total Adjusted Contributory Earnings for Pensionable Earnings up to YAMPE

Year [1]	Unadjusted Average Contributory Earnings		YAMPE	Contributors		Total Adjusted Contributory Earnings	Annual Increase in Total Adjusted Contributory Earnings
	Males	Females		Males	Females		
	($)	($)	($)	(thousands)	(thousands)	($ million)	(%)
2024	47,318	40,579	74,000	8,229	7,522	704,857	N/A
2025	50,527	43,008	81,100	8,328	7,632	760,039	7.8
2026	52,057	44,388	83,500	8,394	7,720	791,120	4.1
2027	53,597	45,792	85,900	8,458	7,806	822,735	4.0
2028	55,186	47,241	88,400	8,524	7,895	855,768	4.0
2029	56,824	48,739	91,000	8,586	7,980	889,721	4.0
2030	58,509	50,283	93,700	8,646	8,062	924,626	3.9
2035	67,503	58,584	108,000	8,963	8,501	1,119,173	3.9
2040	77,903	68,116	124,700	9,256	8,801	1,339,798	3.7
2045	89,672	78,945	143,800	9,579	9,107	1,600,861	3.6
2050	103,230	91,419	165,900	9,872	9,390	1,904,782	3.4
2055	119,058	105,906	191,500	10,076	9,610	2,249,521	3.3
2060	137,386	122,638	220,900	10,212	9,780	2,639,925	3.2
2065	158,604	141,959	254,900	10,342	9,947	3,096,314	3.2
2070	183,008	164,205	294,100	10,539	10,160	3,648,770	3.4
2080	243,502	219,059	391,300	11,106	10,699	5,120,600	3.5
2090	324,241	291,943	520,900	11,705	11,270	7,187,118	3.4
2100	431,955	389,190	693,300	12,213	11,760	9,993,162	3.3

(1) The years shown start in 2024 since it is the first year the YAMPE applies.

B.6 Investment Assumptions

The total assets of the CPP at the end of any given year throughout the projection period are determined by adding the total assets at the end of the previous year to the projected investment income and contribution revenues of the given year, and then subtracting the projected benefits and operating expenses of the given year.

B.6.1 Net Assets as at 31 December 2021

The actual value of the base CPP assets on a market-value accrual basis as at 31 December 2021 was $544 billion. This is the sum of the CPP Account ($108 million) and the assets invested by the CPPIB ($540 billion) for a total of $540 billion, before being adjusted by the amounts receivable minus amounts payable.

The actual value of the additional CPP assets on a market-value accrual basis as at 31 December 2021 was $11 billion. This is the sum of the Additional CPP Account ($19 million) and the assets invested by CPPIB ($11 billion) for a total of $11 billion before being adjusted by the amounts receivable minus amounts payable.

The CPP Account and Additional CPP Account were established in respect of the base Plan and additional Plan to record the contributions, interest, pensions, other benefits, and operating

expenses. It also records the amounts transferred to and received from the CPPIB. The receivables include the contributions due but not yet deposited into the CPP Account, benefit overpayments, and net transfers between the CPP and the QPP for dual contributors. The amounts payable include operating expenses, pensions and other benefits, as well as amounts due to the Canada Revenue Agency (CRA). Benefit and operating expenditures are described in detail in sections B.7 and B.8, respectively of this appendix.

Table 67 reconciles the assets of the base CPP and additional CPP as at 31 December 2021.

Table 67 Net Assets as at 31 December 2021
($ million)

	Base CPP	Additional CPP
CPP Account	108	19
Assets Invested by CPPIB	539,682	10,693
Subtotal CPP Account and Invested Assets by CPPIB	539,790	10,713
Plus Amounts Receivable		
Contributions	4,241	335
Benefit Overpayments	105	8
Net Transfers Due from QPP	105	8
Minus Amounts Payable	517	19
Net CPP Assets	543,725	11,045

B.6.2 Investment Strategy and Two-Pool Structure

The CPPIB invests funds according to its own investment policies. For the purpose of this 31st CPP Actuarial Report, the CPP invested assets have been grouped into three broad categories:

- Equities, consisting of public and private equities;
- Fixed income securities, consisting of nominal fixed income (marketable bonds and non-marketable bonds), credit, and cash; and
- Real assets.

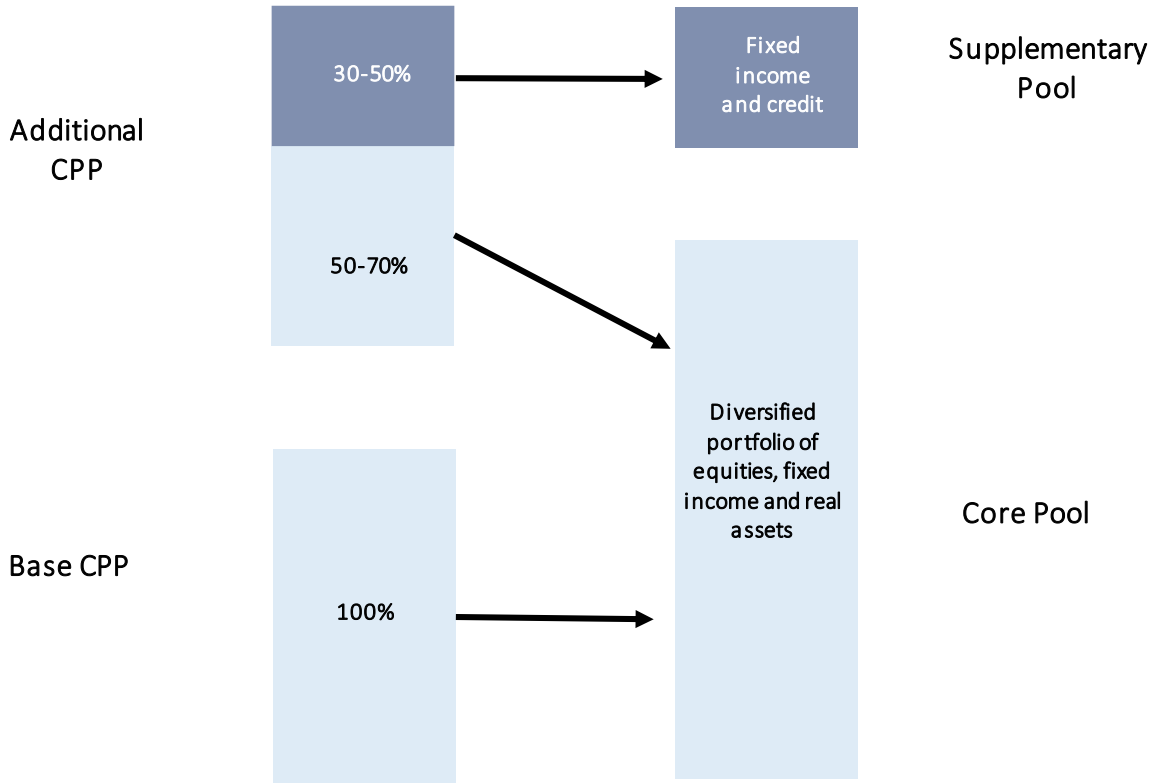
The foundation of the CPPIB's investment strategy is a two-asset portfolio called the "reference portfolio". This portfolio sets how much risk the CPPIB is willing to take in accordance with its mandate. The reference portfolio comprises a global equity benchmark and a Canadian government nominal bonds benchmark. The higher the equity share, the higher the associated risk.

Recognizing the distinct natures of the base and additional CPP, the CPPIB Board approved two different reference portfolios applicable for each component of the Plan. The reference portfolio applicable to the base CPP as at 31 December 2021 is maintained at 85% global equity and 15% Canadian government nominal bonds, whereas, the reference portfolio applicable to the additional CPP as at 31 December 2021 consists of 55% global equity and 45% Canadian government nominal bonds. In the previous report, the reference portfolio for the additional CPP

stood at 50% global equity and 50% Canadian government nominal bonds.

In order to invest the base and additional CPP funds according to their respective reference portfolios, the CPPIB designed a two-pool investment structure. The base CPP's actual assets as of 31 December 2021 constitute the Core pool and are invested according to the base CPP's investment policy. The additional CPP assets are invested in two pools: the Core pool and the Supplementary pool. The Supplementary pool solely comprises fixed income securities and credit. The share of the additional CPP's assets invested in each of the Core and Supplementary pools is determined such that the overall level of risk of the additional CPP is consistent with its reference portfolio. Chart 12 presents a schematic of the two-pool investment structure for the CPP invested assets.

Chart 12 Illustrative Two-Pool Investment Structure of the CPPIB



The CPPIB diversifies its holdings and thus sources of returns, while respecting the risk level of its reference portfolios. As a result, the base and additional CPP assets are invested in several types of assets. The portfolios capturing that diversification are called the strategic portfolios. The CPPIB uses the strategic portfolios to express its long-term goal for allocating assets by asset classes and geographic regions. In its Fiscal 2021 Annual Report, the CPPIB signaled its intention

to continue increasing the CPP Fund's exposure to emerging markets as part of their 2025 strategy.[1] This intention is reflected in all assumptions presented in this section.

As at 31 December 2021, the asset mix of the base CPP consisted of 55% equities, 23% fixed income securities, and 22% real assets, while the asset mix of the additional CPP consisted of 36% equities, 50% fixed income, and 14% real assets. Table 68 further categorizes the actual assets under the CPPIB management into the asset classes identified at the beginning of this section, which correspond to the strategic portfolios' asset classes.

Table 68 Initial Asset Mix as at 31 December 2021 for Base and Additional CPP
(percentages)

	Equity		Fixed Income Securities				
Plan	Public Equities	Private Equities	Marketable Bonds	Non-Marketable Bonds	Credit	Cash (1)	Real Assets
Base	29	26	19	4	16	(16)	22
Additional	19	17	50	0	10	(10)	15

(1) A negative allocation to cash represents financial leverage. This indicates that funds are borrowed in order to increase the amounts invested in the other asset classes.

B.6.3 Investment Income

In general, investment income from a given asset within a portfolio is the product of the market value of that asset and its projected nominal rate of return (which is obtained by adding the applicable projected real rate of return, as described in section B.6.4 below, to the projected inflation rate).

The investment income of the CPP is based on the assumed real rate of return applicable to each type of asset, projected inflation, and the projected asset mix and cash flows. In addition, the assumed real rate of return at the portfolio level includes an allowance for rebalancing and diversification (discussed in section B.6.5). Investment income is also adjusted downward to recognize investment expenses (discussed in section B.6.6).

B.6.4 Real Rates of Return

Real rates of return are required for the projection of revenue arising from investment income. They are assumed for each year of the projection period and for each of the main asset classes in which CPP assets are invested. All real rates of return described in this section are shown before reduction for assumed investment expenses.

The real rates of return were developed by looking at historical returns (expressed in Canadian dollars) and adjusting the returns upward or downward to reflect expectations that differ from the past. Both public market data and customized benchmarks prepared by the CPPIB were used to analyze the historical experience.

[1] President's message; CPPIB Fiscal Year 2021 Annual Report

Future currency variations will impact the real rates of return over the projection period, creating gains and losses. However, as the projection period is over 75 years, these gains and losses are expected to offset each other over time. Thus, it is assumed that currency variations will not have an impact on the real rates of return.

The escalation of the conflict in Ukraine has had significant impacts on financial markets. In an effort to control rising inflation stemming from the COVID-19 pandemic and excarcerbated by the esclatation of the conflict in Ukraine, the Bank of Canada has increased its benchmark interest rate by 225 basis points so far in 2022 (as of July 13, 2022), which has impacted returns on fixed income investments. In addition, stock market indices in the first half of 2022 have decreased significantly across geographies and sectors.

This report considers the escalation of the conflict in Ukraine a subsequent event, and the assumed rates of return have been adjusted accordingly. More specifically, for 2022, the assumed nominal return is -9.0% for the base CPP and -7.7% for the additional CPP. In real terms, this translates into 2022 assumed returns of -15.9% and -14.6% for the base CPP and additional CPP respectively. These returns reflect actual CPPIB results up to 30 June 2022, and continued uncertainty for the remainder of the year. In addition, fixed income returns beyond 2022 are based on a revised interest rate path that reflects the significant rate hikes that occurred in the first half of 2022.

B.6.4.1 Fixed Income Securities

As at 31 December 2021, the CPPIB had 23% of the CPP portfolio invested in fixed income securities, split between nominal fixed income, credit, and cash. Nominal fixed income in the Core pool can be further divided into a non-marketable bond portfolio composed of bonds with various terms to maturity, representing loans made to the provinces, and a marketable bond portfolio consisting of domestic federal and provincial bonds and foreign sovereign bonds. Starting 1 January 2019, the CPPIB started investing part of the additional CPP's contributions in a Supplementary pool composed of fixed income securities and credit.

Canadian Fixed Income

The new money rate is the nominal yield on 10-year-plus Government of Canada bonds and is set for each year in the projection period. The real yield on 10-year-plus federal bonds is equal to the new money rate less the assumed rate of inflation.The real yield on long-term Canadian federal bonds as at 31 December 2021 is about -1.68% and is assumed to gradually increase to 2.0% by 2033 and remain at that level.

The real yields for long-term provincial bonds, as well as for federal and provincial bonds of shorter maturities (mid and short), are based on the real yield on long-term federal bonds adjusted based on historical spreads over the last 20 years. The initial spreads over the real yield on federal long-term bonds are based on spreads prevailing as at 31 December 2021 and reflect

the current economic environment. Since the long-term federal bond yield is assumed to increase between 2022 and 2033 and only stabilize at the end of 2033, bond returns are lower for the first ten years of the projection.

For the Core pool, the yields are determined in relation to yields for Canadian federal universe bonds. The yield for Canadian federal universe bonds is assumed to be represented by a diversified portfolio of Canadian federal bonds. Using the federal long-, mid- and short-term yields developed above, weighted by the Canadian Fixed Income Universe Index market values as at 31 December 2021, the average maturity is set at 8.0 years for Canadian federal universe bonds, and the resulting ultimate real return is 1.3%.

Non-Marketable Bond Portfolio and Rollover Rates (Loans to Provinces, Core Pool)

The non-marketable bond portfolio at the end of 2021 represented 4% of all CPP assets. The provinces are allowed to roll over at maturity for a further 20-year term any bonds that were purchased prior to the 1997 CPP amendments (that came into effect on 1 January 1998). In lieu of exercising their statutory rollover right, an agreement between the provinces and the CPPIB permits each province to repay a bond and contract a replacement bond or bonds for a term of at least five years, with a total principal amount not exceeding the principal amount of the maturing bond and total successive terms of not more than 30 years. During the 20-year period 2002 to 2021, 89% of provincial bonds available for rollover were rolled over at or before maturity. The rollover proportion increases to 100% when considering the five-year period from 2017 to 2021. Using this rollover experience, it is assumed that the rollover rate will be 99% for 2022 and thereafter. The last non-marketable bond is expected to mature in 2049.

On the basis of the average short-, medium-, and long-term experience of the spread between the annual yields on federal and provincial bonds, the current outlook of the economy, and data on rollovers since 2000, a spread over the federal long-term yield was determined for each province. The initial spreads on rollover bonds are set at the actual market spreads at the end of 2021 for provincial bonds issued by the given province. The ultimate spreads, applicable from 2033 onward, are set at the average spreads of provincial bonds issued by a given province during the period 2000 to 2021, excluding the global financial crisis of 2008 and 2009. The weighted long-term average spread for all provinces is approximately 70 basis points. Therefore, an ultimate annual real yield of approximately 2.7% for provincial rollover bonds is assumed for 2033 and thereafter.

The real rate of return of the non-marketable bond portfolio is calculated by taking into consideration any coupon payments made throughout the year, as well as the change in the market value of the portfolio due to changes in the assumed yield rates and in the term to maturity of each bond. Coupons paid and redemption values of bonds at maturity are assumed to be reinvested in the marketable bond portfolio.

Marketable Bond Portfolio (Core Pool)

As the non-marketable bond portfolio matures over the next three decades, it is assumed that the proceeds will be invested in marketable bonds and that the marketable bond portfolio will consist mainly of foreign sovereign bonds (developed market and emerging market). The composition of developed market and emerging market bonds in the portfolio is consistent with information provided by the CPPIB. Since the last report (30th CPP Actuarial Report), it is assumed that corporate bond holdings of the CPPIB are part of the credit asset class (discussed in the subsequent section).

The returns for developed market sovereign bonds are derived from a blend of projected sovereign yields for the Euro Zone, the United States and the United Kingdom. This is obtained by adding a negative spread of 20 basis points to the projected yields of Canadian federal universe bonds. The ultimate real return for the developed market sovereign bonds is assumed to be 1.1%.

The yield for emerging sovereign market bonds is assumed to correspond to a blend of projected local currency long-term yields for the emerging economies of Brazil, China, India, Indonesia, and Mexico. This is expected to be 160 basis points higher than the yield on Canadian federal universe bonds, resulting in an ultimate return for the emerging market sovereign bond portfolio of 2.9%.

The assumed ultimate real rate of return of the Core pool marketable bond portfolio is 1.3% before investment expenses. The real rates of return of the Core pool marketable bond portfolio are expected to be lower over the first few projection years due to the projected increase in yields.

Marketable Bond Portfolio (Supplementary Pool)

The Supplementary pool is expected to be composed mainly of Canadian fixed income securities and credit, such that the mix of Core pool and Supplementary pool assets provides the desired risk profile for the additional CPP. For the purpose of this report, the Canadian fixed income securities are assumed to be represented by a portfolio of Canadian federal and provincial bonds in varying proportions.

The initial asset mix of this portfolio is estimated from the CPPIB 31 December 2021 financial statements. It is assumed that the CPPIB will purchase a variety of federal and provincial bonds in proportions consistent with their investment strategy. It is thus assumed that the bond mix applicable for 2022 and thereafter will be the same as the mix as at 31 December 2021 and will be composed of 70% federal and 30% provincial bonds.

The assumed average maturities of federal and provincial bonds are estimated based on the CPPIB holdings as at 31 December 2021 and are assumed to remain constant throughout the projection period. The average maturity is set at 9.4 years for supplementary federal bonds and 14.8 years for supplementary provincial bonds.

The ultimate real rate of return for the supplementary marketable bonds is assumed to be 1.8%. Similar to the Core pool marketable bonds portfolio, the real rates of return of the Supplementary pool are expected to be lower over the first few projection years due to the projected increase in yields.

Credit (Core and Supplementary)

The credit asset class includes investments in corporate bonds, private debt, and private real estate debt. In the previous report, the Supplementary pool consisted only of Canadian fixed income securities. However, the CPPIB has since introduced credit in the Supplementary pool. At the end of 2021, the CPPIB had approximately 16% of the base CPP and 10% of the additional CPP net assets invested in this asset class.

For the purpose of this report, the expected real rate of return on credit is assumed to correspond to the return on a diversified portfolio of corporate bonds, adjusted to reflect the risk characteristics of the CPPIB's actual holdings. Credit in the Supplementary pool only consists of Canadian securities, while the Core pool credit includes exposure to other developed markets as well as emerging markets. Furthermore, the Core pool credit includes an assumed increasing exposure to both developed markets and emerging markets.

For the Core pool, the returns on the diversified portfolio of corporate bonds are derived from projected U.S. corporate yields. The ultimate real rate of return for the Core pool credit asset class is assumed to be 2.2% from 2033 onward. The assumed ultimate real rate of return for the Supplementary pool credit asset class is 2.9%. This return is higher than the Core pool to reflect that it consists only of Canadian securities as well as its different risk characteristics.

The assumed real rates of return of the credit portfolio for both the Core pool and the Supplementary pool are expected to be lower over the first few projection years due to the projected increase in yields.

CPP Account, Additional CPP Account, and Cash

The CPP Account is established in the accounts of Canada to record the transactions of the base Plan and amounts transferred to and from the CPPIB in respect of the base Plan. The balance in the CPP Account serves as a flow-through account with investments solely in short-term securities.

Similar to the CPP Account, the Additional CPP Account is a flow-through account that records the transactions of the additional Plan and amounts transferred to and from the CPPIB in respect of the additional Plan.

The CPPIB uses financial leverage as part of its investment strategy. Financial leverage in the context of portfolio management consists of borrowing money to invest in other assets with the expectation that the borrowing cost will be less than the return on the assets purchased. As at 31 December 2021, CPPIB's external debt and financing liability represented about 16% of its net

assets. Similar to the previous actuarial report, there is an explicit recognition in this report for the amount of leverage in the asset allocation. The borrowing cost related to financial leverage is assumed to correspond to the expected real rate of return on cash. The initial assumed real rate of return on cash is low, reflecting the current environment, with a smooth transition assumed from the initial to the ultimate assumption of 0.3% for 2033 and thereafter.

B.6.4.2 Equity

The CPP assets invested in equities are currently diversified among public and private equities and across various geographies. In the derivation of the real rates of return for these equity investments, consideration was given to expected dividend yields, expected growth of the underlying economies and long-term risk premiums for various factors such as size, maturity and geography. No distinction is made between realized and unrealized capital gains. Custom equity benchmarks provided by the CPPIB were considered in the derivation of real rates of return for equities.

Public equities

Public equities comprise developed and emerging markets publicly traded equities. Various elements contribute to the return on an equity investment such as earnings, income paid to shareholders, fluctuation in valuation, and exchange rates for non-Canadian investments.

Over long periods, valuation changes and currency fluctuations are not expected to contribute significantly to the return on broad equity markets. Therefore, it is assumed that expectations regarding income and earnings growth are sufficient to project future equity returns, with additional adjustments for the riskiness of small caps and emerging market equities. The income derived from dividend and buyback yields on developed market equities is expected to be 3.1%. This is based on historical income from dividend and buyback yields for developed market equities, adjusted to reflect current and expected economic environments. Growth in earnings is proxied using GDP growth per capita; and it is expected to add 0.9% to the overall real return of developed market equities. Hence, the expected return on developed market equities is 4.0%. Because of their additional risk, small caps are assumed to yield an additional 0.2% and emerging market equities are assumed to yield an additional 1.0%.

The ultimate real rate of return on public equities is projected to be 4.2%. The short-term path is lower due to the subsequent event described in section 2.3.

Private equities

Compared to public equities, private equities are less liquid and their management necessitates a higher degree of expertise. Private equities may also provide institutional investors the opportunity to invest at an earlier stage in the development of a company, which translates into additional risk and greater potential returns. As a result, the return structure of private equities is different compared to public equities. Private equities are expected to generate an additional return in exchange for the additional illiquidity risk and complex management.

In general, private investments have grown in popularity over the last decade. This increase in demand has not necessarily been matched by an increase in supply. Valuations are high and a significant amount of capital is waiting to be allocated at attractive prices. As more and more investors around the globe compete for private placements, it is assumed that the additional return from investing in private equities compared to public equities will be lower than historical levels.

The ultimate real rate of return on private equities is projected to be 5.1%. The short-term path is lower due to the subsequent event described in section 2.3.

B.6.4.3 Real Assets

Real assets such as real estate, infrastructure, and natural resources are considered to share some characteristics of fixed income and equities, as well as to have some unique features related to their specific nature (such as illiquidity). The expected real rate of return on real assets is thus influenced by these features. It is also assumed that real CPP assets will ultimately include a greater exposure to emerging markets than as at 31 December 2021.

The ultimate real rate of return on real assets is projected to be 4.1%. The short-term path is lower due to the subsequent event described in section 2.3.

B.6.4.4 Summary of Real Rates of Return by Asset Type

Table 69 summarizes the assumed real rates of return by asset type throughout the projection period, before reduction for investment expenses. The rates of return by asset type are presented without any allowance for rebalancing and diversification (discussed in section B.6.5). The rebalancing and diversification allowance is presented at the portfolio level in Table 70 for the base CPP and Table 71 for the additional CPP.

It is important to recognize that rates of return for most assets are volatile. The real rates of return presented in Table 69 represent expected trends and assumed levels of returns to be obtained over a long horizon. As such, limited emphasis should be put on individual projection years.

This report considers the escalation of the conflict in Ukraine a subsequent event, and the assumed rates of return have been adjusted accordingly as presented in section B.6.4. Given that the assumed rate of return for 2022 was not developed by asset class, year 2022 is not shown in the tables below.

Table 69 Real Rates of Return by Asset Type (before investment expenses and allocation for rebalancing and diversification) (percentages)

	Equity		Fixed Income Securities						
Year	Public Equities	Private Equities	Marketable Bonds (Core)	Marketable Bonds (Supplementary)	Non-Marketable Bonds	Credit (Core)	Credit (Supplementary)	Cash	Real Assets
2023	3.0	3.9	0.1	(0.4)	1.0	0.9	(0.6)	(0.3)	2.4
2024	3.6	4.6	0.1	0.2	1.0	1.1	0.7	(0.3)	2.9
2025	3.9	4.9	0.2	0.5	1.4	1.3	1.4	(0.3)	3.3
2026	4.2	5.2	0.2	0.7	1.8	1.5	1.9	(0.3)	3.5
2027	4.2	5.2	0.3	0.8	1.8	1.6	2.0	(0.2)	3.6
2028	4.2	5.2	0.4	0.9	1.8	1.7	2.1	(0.1)	3.6
2029	4.2	5.2	0.5	0.9	1.9	1.7	2.1	(0.1)	3.6
2030	4.2	5.2	0.6	1.0	2.0	1.8	2.2	0.0	3.7
2035	4.2	5.1	1.3	1.8	2.0	2.2	2.9	0.3	4.1
2040	4.2	5.1	1.3	1.8	1.1	2.2	2.9	0.3	4.1
2045+	4.2	5.1	1.3	1.8	2.2	2.2	2.9	0.3	4.1

B.6.5 Asset Allocation and Expected Portfolio Rates of Return

This report provides projections of over 75 years. As such, long-term asset mix assumptions are required for the base and additional CPP. As the base CPP continues to mature and the Plan's participants age, the ratio of contributors to beneficiaries is projected to decrease, and the proportion of investment income required to pay benefits is projected to increase. Starting in 2026, it is expected that contributions will be insufficient to cover all expenditures, and that a portion of investment income will be required to cover expenditures. The portion of investment income required to pay expenditures will be small at the beginning but is projected to increase over time, reaching about 16% in 2050 and 34% by 2070. Therefore, the importance of reliable investment income will grow over time for the base CPP.

The additional CPP will rely even more on investment income due to the difference in its financing approach compared to the base CPP. Deviations in the additional CPP portfolio's rate of return are expected to greatly impact the sustainability of that plan as a result of the higher reliance of the additional Plan on investment income. Given the long horizon of this report, it is important to consider how much investment risk is appropriate for the base and additional CPP over the long term, bearing in mind how each part is affected by investment returns.

For both the base and additional Plans, the expected portfolio real rates of return include an allowance for rebalancing and diversification of the assets. This allowance takes into account the beneficial effect of periodically rebalancing a diversified portfolio to maintain the desired relative assets allocation by asset classes. In other words, the expected return of a portfolio is greater than the weighted average of the expected return of its components. The size of the allowance depends on the asset mix and the risk characteristics of the individual assets.

Base CPP

It is assumed that the level of risk of the base CPP investment portfolio will decrease over time. Consistent with the CPPIB's current reference portfolio for the base CPP, a level of risk equivalent to that of a reference portfolio of about 85% equity and 15% fixed income is assumed initially. The volatility of the initial base CPP portfolio, as measured by the one-year standard deviation of return, is estimated at 12.4% annually[1]. Thereafter, it is projected that the volatility of the rate of return of the Core pool will gradually decrease to 10.7% in 2033, equivalent to a hypothetical reference portfolio of about 70% equity and 30% fixed income. The decrease in portfolio risk is assumed to progress in three-year steps reflecting the triennial reviews of the CPP. Hence, the asset mix is projected to progress from its initial allocation (base CPP assets as at 31 December 2021) to a portfolio constructed to match the level of risk of a hypothetical reference portfolio of 70% equity and 30% fixed income. Table 70 presents the projected asset allocation, the expected volatility of the portfolio, and the expected portfolio real rate of return before investment expenses for the base Plan.

Due to the assumed three-year steps progression of the portfolio risk, the total portfolio real rate of return does not move in a linear fashion. The expected real rate of return of the portfolio tends to decrease each time the level of risk of the portfolio decreases towards its ultimate level. However, expected returns on fixed income are expected to gradually increase up to their ultimate values once yields stabilize. The net effect is a general increasing trend in the total portfolio real rate of return with periodic adjustments corresponding to triennial portfolio risk recalibration.

[1] Although the CPPIB current base CPP reference portfolio is 85% equity and 15% fixed income with an estimated one-year standard deviation of 13.9%, its' actual portfolio as at 31 December 2021 corresponds to a hypothetical reference portfolio of 82% equity and 18% fixed income with an estimated one-year standard deviation of 12.4%.

Table 70 Asset Mix, Portfolio Risk and Expected Rates of Return (before investment expenses)
Base CPP (%)

	Equity		Fixed Income Securities						
Year	Public Equities	Private Equities	Marketable Bonds	Non-Marketable Bonds	Credit	Cash	Real Assets	Expected Long-term Volatility	Total Real Rate of Return [1],[2]
2022	29	26	19	4	16	(16)	22	12.4	(15.74)
2023	29	26	20	3	16	(16)	22	12.2	3.09
2024	29	26	20	3	16	(16)	22	12.1	3.61
2025	28	25	20	2	16	(13)	22	11.7	3.83
2026	28	25	20	2	16	(13)	22	11.6	4.08
2027	28	25	20	2	16	(13)	22	11.6	4.11
2028	27	25	19	2	16	(10)	21	11.3	4.05
2029	27	25	19	1	16	(10)	21	11.3	4.08
2030	27	25	20	1	16	(10)	21	11.3	4.10
2035	25	25	18	1	16	(5)	20	10.7	4.21
2040	25	25	19	0	16	(5)	20	10.7	4.20
2045+	25	25	19	0	16	(5)	20	10.7	4.20

(1) The assumed total real rate of return is shown before reduction for investment expenses. The assumed total real rate of return net of expenses is obtained by reducing the total real rate of return by 18 basis points.
(2) The assumed total real rate of return includes an allowance for rebalancing and diversification. At the portfolio level, this allowance is assumed to add 0.45% to the rate of return annually over the projection period.

Additional CPP

The additional CPP assets are invested in both the Core and Supplementary pools. Table 71 presents the projected asset allocation, the expected volatility, and the expected real rate of return before investment expenses for the additional CPP.

It is expected that the Supplementary pool will transition by 2026 from being purely invested in Canadian marketable bonds to being about 48% invested in marketable bonds, with the remainder being allocated to Credit.

The share of the additional CPP assets invested in each pool is selected in order to match the desired level of risk of the additional CPP's reference portfolio. To increase the total portfolio risk of the additional CPP, a higher allocation to the Core pool would be selected. Similarly, a lower allocation to the Core pool would lower the total portfolio risk for the additional Plan.

It is assumed that the level of risk of the additional CPP will be kept constant over the projection period at a level corresponding to the current CPPIB reference portfolio of about 55% equity and 45% fixed income with an estimated volatility of 7.7%. During the first few projection years, this level of risk is obtained by investing 65% of the additional CPP assets in the Core pool and 35% in the Supplementary pool. Because the level of risk of the Core pool's investment returns is expected to decrease gradually, a higher share of the additional CPP assets is expected to be allocated to the Core pool to maintain the additional CPP portfolio volatility at 7.7%. It is assumed that 68% of the additional CPP assets will be allocated to the Core pool for the year 2033 and thereafter.

Table 71 Asset Mix, Portfolio Risk and Expected Rates of Return (before investment expenses)
Additional CPP (%)

		Supplementary Pool Allocation			
Year	Core Pool Allocation	Marketable Bonds	Credit[1]	Expected Long-term Volatility [2],[3]	Total Real Rate of Return
2022	65	35	0	7.7	(14.50)
2023	65	30	4	7.8	2.00
2024	65	26	9	8.0	2.61
2025	66	21	13	8.0	2.94
2030	66	16	17	7.9	3.41
2035	68	15	17	7.7	3.75
2040	68	15	17	7.7	3.75
2045+	68	15	17	7.7	3.75

(1) Fluctuation in volatility in the years before the ultimate in 2033 is due to the changing composition of the supplementary pool to include credit.
(2) The assumed total real rate of return is shown before reduction for investment expenses. For all years, the assumed total real rate of return net of expenses is obtained by reducing the total real rate of return by 13 basis points.
(3) The assumed total real rate of return includes an allocation for rebalancing and diversification. At the portfolio level, this allocation is assumed to add 0.45% to the rate of return annually over the projection period.

B.6.6 Investment Expenses

CPPIB's total investment expenses consist of operating expenses, transaction costs, and investment management fees. Over the last three calendar years, the total investment expenses have averaged 0.90% of total assets, ranging from 0.84% to 1.10%. The majority of those investment expenses were incurred through active management decisions. Considering how total investment expenses evolved over the last decade, it is assumed that, going forward, total investment expenses of the CPPIB will be 0.95% of the Core Pool.

Active management is implemented to generate excess returns (after reduction for active management expenses). Thus, the additional returns from a successful active management program should equal at least the cost incurred to pursue active management. For the purpose of this report and in accordance with the Canadian Institute of Actuaries' guidance regarding the determination of best-estimate discount rates, it is assumed that the additional returns generated by active management will equal the additional expenses incurred from active management. These expenses are assumed to be the difference between total investment expenses and the assumed expenses that would be incurred for the passive management of the portfolios.

It is assumed that investment expenses of 0.18% would be incurred to passively manage the Core pool. Since the base CPP assets are invested only in the Core pool, the assumed investment

expenses from passive management of 0.18% represents $994 million and $1,592 million in years 2022 and 2033, respectively, for the base CPP. The investment expenses for active management for the base CPP are therefore 0.77%.

The passive management investment expenses from the Supplementary pool are assumed to be 0.03%. It is further assumed, that there are no active management expenses associated with the Supplementary pool. The investment expenses of the additional CPP will depend on how much of the fund is invested in the Core pool versus the Supplementary pool, and the investment expenses associated with each of these pools. For years 2035 and thereafter, it is assumed that 68% of additional Plan assets are invested in the Core pool and 32% are invested in the Supplementary pool. Such allocation results in total investment expenses for the additional Plan being 0.65% and the overall investment expenses from passive management related to the additional CPP being 0.13%. The investment expenses for active management for the additional CPP are therefore 0.52%.

The assumed investment expenses from passive management of additional CPP are $21 million and $360 million in year 2022 and 2033, respectively.

The following section shows the overall rate of return on CPP assets net of investment expenses for the base and additional CPP.

B.6.7 Overall Rate of Return on Base and Additional CPP Assets

The best-estimate rates of return on total assets for each of the base and additional Plans are derived from the weighted average assumed rates of return on all types of assets, using the assumed asset mix proportions as weights. The best-estimate rates of return are further adjusted to incorporate an allocation for rebalancing and diversification. In addition, the best-estimate rates of return are increased to reflect additional returns due to active management and reduced to reflect all investment expenses. The projected nominal returns are the sum of the assumed levels of inflation and real returns. The ultimate net rates of return are shown in Table 72.

Table 72 Ultimate Rates of Return on Base and Additional CPP Assets
(percentages)

	Base CPP		Additional CPP	
	Nominal	Real	Nominal	Real
Weighted Average Rate of Return (before investment expenses)	6.20	4.20	5.75	3.75
Additional Rate of Return due to Active Management	0.77	0.77	0.52	0.52
Total Weighted Average Rates of Return before Investment Expenses	6.97	4.97	6.27	4.27
Expected Investment Expenses				
Expenses due to Passive Management	(0.18)	(0.18)	(0.13)	(0.13)
Additional Expenses due to Active Management	(0.77)	(0.77)	(0.52)	(0.52)
Total Expected Investment Expenses	(0.95)	(0.95)	(0.65)	(0.65)
Ultimate Rate of Return after Investment Expenses	6.02	4.02	5.62	3.62

The resulting nominal and real rates of return for selected projection years are shown in Table 73. The projected average annual real rate of return over the next 75 years is 3.69% for the base CPP and 3.27% for the additional CPP.

Table 73 Annual Rates of Return on CPP Assets
(percentages)

	Base CPP		Additional CPP	
Year	Nominal	Real	Nominal	Real
2022	(9.02)	(15.92)	(7.72)	(14.62)
2023	5.91	2.91	4.87	1.87
2024	5.93	3.43	4.98	2.48
2025	5.90	3.65	5.06	2.81
2026	5.90	3.90	5.14	3.14
2040+	6.02	4.02	5.62	3.62
Average over:				
2023-2027(1)	5.91	3.56	5.05	2.70
2023-2032(1)	5.90	3.73	5.15	2.98
2022-2096	5.79	3.69	5.37	3.27

(1) For 5 and 10 year averages, year 2022 was excluded given that it creates a strong downward bias.

The 75-year (2022-2096) average annual real rate of return on investments are lower for both components of the CPP compared to the 30th CPP Actuarial Report averages for the same period. This decrease is mainly due to lower expected returns on fixed income over that period compared to the previous valuation and the impact of the subsequent event.

For the base CPP, the 75-year (2022-2096) average annual rate of return on investments is 31 basis points lower than the 4% average (over the same period) of the previous triennial valuation.

For the additional CPP, the 75-year (2022-2096) average annual rate of return on investments decreases by 23 basis points compared to the average of 3.5% (over the same period) of the 30th CPP Actuarial Report.

B.7 Benefit Expenditures

B.7.1 Benefits Payable as at 31 December 2021 and Projected Benefits

The number of base CPP beneficiaries in pay and average monthly benefits payable as at 31 December 2021 are shown in Table 74.

Table 74 Benefits Payable as at 31 December 2021 – Base CPP

	Number of Beneficiaries in pay		Average Monthly Benefit	
Benefit Type	Males	Females	Males	Females
	in thousands		($)	($)
Retirement	2,709	2,961	711	518
Post-retirement Benefit	926	779	47	39
Survivor				
- Aged less than 65	49	158	399	464
- Aged 65 and over	189	767	134	364
Disability (1)	145	183	1,012	937

	Number of Beneficiaries in pay	Average Monthly Benefit
Benefit Type	Males and Females	Males and Females
	in thousands	($)
Orphan	59	258
Disabled Contributor's Child	76	258

(1) The figures given in the table for the disability benefit refer to the disability pension.

The approach used in this report to project future benefits paid is based on deterministic projections using grouped data. The amount of benefit expenditures is determined by taking into account the administrative agreement established in section 58(1) and 58(2) of the *Canada Pension Plan Regulations* between the CPP and the QPP for beneficiaries who had contributed to both plans.

The retirement, survivor, disability, and children's benefit expenditures for each year following the year of benefit take-up for a given age, sex, and cohort is computed as the product of:

- benefit expenditures in the year of take-up (described later in this appendix);
- the probability of survival from the age at benefit take-up to the attained age;
- the rules regarding combined retirement and survivor benefits and combined disability and survivor benefits, as applicable; and
- the Pension Index, which recognizes the annual inflation adjustment to benefits each 1 January following benefit emergence.

The amounts of the benefits payable during any given calendar year are then obtained by simply summing the annual expenditures applicable for the year as described above, in respect of all age and sex cohorts having emerged in the given and all previous calendar years. The projected number of beneficiaries and amounts of benefit expenditures for the base and additional Plans are shown in various tables in the Results sections 5 and 6 of this report.

All projections of base CPP benefits start from the year 1966 instead of the beginning of the current projection period (2022). This is done for the following reasons:

- The valuation methodology can be validated for the historical period up to the valuation year (1966 to 2021) by comparing the projected values (contributions, benefits, beneficiaries, etc.) with actual experience. Based on this comparison, calibration factors of actual to projected historical experience are obtained which are then used for the future projections of the different types of benefit. For example, the calibration factors for retirement benefit experience for those starting their pension between ages 60 and 65 are 0.99 for males and 0.95 for females.
- The projection of benefits already in pay as at the valuation date (31 December 2021) is fully integrated with the projection of benefits emerging after that date thus ensuring full consistency between past experience and the future.

Even though the additional Plan started as of 1 January 2019, the additional Plan benefits have not started to be paid out as of 31 December 2021. As such, there are no additional benefits in pay as at the valuation date. The same calibration factors developed for the base Plan benefits are assumed to apply to the additional Plan projected benefits except in the case of the additional retirement benefits, where microsimulation was used to estimate the calibration factors. As experience develops for the additional Plan, more precise calibration factors for each type of benefit will be determined separately for that CPP component.

B.7.2 Benefit Eligibility Rates

As described in Appendix A (Summary of Plan Provisions) of this report, eligibility for benefits varies according to the type of benefit. The eligibility rules for the survivor benefit are the same as for the death benefit. The eligibility rules for base CPP benefits determine eligibility for additional CPP benefits.

Benefit eligibility rates (as a percentage of the Canada less Québec population) for retirement, disability, and death/survivor benefits are projected using regression formulae that were developed to closely reproduce historical eligibility rates observed from CPP records of earnings data provided by ESDC over the period 1966 to 2019. The projected eligibility rates take into account the applicable eligibility rules for each type of benefit, the proportion of contributors, and the length of the contributory period for existing and future earners.

The disability and survivor benefit eligibility rates developed as above must be adjusted to project the earnings-related portion of these two types of benefits. Table 75 shows the resulting eligibility rates for the various benefit types by sex and age for selected years.

The retirement eligibility rates for some ages and years are greater than 100% due to individuals who contributed to the CPP and then left the country with no further information available as to their status. Since these individuals are not counted in the population, the retirement eligibility rates can be higher than 100%.

Table 75 Benefit Eligibility Rates by Type of Benefit
(percentages)

Year	Retirement Benefit Eligibility Rate at Age 65		Survivor/Death Benefit Eligibility Rate at Age 65	
	Males	Females	Males	Females
2022	103.5	100.2	101.1	77.5
2023	103.2	100.2	101.0	78.4
2024	102.9	100.2	100.8	79.1
2025	102.6	100.1	100.6	79.8
2026	102.3	100.1	100.3	80.4
2027	101.9	100.0	100.0	80.9
2028	101.7	99.9	99.7	81.4
2029	101.3	99.7	99.4	81.8
2030	101.0	99.5	99.2	82.1
2035	100.0	99.0	98.1	83.5
2040	100.8	100.0	97.4	84.3
2045	100.7	100.1	97.0	85.0
2050	100.6	100.3	96.8	85.6
2055	102.0	101.6	96.9	86.2
2060	102.4	101.9	97.3	86.7
2065	102.2	101.8	97.6	87.2
2070	103.8	103.3	98.1	87.7
2080	103.4	103.1	98.7	88.3
2090	103.5	103.3	99.2	88.7
2100	103.9	103.7	99.6	89.0

Year	Survivor/Death Benefit Eligibility Rate at Ages 20-64		Disability Benefit Eligibility Rate at Ages 20-64 [1]		Post-Retirement Disability Benefit Eligibility Rate at Ages 60-64 [2]	
	Males	Females	Males	Females	Males	Females
2022	79.9	70.8	70.7	64.0	49.8	42.6
2023	80.0	71.2	71.9	65.1	52.3	45.0
2024	81.5	72.3	73.5	66.7	54.2	46.6
2025	81.9	72.9	75.4	68.6	55.3	47.4
2026	81.7	73.0	75.8	69.2	55.4	47.4
2027	81.2	73.0	75.7	69.3	56.3	47.9
2028	81.5	73.4	76.5	70.1	56.6	48.1
2029	83.0	74.2	77.7	71.4	56.5	48.1
2030	83.4	74.8	78.1	72.0	56.6	48.5
2035	85.0	76.5	79.3	74.1	57.5	49.5
2040	86.4	77.8	80.0	75.3	58.3	50.6
2045	87.3	78.5	79.6	75.3	58.6	51.0
2050	87.9	78.8	79.3	75.1	58.5	51.1
2055	88.3	79.1	80.2	76.2	59.6	51.6
2060	88.6	79.4	80.3	76.4	59.4	51.6
2065	88.9	79.8	80.9	77.0	59.5	51.7
2070	89.1	80.1	81.2	77.3	60.0	52.2
2080	89.9	80.6	81.6	77.8	60.3	52.3
2090	90.5	80.9	81.6	77.8	60.5	52.6
2100	90.8	81.2	81.9	78.1	60.6	52.6

(1) These are eligibility rates for the disability benefit prior to starting the retirement pension, i.e. for the disability pension only, excluding eligibility for the post-retirement disability benefit. Eligibility for the post-retirement disability benefit is shown separately in the table.
(2) Applies to base CPP only.

B.7.3 Adjustments to Proportion of Contributors and Pensionable Earnings for Benefit Computation Purposes

The effect of credit-splitting of pensionable earnings between spouses or common-law partners in the event of divorce or separation is accounted for by adjusting the projected proportion of contributors and average pensionable earnings of the respective spouses or common-law partners. The average pensionable earnings used to determine the initial amounts of the retirement pensions are also adjusted to exclude the earnings of working beneficiaries. Table 76 presents the resulting adjusted proportion of contributors. The average pensionable earnings up to the YMPE and the YAMPE for benefit computation purposes appear in Table 77 and Table 78, respectively.

Table 76 Proportion of Contributors to CPP (adjusted for benefit computation purposes) (percentages)[1]

	Males			Females		
Age Group	2022	2025	2050	2022	2025	2050
20-24	80.2	82.9	85.9	79.6	82.2	85.9
25-29	88.7	89.4	93.6	86.6	87.5	92.8
30-34	91.0	92.1	93.9	86.3	87.5	91.0
35-39	90.1	91.9	93.4	84.0	86.1	90.4
40-44	90.0	90.0	91.6	84.0	85.4	89.7
45-49	87.7	89.3	90.9	82.9	84.8	89.2
50-54	85.8	86.9	88.4	81.4	83.2	87.6
55-59	78.6	81.0	83.0	71.9	74.1	78.5
60-64	62.6	64.6	67.9	52.6	54.1	58.2
65-69	28.9	30.4	33.4	19.5	20.6	23.6
All Ages	78.9	80.2	82.4	73.2	74.6	78.7

(1) The proportion of contributors shown excludes working beneficiaries.

Table 77 Average Pensionable Earnings up to YMPE (adjusted for benefit computation purposes)[1] (dollars)

	Males			Females		
Age Group	2022	2025	2050	2022	2025	2050
20-24	29,068	31,555	60,907	24,512	26,716	52,679
25-29	41,471	45,044	89,793	37,556	40,882	83,377
30-34	46,306	50,484	101,218	40,903	44,725	91,652
35-39	48,215	52,709	105,966	42,797	46,944	96,387
40-44	49,618	54,116	108,886	44,776	48,989	100,480
45-49	50,149	54,789	110,120	45,550	49,898	102,269
50-54	49,978	54,559	109,262	45,368	49,618	101,374
55-59	47,957	52,199	103,786	42,997	47,120	95,682
60-64	47,768	51,724	101,320	42,481	46,357	93,338
65-69	47,674	52,403	101,551	41,780	45,879	91,405
All Ages	44,867	49,073	97,911	40,035	43,907	89,733
YMPE	64,900	71,200	145,600	64,900	71,200	145,600

(1) Average pensionable earnings shown exclude the earnings of working beneficiaries.

Table 78 Average Pensionable Earnings up to YAMPE (adjusted for benefit computation purposes) [1] (dollars)

	Males			Females		
Age Group	2022 [2]	2025	2050	2022 [2]	2025	2050
20-24	–	32,200	62,054	–	27,006	53,247
25-29	–	47,343	94,141	–	42,484	86,755
30-34	–	54,077	108,157	–	47,220	96,976
35-39	–	56,915	114,166	–	49,928	102,713
40-44	–	58,683	117,836	–	52,308	107,456
45-49	–	59,505	119,353	–	53,285	109,382
50-54	–	59,158	118,204	–	52,852	108,171
55-59	–	56,330	111,755	–	49,947	101,630
60-64	–	55,868	109,177	–	49,140	99,219
65-69	–	57,028	110,361	–	49,079	98,144
All Ages	–	52,673	104,957	–	46,417	95,097
YAMPE		81,100	165,900		81,100	165,900

(1) Average pensionable earnings shown exclude the earnings of working beneficiaries.
(2) Average pensionable earnings up to the YAMPE are not shown for the year 2022, since the YAMPE is only applicable starting in 2024.

B.7.4 Average Earnings-Related Benefits

Base CPP

To determine base CPP benefits, the valuation model first calculates an average earnings-related benefit for all individuals born in a given calendar year, for each sex, and all relevant ages. This average earnings-related benefit is dependent on four main components:

- Average pensionable earnings, adjusted for benefit computation purposes, relative to the YMPE;

- Average proportion of contributors adjusted for benefit computation purposes;
- 25% of the MPEA for the attained year; and
- the number of years in the elapsed contributory period at the attained age.

The base CPP average earnings-related benefit is then further adjusted to take into account certain provisions of the CPP statute as applicable:

- Disability exclusion: the period during which an individual received a CPP disability pension is excluded from the contributory period;
- Child-rearing provision (exclusion): the period during which an individual was caring for a child younger than age 7 is excluded from the contributory period if earnings during the child-rearing period were sufficiently low;
- Post-65 drop-out: earnings of contributors over age 65, who are not yet retirement beneficiaries, may replace earnings before age 65 if those earnings are lower;
- General drop-out provision (exclusion): 17% of the lowest earnings months up to a maximum of about 8 years may be dropped from the contributory period.

Table 79 shows the resulting projected average earnings-related benefits for the base CPP as a percentage of the maximum base CPP earnings-related benefits at ages 60 and 65 by sex and year of birth for various cohorts of contributors. The average base CPP earnings-related benefit for males at age 65 as a percentage of the maximum is about 10 to 15 percentage points lower than at age 60 due to the fact that males who take their benefit at age 65 have a longer contributory period (producing lower career average earnings) and a historical lower earnings profile than those who take an early benefit at age 60. For females, the difference between age 60 and 65 is more pronounced for older cohorts of contributors but decreases for younger cohorts.

The earnings-related benefits for males as a percentage of the maximum is expected to generally decrease over time because of the lower participation and pensionable earnings (as a proportion of the YMPE) of younger contributors in the early years of their contributory period. For females, this decline is offset by the expected higher earnings of future female cohorts. As a result, the gap between the male and female average base CPP earnings-related benefits is expected to decrease over time.

Table 79	Average Earnings-Related Benefit as Percentage of Maximum Benefit - Base CPP			
	Average Earnings-Related Benefit (%)			
	Males		Females	
Year of Birth	Age 60	Age 65	Age 60	Age 65
1950	79	65	59	52
1951	79	66	59	52
1952	80	65	62	53
1953	79	65	62	53
1954	79	65	62	53
1955	79	65	63	53
1960	74	63	59	54
1965	69	62	56	53
1970	69	61	56	53
1980	70	61	57	54
1990	69	61	59	56
2000	68	60	59	56
2010	70	61	61	58
2020	71	62	62	59
2030	70	61	61	58

Additional CPP

For the additional CPP, the valuation model also calculates an average earnings-related benefit based on contributors' highest earnings over forty years for all persons of a birth cohort for each calendar year, sex, and all relevant ages. This average earnings-related additional benefit is dependent on five main components:

- Average additional pensionable earnings, adjusted for benefit computation purposes, relative to the YMPE;
- Average proportion of contributors adjusted for benefit computation purposes;
- First additional benefit calculated as 8.33% of the MPEA to increase the overall Plan's replacement rate to 33% of the MPEA;
- Second additional benefit calculated as 33.33% of 14% of the MPEA to increase coverage to 114% of the MPEA; and
- the fixed contributory period of 40 years.

The additional CPP average earnings-related benefit is further adjusted to take into account certain provisions of the CPP statute as applicable:

- Disability drop-in: individuals who became disabled in 2019 or later will have imputed income assigned to those disability periods; and

- Child-rearing provision (drop-in): an imputed income may be assigned to periods of caring for children younger than age 7 on or after 1 January 2019.

The average additional earnings-related benefit is used in the calculation of the total emerging additional earnings-related benefit expenditures for a given calendar year, for each sex, and all relevant ages.

Table 80 shows the resulting projected average additional earnings-related benefits as a percentage of the maximum additional earnings-related benefits at ages 60 and 65 by sex and year of birth for various cohorts of contributors. The maximum additional benefit is the maximum benefit for both parts of the additional CPP, that is, below the YMPE, and from the YMPE up to YAMPE combined together.

The average additional earnings-related benefit for males at age 65 as a percentage of the maximum is about 2 to 5 percentage points higher than at age 60 due to the longer contributory periods, which is beneficial in the context of the additional CPP's fixed forty years contributory period. For females, the difference between ages 60 and 65 is less pronounced.

The additional earnings-related benefits as a percentage of the maximum are expected to increase over time for both males and females, since contributory periods are projected to increase relative to the fixed forty years. For later birth cohorts, it is projected that the gap between male and female average earnings-related benefits will stay about the same over time.

Table 80 Average Additional Earnings-Related Benefit as Percentage of Maximum Additional Benefit - Additional CPP

	Average Earnings-Related Benefit (%)			
	Males		Females	
Year of Birth	Age 60	Age 65	Age 60	Age 65
1965	5	9	4	7
1970	10	15	8	12
1980	24	27	20	23
1985	30	34	26	28
1990	36	40	31	34
2000	43	46	38	40
2010	44	47	39	41
2020	45	47	40	42
2030	44	46	39	42

B.7.5 Retirement Pension Expenditures

Retirement expenditures result from retirement pensions paid under the base and additional CPP. The retirement pensions paid under both components of the CPP are earnings-related. The total retirement pension payable is the sum of the base and additional pension amounts.

Retirement Pension

New retirement expenditures are determined for each age from 60 to 70, sex, and calendar year of emergence starting from 1967. Total new retirement benefits are calculated as the product of:

- the population;
- the retirement pension eligibility rate;
- the retirement pension take-up rate;
- the actuarial adjustment factor for early or late pension take-up; and
- the average earnings-related benefit previously described.

Retirement Benefit Take-up Rates

The projected retirement benefit take-up rates (or more simply retirement take-up rates) by age, sex, and calendar year are determined by taking into account the assumed future work patterns of earners aged 60 and over and the corresponding CPP experience from 1967 to 2021. The retirement benefit take-up rates correspond to the ratio of the number of emerging retirement beneficiaries to the product of the population and the retirement benefit eligibility rate (i.e. the ratio of the number of new retirement beneficiaries to the eligible population) for each age, sex, and calendar year. The same retirement take-up rates for the base CPP apply to the additional CPP.

The unreduced pension age under the *Canada Pension Plan* is 65. Since 1987, a person can choose to receive a reduced retirement pension as early as age 60 (as well as an increased pension after age 65). This provision has had the overall effect of lowering the average age at pension take-up. In 1986, the average age at pension take-up was 65.2 compared to an average age of 62.7 over the decade ending in 2019.

Chart 13 presents the evolution of the retirement take-up rates at age 60 for males and females. A significant increase was observed in the retirement take-up rates at age 60 for the cohort reaching age 60 in 2012. This observed increase may have resulted from two provisions of the *Economic Recovery Act (stimulus)* of 2009:

1. The work cessation test to receive the pension early (prior to age 65) was removed in 2012, so that starting that year, individuals no longer needed to lower their earnings to take an early CPP retirement pension.

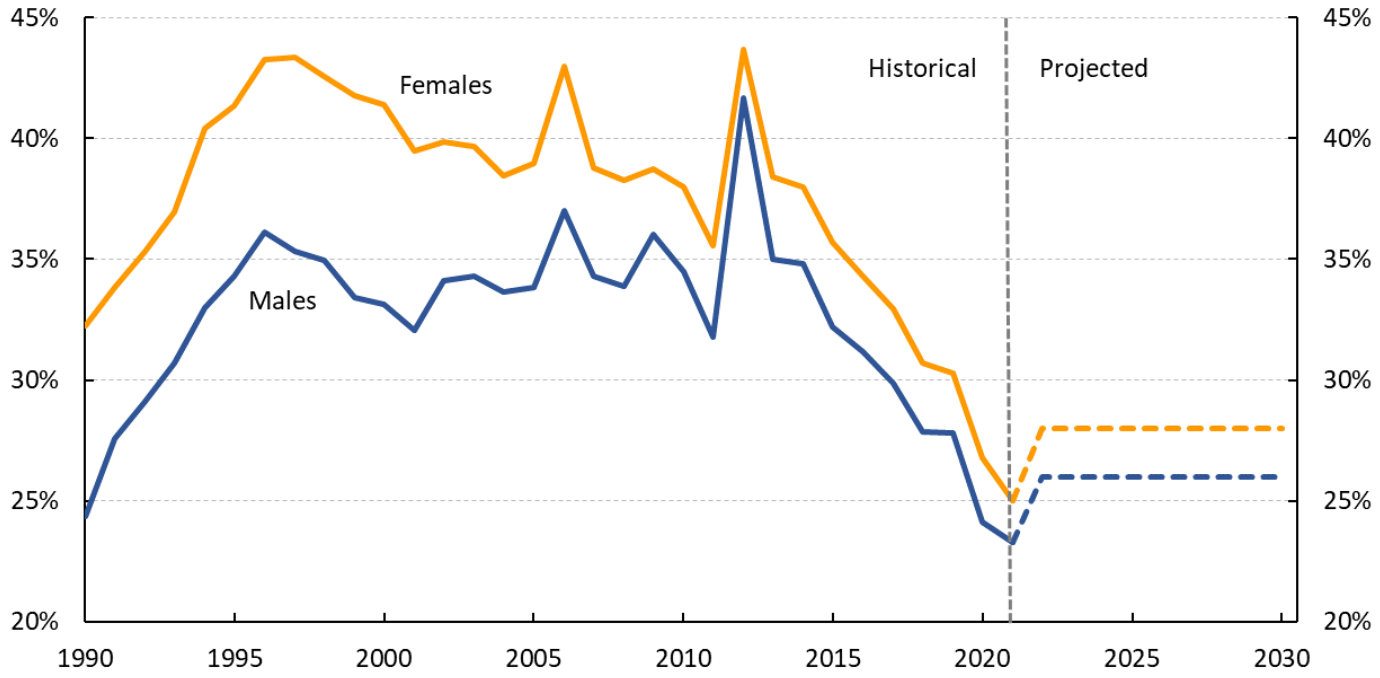
2. Greater reductions in early retirement pensions were scheduled to be phased in over a five-year period, starting in 2012.

After 2012, the age 60 retirement take-up rates continually decreased to below their pre-2012 levels as the higher actuarial adjustments were phased in, the effect of the removal of the work cessation test diminished, and individuals stayed longer in the workforce.

For cohorts reaching age 60 in 2019 (before the pandemic), the retirement take-up rates were 27.8% for males and 30.3% for females. For cohorts reaching age 60 in 2021, the retirement take-up rates were 23.3% for males and 25.0% for females. The take-up rate for males is the lowest one since 1989, while the take-up rate for females is a record low since the flexible retirement age provision was first introduced in 1987. At this time, it is not clear to what extent the COVID-19 pandemic contributed to the significant reduction in retirement take-up rates at age 60 during the years 2020 and 2021. The decreasing trend will be monitored for the next CPP valuation.

The assumption reflects the pre-pandemic trend in retirement take-up rates at age 60, while giving partial credibility to the years 2020 and 2021. For cohorts reaching age 60 in 2022 and thereafter, the retirement take-up rates are assumed to be 26.0% for males and 28.0% for females.

Chart 13 Historical and Projected Retirement Pension Take-up Rates at age 60



The retirement take-up rates for ages 61 to 64 for the year 2022 and thereafter are determined using the observed averages over recent years 2018-2019. The retirement take-up rates for ages 66 to 69 are projected over the next 10 years using the increasing trends observed over the 10-year period ending in 2019. To reflect the waiving of the requirement for an application for the retirement pension upon reaching age 70, as provided under the *Budget Implementation Act, 2019, No. 1*, the retirement take-up rates for age 70 are set to equal to 4.0% for males and 3.5% for females, which are the last known historical values for the year 2021.

The retirement take-up rates at age 65 are derived such that the sum of the retirement rates for each cohort is 100%. The sum of 100% is gradually achieved over the first five years of the

projection. The resulting rates at age 65 are determined to be 42.5% for males and 43.8% for females in 2031 and thereafter. Table 81 shows the projected retirement take-up rates by age for both males and females.

The assumed ultimate retirement take-up rates result in projected average ages at retirement pension take-up in 2031 of 63.6 for males and 63.4 for females. This compares to average retirement take-up ages of 62.4 and 62.3 years, respectively for males and females in 2012.

Table 81 Retirement Pension Take-up Rates (2031+)
(percentages)

	Cohort aged 65 in 2031+	
Age	Males	Females
60	26.0	28.0
61	4.7	4.8
62	4.0	4.2
63	3.6	3.6
64	7.1	6.7
65	42.5	43.8
66	2.9	2.1
67	2.0	1.4
68	1.5	1.0
69	1.7	0.9
70	4.0	3.5
Total	100.0	100.0

Projected New Retirement Pensions

Table 82 shows the projected number of new retirement beneficiaries and their projected average base and additional monthly retirement pensions by sex. New additional average retirement pensions are quite low in the early years due to the lower benefit accrual rates during the phase-in period and the few years of additional contributions. These averages are projected to grow rapidly as the number of years of contributions to the additional CPP increases.

Table 82 New Retirement Beneficiaries and Pensions

Year	Base CPP					
	Number of New Retirement Beneficiaries			Average Monthly Retirement Pension		
	Males	Females	Total	Males	Females	Total
				($)	($)	($)
2022	179,051	181,119	360,170	744	593	668
2023	190,941	193,832	384,774	773	621	697
2024	195,355	200,057	395,412	802	649	725
2025	204,347	208,675	413,022	834	681	756
2026	204,084	210,746	414,831	865	711	787
2027	195,547	202,045	397,592	897	735	815
2028	196,698	202,818	399,516	919	756	836
2029	195,566	202,715	398,281	941	778	858
2030	192,967	200,130	393,097	963	799	879
2035	182,557	192,934	375,491	1,099	922	1,008
2040	185,449	198,778	384,227	1,266	1,072	1,165
2045	206,080	218,087	424,168	1,448	1,244	1,343
2050	234,334	241,894	476,228	1,670	1,455	1,560
2055	258,529	262,238	520,767	1,932	1,710	1,820
2060	269,786	272,020	541,806	2,232	1,996	2,114
2065	259,152	267,220	526,372	2,598	2,337	2,466
2070	247,691	260,959	508,650	3,008	2,721	2,861
2080	257,293	269,855	527,147	3,996	3,639	3,813
2090	283,788	295,047	578,835	5,278	4,826	5,048
2100	294,913	308,468	603,381	7,060	6,475	6,761

Year	Additional CPP					
	Number of New Retirement Beneficiairies			Average Monthly Retirement Pension		
	Males	Females	Total	Males	Females	Total
				($)	($)	($)
2022	131,098	120,128	251,227	6	5	5
2023	143,845	132,832	276,678	9	8	9
2024	151,968	142,164	294,133	14	12	13
2025	161,712	151,567	313,279	22	18	20
2026	164,093	156,088	320,181	30	25	28
2027	159,945	153,334	313,279	39	32	36
2028	163,024	156,761	319,785	50	40	45
2029	164,373	159,932	324,304	60	48	54
2030	168,472	166,565	335,037	69	55	62
2035	181,737	192,250	373,987	134	109	121
2040	185,449	198,778	384,227	218	180	198
2045	206,080	218,087	424,168	325	271	298
2050	234,334	241,894	476,228	459	385	421
2055	258,529	262,238	520,767	626	527	576
2060	269,786	272,020	541,806	809	685	747
2065	259,152	267,220	526,372	969	825	896
2070	247,691	260,959	508,650	1,122	965	1,041
2080	257,293	269,855	527,147	1,488	1,296	1,390
2090	283,788	295,047	578,835	1,962	1,722	1,840
2100	294,913	308,468	603,381	2,630	2,315	2,469

Retirement Beneficiaries Mortality

Projections of retirement pensions in pay require applying survival probabilities to retirement beneficiaries. The mortality rates of CPP retirement beneficiaries used in the projections vary by age, sex, calendar year, and level of emerging pension. The mortality rates were developed based on CPP retirement beneficiaries' mortality experience for the year 2019 and the mortality improvement assumptions for the general population in this report. The projected mortality rates of retirement beneficiaries are then adjusted by level of the emerging base CPP pensions. The resulting projected mortality rates and life expectancies of retirement beneficiaries are shown in Table 83, Table 84, and Table 85.

Table 83 Mortality Rates of Retirement Beneficiaries
(annual deaths per 1,000)

	Males				Females			
Age	2022	2025	2050	2075	2022	2025	2050	2075
60	5.3	5.0	3.8	3.1	3.0	2.8	2.2	1.8
65	11.5	10.8	8.5	6.9	6.6	6.3	5.0	4.1
70	16.8	15.7	12.3	10.0	10.8	10.2	8.2	6.7
75	26.6	24.8	19.5	16.0	17.8	16.8	13.6	11.1
80	45.6	42.6	33.6	27.5	31.6	30.0	24.3	19.9
85	80.9	75.0	58.4	47.8	57.5	54.1	43.1	35.3
90	145.8	136.7	112.0	95.8	108.5	102.1	84.2	72.1

Table 84 Life Expectancies of Retirement Beneficiaries, with improvements after the year shown (1)

	Males				Females			
Age	2022	2025	2050	2075	2022	2025	2050	2075
60	25.6	25.9	27.4	28.9	28.6	28.8	30.2	31.5
65	21.1	21.4	22.9	24.2	23.9	24.0	25.4	26.7
70	17.0	17.3	18.6	19.9	19.4	19.6	20.9	22.1
75	13.2	13.4	14.6	15.7	15.3	15.4	16.6	17.7
80	9.7	9.9	11.0	11.9	11.5	11.7	12.6	13.6
85	6.8	7.0	7.8	8.5	8.2	8.4	9.2	9.9
90	4.5	4.7	5.2	5.7	5.6	5.7	6.2	6.7

(1) These are cohort life expectancies that take into account assumed future improvements in mortality of the general population and therefore differ from calendar year life expectancies, which are based on the mortality rates of the given attained year.

Table 85 Life Expectancies of Retirement Beneficiaries by Level of Base CPP Pension (2022), with future improvements(1)

	CPP Level of Pension as % of Maximum							
	Males				Females			
Age	< 37.5%	37.5-75%	75-95%	95-100%	< 37.5%	37.5-75%	75-95%	95-100%
60	24.3	24.9	25.5	26.7	27.8	28.7	29.2	29.7
65	20.3	20.5	21.0	22.0	23.3	23.9	24.4	24.8
70	16.6	16.6	16.9	17.6	19.1	19.5	19.8	20.1
75	12.9	12.9	13.0	13.5	15.1	15.3	15.6	15.7
80	9.6	9.6	9.6	9.9	11.4	11.5	11.7	11.7
85	6.7	6.7	6.7	6.9	8.2	8.2	8.3	8.3
90	4.5	4.5	4.5	4.5	5.5	5.5	5.6	5.6

(1) These are cohort life expectancies that take into account assumed future improvements in mortality of the general population and therefore differ from calendar year life expectancies, which are based on the mortality rates of the given attained year.

B.7.6 Post-Retirement Benefit Expenditures

Post-retirement benefits are paid to retirement beneficiaries who continue to work and contribute to the Plan. Post-retirement benefits are payable under both the base and additional CPP.

Working retirement beneficiaries younger than 65 are required along with their employers to contribute, whereas contributions are voluntary once reaching age 65 (up to age 69). Employers of those working beneficiaries opting to contribute are required to also contribute. The post-retirement contributions paid in a year are applied toward providing post-retirement benefits in the following years. Post-retirement benefits are described in more detail in Appendix A – Summary of Plan Provisions.

Table 86 presents the assumed share of CPP retirement beneficiaries who work and contribute to the CPP in the year of and years following pension take-up, by age and sex.

In the year of retirement, contributions are first applied toward maximizing the base and additional retirement pensions, with remaining contributions then applied toward a post-retirement benefit. The contributions to the additional Plan increase over the phase-in period both due to the increase in the contribution rate and the introduction of the YAMPE over two years. This affects the proportion of working beneficiaries who contribute in the year of pension take-up. This proportion is assumed to remain constant once the phase-in of the additional CPP is complete in 2025.

The assumption for the proportion of CPP retirement beneficiaries who are contributors after the year of retirement pension take-up is kept constant for the entire projection period.

The figures in Table 86 reflect that not all working beneficiaries contribute to the CPP, due to the following:

- having earnings less than the YBE, and
- opting out of contributing between the ages 65 and 69.

Table 86 Proportion of CPP Retirement Beneficiaries who are Contributors
(percentages)

	Year of Retirement Pension Take-Up (2025+)		After Year of Retirement Pension Take-Up	
Age	Males	Females	Males	Females
60	40	30	0	0
61	50	40	77	64
62	45	35	54	42
63	50	35	49	40
64	50	40	43	35
65	24	19	41	21
66	47	43	27	22
67	47	43	20	16
68	43	38	16	11
69	38	33	11	9

In order to project the contributions of working beneficiaries, assumptions are required with respect to their average contributory earnings (i.e., average earnings between the YBE and YAMPE on which contributions are made). For both males and females, the average contributory earnings of working beneficiaries for years after the year of retirement pension take-up are assumed to be between 20% and 35% lower than the contributory earnings of contributors who are not beneficiaries, depending on the age and sex. The resulting average annual contributory earnings of working beneficiaries up to the YMPE and YAMPE are presented respectively in Table 87 and Table 88.

Table 87 Average Contributory Earnings of Working Beneficiaries with Pensionable Earnings up to the YMPE
(dollars)

	Below Age 65		Age 65 and Above	
Year	Males	Females	Males	Females
2022	36,718	28,463	34,926	26,948
2023	38,004	29,588	36,138	27,847
2024	39,545	31,014	37,486	28,819
2025	40,706	32,211	38,623	29,720
2026	41,898	33,461	39,849	30,710
2027	43,071	34,721	41,036	31,749
2028	44,188	35,841	42,141	32,720
2029	45,362	36,983	43,249	33,743
2030	46,540	38,054	44,317	34,790
2035	51,893	42,560	49,689	39,864
2040	59,479	49,055	57,017	46,125
2045	69,351	57,831	66,474	54,358
2050	81,821	69,141	78,087	64,608
2055	95,960	81,826	91,134	76,120
2060	111,756	95,934	105,846	88,972
2065	128,416	110,603	121,703	102,778
2070	146,194	125,868	138,656	117,423
2080	193,798	167,269	184,596	157,062
2090	259,634	224,522	247,153	210,821
2100	347,318	300,829	329,630	281,786

Table 88 Average Contributory Earnings of Working Beneficiaries with Pensionable Earnings up to the YAMPE
(dollars)

Year [1]	Below Age 65		Age 65 and Above	
	Males	Females	Males	Females
2024	40,811	31,449	38,894	29,321
2025	43,256	33,098	41,484	30,784
2026	44,543	34,416	42,814	31,829
2027	45,801	35,735	44,093	32,918
2028	46,973	36,887	45,267	33,921
2029	48,196	38,048	46,440	34,978
2030	49,432	39,131	47,588	36,054
2035	54,796	43,449	53,166	41,051
2040	62,702	50,000	60,929	47,438
2045	73,171	59,066	71,042	55,976
2050	86,586	70,985	83,567	66,779
2055	101,778	84,360	97,629	78,924
2060	118,675	99,168	113,428	92,443
2065	136,293	114,317	130,333	106,781
2070	154,750	129,677	148,233	121,754
2080	204,948	172,249	197,188	162,820
2090	274,699	231,467	264,042	218,733
2100	367,707	310,536	352,211	292,582

(1) The years shown start in 2024 since it is the first year the YAMPE applies.

Around 457,000 working beneficiaries started to contribute in 2012, generating about an extra $1.1 billion in contributions that year. The number of working beneficiaries who contribute grew to about 619,000 in 2019 with corresponding contributions representing about $1.8 billion.

The corresponding post-retirement benefits started to be payable the year after contributions were made. In 2013, post-retirement benefits totaled about $63 million based on contributions made in 2012. In 2020, post-retirement benefits paid in respect of the base Plan amounted to $775 million based on contributions made in 2019 and earlier.

Table 89 shows the projected number of working beneficiaries with their contributions and resulting post-retirement benefits by year. Contributions and benefits are split between the base and additional CPP. Total contributions from working beneficiaries are projected to be about $2.1 billion in 2022 and $7.2 billion in 2050. Total post-retirement benefits payable are projected to be about $1.1 billion in 2022 and $8.7 billion in 2050.

The projected number of working beneficiaries who contribute, their earnings, and contributions are reflected in all other tables in this report that present contributors, earnings, and contributions projections, unless otherwise indicated. Similarly, the post-retirement benefits are

presented in combination with retirement benefits as total retirement expenditures in all other tables in this report where expenditures are shown by type of benefit, unless otherwise indicated.

Table 89 Working Beneficiaries – Contributors, Contributions, and Post-Retirement Benefits

Year	Number of Contributing Working Beneficiaries	Base CPP		Additional CPP	
		Contributions	Post-Retirement Benefits	Contributions	Post-Retirement Benefits
	(thousands)	($ million)	($ million)	($ million)	($ million)
2022	596	1,836	1,026	278	39
2023	620	1,974	1,217	399	72
2024	645	2,135	1,385	481	122
2025	662	2,259	1,563	561	174
2026	673	2,375	1,751	590	226
2027	675	2,457	1,923	611	287
2028	672	2,514	2,100	625	357
2029	668	2,569	2,280	638	431
2030	662	2,616	2,463	649	507
2035	629	2,803	3,373	683	904
2040	647	3,311	4,259	802	1,326
2045	717	4,293	5,178	1,042	1,800
2050	814	5,758	6,308	1,411	2,371
2055	903	7,495	7,842	1,850	3,078
2060	963	9,311	9,910	2,308	3,961
2065	951	10,592	12,483	2,622	5,027
2070	925	11,748	15,328	2,884	6,191
2080	980	16,587	22,022	4,063	8,900
2090	1,089	24,714	31,032	6,063	12,526
2100	1,157	35,077	45,143	8,621	18,240

B.7.7 Disability Benefit Expenditures

Disability expenditures result from disability benefits paid under the base and additional CPP.

Under the base CPP, disability benefits consist of the disability pension and the post-retirement disability benefit. The base CPP disability pension consists of both a flat-rate and earnings-related benefit. The post-retirement disability benefit is equal to the flat-rate benefit.

Under the additional CPP, disability benefits consist only of the additional disability pension, which is an earnings-related benefit. Eligibility for the additional disability pension follows from eligibility for the base disability pension. There is no post-retirement disability benefit payable under the additional CPP.

Disability Pension

New disability pension expenditures are determined by age and sex for each year starting in 1970 as the product of:

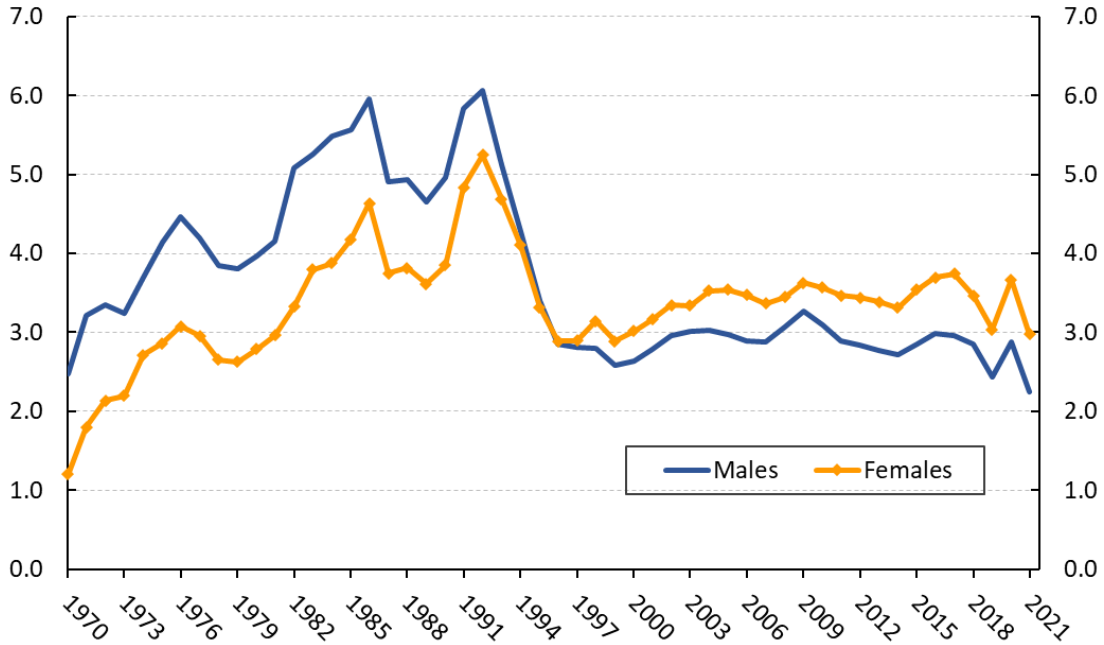
- the population;
- the disability eligibility rate;
- the disability incidence rate; and
- the average annual amount of the benefit.

The value of the emerging disability earnings-related benefit by age and sex is equal to the sum of 75% of the average retirement earnings-related benefits for the base and additional Plans.

Disability Incidence Rates

Chart 14 shows the historical disability incidence rates for the CPP disability pension, and Table 90 provides the assumed ultimate disability incidence rates for the disability pension (base and additional CPP) and post-retirement disability benefit (base CPP).

Chart 14 Historical Disability Incidence Rates
(per 1,000 eligible)



It can be seen from Chart 14 that the incidence of new CPP disability cases (i.e. the number of new cases as a proportion of the eligible population) generally increased from 1970 to the early 1990s. The annual rate of change in incidence rates was particularly acute between 1989 and the

recession of the early 1990s. After reaching a peak in 1992, disability incidence rates then declined rapidly during the 1990s. With the exception of more recent years (2019-2021), the disability incidence rates have remained relatively stable since the late 1990s.

The decline after 1992 reflects the economic recovery that occurred following the 1990-91 recession. As well, beginning in 1994, the CPP administration initiated a range of measures designed to effectively manage the growing pressure on the disability program.

More recent experience over the last three years has been very volatile, and the disability incidence rates for 2021 stand at levels that are historically low (2.25 per thousand for males and 2.98 per thousand for females). The volatility observed over the years 2019 to 2021 is attributable to administrative and COVID-19 related factors. It is not expected that such volatility will continue and, therefore, the last three years of data were not considered in the development of the ultimate disability incidence rate assumptions.

Based on the above and experience over the period 2007 to 2018, the aggregate (all ages combined using the 2021 eligible population for weights) incidence rates for the disability pension are expected to increase from 2021 to 2026. Thereafter, they are projected to remain constant at the values reached in 2026 of 2.90 and 3.60 per thousand eligible males and females, respectively. These projected aggregate rates are then distributed by age in accordance with the 2021 eligible population for each sex.

Post-retirement Disability Incidence Rates

The base CPP post-retirement disability benefit came into effect in 2019 and applies only to early retirement beneficiaries (before age 65) who become disabled.

For this 31st CPP Actuarial Report, initial benefit data regarding post-retirement disability benefits were available, as provided by ESDC. The assumed post-retirement disability incidence rates by age and sex were derived based on the data for years 2019 and 2020 along with historical records of earnings data of early retirement beneficiaries.

It is projected that, in 2026, the overall disability incidence rates in respect of the post-retirement disability benefit for early retirement beneficiaries will be 10.08 per 1,000 eligible males and 9.06 per 1,000 eligible females. As more experience data regarding post-retirement disability benefits become available, the assumptions for the incidence rates will be revised accordingly for future CPP actuarial reports.

The post-retirement disability incidence rates, which equal the ratio of the number of new post-retirement disability beneficiaries by age and sex to the respective eligible populations, are shown in Table 90.

Table 90 Ultimate Disability Incidence Rates (2026+) (1)
(per 1,000 eligible)

	Disability Pension		Post-retirement Disability Benefit	
Age	Males	Females	Males	Females
25	0.23	0.26	–	–
30	0.50	0.66	–	–
35	0.97	1.54	–	–
40	1.52	2.36	–	–
45	2.18	3.24	–	–
50	3.27	4.52	–	–
55	6.31	7.67	–	–
60	9.23	9.56	–	–
61	9.24	9.40	12.93	11.27
62	9.24	9.23	8.32	7.38
63	9.24	9.07	8.32	7.26
64	9.25	8.91	12.94	12.48
All Ages	2.90	3.60	10.08	9.06

(1) The disability incidence rates shown are adjusted by the eligible population in 2021.

Projected New Disability Benefits

Table 91 shows the projected number of new disability beneficiaries for the disability pension and post-retirement disability benefit, and Table 92 shows the projected average new base and additional disability pensions and the post-retirement disability benefits by sex and year.

Table 91 New Disability Beneficiaries

Base CPP
Number of Beneficiaries

	Disability Pension			Post-retirement Disability Benefit			ALL Disability Benefits		
Year	Males	Females	Total	Males	Females	Total	Males	Females	Total
2022	15,135	17,791	32,926	1,041	913	1,953	16,176	18,704	34,879
2023	16,270	18,923	35,193	1,169	1,018	2,187	17,439	19,941	37,380
2024	17,406	20,057	37,463	1,290	1,108	2,397	18,696	21,164	39,860
2025	18,580	21,313	39,892	1,411	1,193	2,604	19,991	22,505	42,496
2026	19,512	22,263	41,775	1,507	1,260	2,767	21,019	23,523	44,542
2027	19,507	22,363	41,870	1,505	1,256	2,761	21,012	23,619	44,631
2028	19,638	22,648	42,286	1,460	1,223	2,683	21,097	23,871	44,969
2029	19,850	23,049	42,899	1,408	1,189	2,597	21,257	24,238	45,496
2030	20,003	23,378	43,381	1,371	1,170	2,541	21,374	24,548	45,923
2035	21,222	25,278	46,501	1,371	1,197	2,567	22,593	26,475	49,068
2040	23,061	27,338	50,399	1,420	1,265	2,685	24,482	28,602	53,084
2045	24,840	28,989	53,829	1,640	1,430	3,070	26,479	30,420	56,899
2050	25,981	30,054	56,035	1,835	1,568	3,403	27,816	31,622	59,438
2055	26,494	30,641	57,134	2,058	1,720	3,778	28,552	32,361	60,912
2060	25,932	30,478	56,410	2,126	1,775	3,901	28,058	32,254	60,312
2065	25,667	30,682	56,349	1,959	1,705	3,664	27,626	32,387	60,013
2070	26,309	31,457	57,766	1,963	1,724	3,687	28,272	33,181	61,453
2080	27,933	33,316	61,249	2,056	1,790	3,846	29,989	35,106	65,095
2090	29,777	35,342	65,119	2,299	1,979	4,279	32,076	37,321	69,398
2100	30,678	36,490	67,168	2,355	2,048	4,403	33,033	38,538	71,571

Additional CPP
Number of Beneficiaries

	Disability Pension			Post-retirement Disability Benefit			ALL Disability Benefits		
Year	Males	Females	Total	Males	Females	Total	Males	Females	Total
2022	12,343	13,129	25,472	–	–	–	12,343	13,129	25,472
2023	13,835	14,689	28,524	–	–	–	13,835	14,689	28,524
2024	15,454	16,370	31,824	–	–	–	15,454	16,370	31,824
2025	16,829	17,884	34,713	–	–	–	16,829	17,884	34,713
2026	17,922	19,067	36,989	–	–	–	17,922	19,067	36,989
2027	18,092	19,463	37,555	–	–	–	18,092	19,463	37,555
2028	18,367	19,977	38,345	–	–	–	18,367	19,977	38,345
2029	18,695	20,575	39,269	–	–	–	18,695	20,575	39,269
2030	19,074	21,371	40,444	–	–	–	19,074	21,371	40,444
2035	21,222	25,278	46,501	–	–	–	21,222	25,278	46,501
2040	23,061	27,338	50,399	–	–	–	23,061	27,338	50,399
2045	24,840	28,989	53,829	–	–	–	24,840	28,989	53,829
2050	25,981	30,054	56,035	–	–	–	25,981	30,054	56,035
2055	26,494	30,641	57,134				26,494	30,641	57,134
2060	25,932	30,478	56,410	–	–	–	25,932	30,478	56,410
2065	25,667	30,682	56,349	–	–	–	25,667	30,682	56,349
2070	26,309	31,457	57,766	–	–	–	26,309	31,457	57,766
2080	27,933	33,316	61,249	–	–	–	27,933	33,316	61,249
2090	29,777	35,342	65,119	–	–	–	29,777	35,342	65,119
2100	30,678	36,490	67,168	–	–	–	30,678	36,490	67,168

Table 92 New Disability Pensions and Post-retirement Disability Benefits
(dollars)

Year	Base CPP Average Monthly Disability Pension Males	Base CPP Average Monthly Disability Pension Females	Base CPP Average Monthly Disability Pension Total	Additional CPP Average Monthly Disability Pension Males	Additional CPP Average Monthly Disability Pension Females	Additional CPP Average Monthly Disability Pension Total	Base CPP Post-retirement Disability Benefit
2022	1,068	994	1,028	7	6	7	525
2023	1,121	1,047	1,081	12	10	11	561
2024	1,156	1,082	1,117	18	16	17	578
2025	1,191	1,117	1,152	27	23	25	592
2026	1,224	1,149	1,184	36	30	33	605
2027	1,254	1,180	1,215	47	39	43	618
2028	1,287	1,212	1,247	59	49	54	630
2029	1,321	1,244	1,280	70	58	64	642
2030	1,356	1,277	1,314	79	65	72	655
2035	1,537	1,454	1,492	138	113	124	724
2040	1,742	1,656	1,695	209	172	189	799
2045	1,966	1,880	1,920	292	239	264	882
2050	2,219	2,134	2,174	387	316	349	974
2055	2,501	2,419	2,457	485	394	436	1,075
2060	2,827	2,744	2,783	577	469	518	1,187
2065	3,214	3,119	3,163	658	539	593	1,311
2070	3,640	3,539	3,586	756	623	683	1,447
2080	4,687	4,564	4,620	1,007	836	914	1,764
2090	6,021	5,873	5,941	1,344	1,123	1,224	2,150
2100	7,771	7,581	7,668	1,781	1,492	1,624	2,621

Disability Benefit Termination Rates

All emerging disability benefits (disability pensions and post-retirement disability benefits) are projected by age and sex for each future year until termination of disability (due to recovery, death, or attainment of age 65). The projected disability termination rates presented in Table 93 apply by age, sex, and duration of disability (i.e. the period of being in receipt of a disability benefit) on an attained calendar year basis. The average graduated experience over the 15-year period 2005 to 2019 is used to produce base year rates for 2019. The base year termination rates are then projected for 2022 and thereafter for males and females, by age of disability onset, and duration of disability using assumed recovery and mortality improvement rates.

Recovery improvement rates are assumed to trend to an ultimate level of 0% by 2026 (i.e. recovery rates are assumed to be constant after 2026), and mortality improvement rates of disability beneficiaries are assumed to trend to an ultimate level of 0.8% by the same year.

Table 93 Disability Termination Rates in 2022 and 2035 (1)
(per 1,000 people)

	2022											
	Males						Females					
Age	1st Year	2nd Year	3rd Year	4th Year	5th Year	6+ Year	1st Year	2nd Year	3rd Year	4th Year	5th Year	6+ Year
30	40	59	57	51	45	31	33	49	55	45	40	31
40	41	58	51	39	32	22	29	47	43	31	22	21
50	57	67	50	39	32	24	38	56	43	30	21	17
60	68	71	56	50	41	0	48	57	39	28	25	0

	2035											
	Males						Females					
Age	1st Year	2nd Year	3rd Year	4th Year	5th Year	6+ Year	1st Year	2nd Year	3rd Year	4th Year	5th Year	6+ Year
30	37	56	55	49	44	31	31	46	53	44	39	30
40	38	55	49	38	31	21	27	44	42	30	21	20
50	52	63	47	36	30	22	35	53	40	28	20	16
60	62	65	52	45	38	0	44	52	36	26	23	0

(1) Assumed termination rates for all disability benefits (disability pension and post-retirement disability benefit).

B.7.8 Survivor Pension Expenditures

Survivor expenditures result from survivor's benefits paid under the base and additional CPP. Under both components of the CPP, the survivor's pension changes form at age 65.

Under the base CPP, the survivor's pension payable to individuals younger than 65 consists of a flat-rate and earnings-related benefit. At ages 65 and older, the pension payable is earnings-related. The additional survivor's pension payable takes the same form as the base survivor's pension, except that the additional survivor's pension is strictly earnings-related with no flat-rate benefit payable.

New Survivor's Pension

New survivor pension expenditures are determined by age and sex for each year starting in 1968 as the product of:

- the number of deaths in the population;
- the probability of being married or in a common-law union at the time of death;
- the survivor eligibility rate;
- the spouses age distribution;
- the average annual amount of the benefit (flat-rate and average earnings-related benefits); and
- if applicable, the appropriate factor taking into account the base CPP earnings-related benefit limits that apply to combined survivor-disability and combined survivor-retirement pensions.

For each age and sex, the actual proportions of contributors married or in a common-law relationship at the time of death are determined from benefit statistics. The smoothed averages from recent experience over the years 2009 to 2021 , with further adjustments for younger and older ages, are used to determine the assumed proportions for future years. On the basis of the trends shown over the period 2009 to 2021, the proportions are extrapolated to 2023 and kept constant thereafter. These proportions account for benefits payable to same-sex couples. Values are shown in Table 94.

Table 94 Assumed Proportion of Contributors Married or in a Common-Law Relationship at Time of Death (2023+)
(percentages)

Age	Males	Females
20	0	0
30	18	27
40	37	59
50	54	67
60	54	57
70	62	51
80	65	34
90	49	11

The value of the emerging earnings-related survivor benefit is equal to 37.5% or 60% of the average retirement earnings-related benefit, depending on whether the surviving spouse or common-law partner is under age 65 or aged 65 or older, respectively. It is further adjusted to account for the fact that eligibility rules are more stringent for survivor benefits than for retirement benefits.

The projected number of new survivor beneficiaries by age (below 65, and 65 and older) is shown in Table 95. The projected average monthly survivor pensions of emerging (new) benefits for the base and additional CPP by age and sex are shown in Table 96.

Table 95 New Survivor Beneficiaries

Base CPP
Number of New Survivor Beneficiaries

	Under 65			65 and Over			All Ages		
Year	Males	Females	Total	Males	Females	Total	Males	Females	Total
2022	5,483	17,218	22,701	18,392	49,655	68,047	23,875	66,873	90,748
2023	5,407	16,929	22,337	18,961	50,341	69,302	24,368	67,271	91,639
2024	5,410	16,993	22,403	19,677	51,903	71,581	25,087	68,896	93,983
2025	5,389	16,931	22,319	20,392	53,521	73,912	25,780	70,451	96,232
2026	5,346	16,823	22,169	21,107	55,201	76,307	26,452	72,024	98,476
2027	5,306	16,707	22,014	21,820	56,937	78,757	27,126	73,644	100,771
2028	5,286	16,613	21,899	22,526	58,729	81,255	27,812	75,342	103,154
2029	5,291	16,626	21,917	23,218	60,560	83,778	28,509	77,186	105,695
2030	5,282	16,527	21,810	23,892	62,422	86,314	29,175	78,949	108,124
2035	5,293	16,131	21,424	26,873	71,866	98,739	32,166	87,997	120,163
2040	5,416	16,103	21,520	28,975	79,881	108,855	34,391	95,984	130,375
2045	5,536	16,386	21,922	30,109	84,853	114,962	35,646	101,239	136,884
2050	5,574	16,805	22,378	30,587	87,104	117,690	36,160	103,909	140,069
2055	5,509	17,087	22,596	31,002	87,817	118,819	36,510	104,904	141,415
2060	5,359	17,074	22,434	31,743	88,930	120,673	37,102	106,005	143,107
2065	5,188	16,681	21,868	32,797	92,431	125,228	37,984	109,112	147,097
2070	5,069	16,139	21,208	33,879	98,205	132,084	38,949	114,343	153,292
2080	4,918	15,409	20,328	35,003	109,429	144,432	39,921	124,839	164,760
2090	4,818	15,101	19,920	34,528	111,491	146,019	39,347	126,592	165,939
2100	4,626	14,726	19,351	34,121	109,742	143,863	38,747	124,468	163,215

Additional CPP
Number of New Survivor Beneficiaries

	Under 65			65 and Over			All Ages		
Year	Males	Females	Total	Males	Females	Total	Males	Females	Total
2022	3,935	11,768	15,703	4,396	4,975	9,372	8,332	16,743	25,074
2023	4,071	12,119	16,190	5,044	6,065	11,110	9,115	18,184	27,300
2024	4,267	12,717	16,984	5,788	7,402	13,190	10,055	20,119	30,174
2025	4,370	13,015	17,385	6,567	8,885	15,452	10,937	21,900	32,837
2026	4,427	13,203	17,630	7,383	10,527	17,910	11,809	23,730	35,540
2027	4,467	13,341	17,808	8,230	12,331	20,561	12,697	25,672	38,369
2028	4,513	13,461	17,974	9,104	14,290	23,394	13,617	27,751	41,368
2029	4,577	13,664	18,241	10,025	16,423	26,448	14,602	30,087	44,689
2030	4,703	13,979	18,682	11,155	18,909	30,064	15,859	32,888	48,747
2035	5,242	15,283	20,525	17,073	33,833	50,905	22,315	49,116	71,430
2040	5,401	15,748	21,150	22,097	50,835	72,932	27,498	66,584	94,081
2045	5,533	16,255	21,789	25,819	66,336	92,155	31,353	82,591	113,944
2050	5,573	16,766	22,339	28,346	76,690	105,036	33,919	93,456	127,375
2055	5,509	17,080	22,589	29,982	82,927	112,908	35,490	100,007	135,497
2060	5,359	17,074	22,433	31,378	87,308	118,686	36,737	104,382	141,119
2065	5,188	16,681	21,868	32,705	92,098	124,803	37,893	108,779	146,672
2070	5,069	16,139	21,208	33,867	98,172	132,039	38,936	114,311	153,247
2080	4,918	15,409	20,328	35,003	109,429	144,432	39,921	124,839	164,760
2090	4,818	15,101	19,920	34,528	111,491	146,019	39,347	126,592	165,939
2100	4,626	14,726	19,351	34,121	109,742	143,863	38,747	124,468	163,215

Table 96 New Survivor Pensions
(dollars)

Base CPP
Average New Monthly Survivor's Pension

Year	Under 65			65 and Over		
	Males	Females	Total	Males	Females	Total
2022	404	483	464	169	364	311
2023	424	508	488	163	365	309
2024	440	524	504	172	375	319
2025	454	539	518	184	387	331
2026	468	552	531	195	398	342
2027	480	564	544	205	407	351
2028	493	576	556	215	416	360
2029	505	589	569	225	425	370
2030	518	603	582	235	435	380
2035	590	677	655	289	491	436
2040	672	765	741	349	556	501
2045	765	866	841	415	629	573
2050	870	980	953	488	711	653
2055	988	1,108	1,079	569	804	743
2060	1,123	1,254	1,222	662	911	846
2065	1,276	1,418	1,384	773	1,041	971
2070	1,452	1,611	1,573	901	1,194	1,119
2080	1,879	2,082	2,033	1,226	1,580	1,495
2090	2,426	2,696	2,630	1,656	2,098	1,993
2100	3,139	3,487	3,403	2,221	2,786	2,652

Additional CPP
Average New Monthly Survivor's Pension

Year	Under 65			65 and Over		
	Males	Females	Total	Males	Females	Total
2022	2	3	3	1	1	1
2023	4	4	4	2	1	2
2024	6	7	7	3	2	2
2025	9	10	10	4	2	3
2026	12	13	13	5	3	4
2027	15	17	17	6	4	5
2028	19	21	21	7	5	6
2029	23	25	25	8	6	7
2030	26	29	28	9	7	8
2035	46	52	51	17	14	15
2040	71	83	80	29	26	27
2045	100	123	117	49	44	46
2050	134	170	161	78	76	77
2055	170	224	210	120	126	125
2060	206	281	263	175	197	191
2065	242	337	315	241	290	277
2070	281	396	369	318	399	378
2080	378	534	496	499	660	621
2090	507	713	663	713	968	908
2100	675	947	882	969	1,307	1,227

Survivor Beneficiaries Mortality

All survivor pensions emerging by year, age, and sex of the surviving spouse or common-law partner are projected to each subsequent year using the assumed survivor mortality rates, which reflect the higher mortality of widows and widowers compared to that of the general population. The assumed survivor mortality rates are developed based on survivor beneficiaries' mortality experience over the period 1966 to 2020 and the mortality improvement assumptions for the general population, as described earlier. Table 97 and Table 98 show the projected mortality rates of survivor beneficiaries and the resulting projected life expectancies of survivor beneficiaries by age and sex, respectively.

Table 97 Mortality Rates of Survivor Beneficiaries
(annual deaths per 1,000)

	Males				Females			
Age	2022	2025	2050	2075	2022	2025	2050	2075
60	9.1	8.6	6.7	5.4	6.2	5.9	4.6	3.8
65	14.2	13.4	10.5	8.6	9.5	9.1	7.2	5.9
70	22.3	20.8	16.3	13.3	14.8	14.0	11.2	9.2
75	35.5	33.2	26.1	21.3	22.8	21.6	17.4	14.3
80	57.4	53.7	42.3	34.6	37.0	35.2	28.5	23.3
85	92.9	86.2	67.1	54.9	62.6	58.9	46.9	38.4
90	156.4	146.6	120.1	102.8	112.3	105.7	87.2	74.6

Table 98 Life Expectancies of Survivor Beneficiaries, with improvements after the year shown (1)

	Males				Females			
Age	2022	2025	2050	2075	2022	2025	2050	2075
60	23.8	24.1	25.8	27.4	27.1	27.3	28.8	30.3
65	19.6	19.8	21.4	22.9	22.6	22.8	24.3	25.7
70	15.6	15.9	17.3	18.7	18.5	18.6	20.0	21.3
75	12.1	12.3	13.6	14.8	14.6	14.8	16.0	17.1
80	9.0	9.2	10.3	11.3	11.1	11.2	12.2	13.2
85	6.4	6.6	7.5	8.2	8.0	8.1	9.0	9.7
90	4.4	4.5	5.0	5.5	5.4	5.6	6.1	6.6

(1) These are cohort life expectancies that take into account assumed future improvements in mortality of the general population and therefore differ from calendar year life expectancies, which are based on the mortality rates of the given attained year.

B.7.9 Death Benefit Expenditures

Death benefits are flat-rate amounts that are payable only under the base CPP. There are no death benefits under the additional Plan.

The amount of lump sum death benefits payable each year is determined by age and sex as the product of:

- the number of deaths at ages 18 and over in the population;
- the survivor eligibility rate; and
- the amount of the death benefit determined by the year of death.

Table 99 shows the projected number of death benefits.

Table 99 Number of Death Benefits

Year	Males	Females	Total
2022	103,630	72,630	176,260
2023	104,342	73,988	178,330
2024	106,942	76,777	183,719
2025	109,329	79,547	188,875
2026	111,747	82,395	194,142
2027	114,268	85,389	199,657
2028	116,941	88,502	205,442
2029	119,890	91,763	211,653
2030	122,706	95,095	217,801
2035	137,706	113,058	250,764
2040	152,482	132,091	284,573
2045	163,691	148,744	312,435
2050	171,020	160,789	331,810
2055	175,552	168,056	343,607
2060	178,486	171,667	350,153
2065	182,782	175,118	357,900
2070	190,979	181,849	372,828
2080	213,925	203,688	417,613
2090	227,095	219,656	446,751
2100	226,831	222,900	449,731

B.7.10 Children's Benefit Expenditures

Children's benefits are flat-rate amounts that are payable only under the base CPP. There are no children's benefits under the additional Plan. The amount of the benefit payable to orphans and to children of disabled contributors is the same.

The number of disabled contributor's child and orphan benefits emerging each year starting in 1970 and 1968, respectively, are determined by the projected number of children of new disability and/or survivor beneficiaries, based on the assumed fertility rates. The resulting number of emerging child beneficiaries by age, sex, and calendar year are thereafter projected from one year to the next, incorporating the following reasons for termination of benefits:

- attainment of age 25 by the child;
- ceasing full-time attendance at school while over age 18; and
- regarding disabled contributor's child benefits only, termination (by reason of recovery, death, or attainment of age 65) of the parent's disability benefits.

As of 1 January 2019, eligible children of early retirees who are deemed disabled and meet disability eligibility requirements receive the children's benefit.

Table 100 shows the projected number of new children's benefits by type and year.

Table 100 New Children's Benefits

Year	Disabled Contributor's Child [1]	Orphans	Total
2022	11,709	8,674	20,383
2023	12,670	8,648	21,318
2024	13,727	8,844	22,571
2025	14,910	8,911	23,821
2026	15,861	8,940	24,801
2027	16,115	8,970	25,085
2028	16,543	9,054	25,598
2029	17,045	9,261	26,306
2030	17,423	9,349	26,772
2035	19,265	9,718	28,983
2040	21,139	10,212	31,351
2045	22,449	10,495	32,944
2050	22,970	10,431	33,401
2055	23,051	10,100	33,151
2060	22,997	9,744	32,741
2065	23,443	9,494	32,937
2070	24,178	9,379	33,557
2080	25,749	9,205	34,954
2090	26,811	8,892	35,704
2100	27,943	8,561	36,505

(1) Includes benefits payable to children of disabled retirees receiving the post-retirement disability benefit.

B.8 Operating Expenses

The operating expenses of the CPP have historically arisen from different sources, including ESDC, the CRA, Public Services and Procurement Canada, the Office of the Superintendent of Financial Institutions Canada, the Department of Finance Canada, and the CPPIB, where the majority of the operating expenses are attributable to ESDC and the CRA. For the purpose of this 31st CPP Actuarial Report, operating expenses of the CPPIB are included in the investment expenses assumptions for the base and additional CPP, as discussed in section B.6.6 of this report. For the following discussion, operating expenses pertain only to those expenses incurred by government organizations (e.g. ESDC).

In the calendar year 2021, operating expenses for the base and additional Plans from all sources (other than the CPPIB) amounted to about $759 million and $187 million, respectively, for a total of $946 million. The base and additional Plan operating expenses equal, respectively, 0.1% and 0.024% of total employment earnings, for a total of 0.124% of total employment earnings in 2021.

Based on actual expenses for years 2020 and 2021 along with estimates provided by ESDC for years 2022 to 2024, the annual total operating expenses in respect of both the base and

additional CPP are on average close to 0.115% of total annual employment earnings over the period 2020-2024. It is assumed that total operating expenses (excluding the CPPIB) will transition linearly from 0.124% of total employment earnings in 2021 to 0.115% of total earnings by 2024 and remain at that level thereafter.

Based on information provided by ESDC, it is assumed for this report that operating expenses will be allocated as 73% to the base Plan and 27% to the additional Plan, and that this allocation of expenses will be reached by 2024 and remain constant thereafter. As such, it is projected that base Plan operating expenses as a percentage of total employment earnings will transition from 0.1% in 2021 to 0.084% by 2024 and remain constant thereafter. For the additional Plan, it is projected that total operating expenses as a percentage of total employment earnings will transition from 0.024% in 2021 to 0.031% by 2024 and remain constant thereafter.

Table 101 and Table 102 show the projected total operating expenses of the base CPP and additional CPP, respectively as a percentage of total employment earnings.

Table 101 Operating Expenses – Base CPP (1)

Year	Operating Expenses ($ million)	Total Earnings (2) ($ million)	Operating Expenses as % of Total Earnings (%)
2022	775	823,656	0.094
2023	768	863,211	0.089
2024	756	899,943	0.084
2025	787	937,262	0.084
2026	817	972,783	0.084
2027	847	1,009,361	0.084
2028	879	1,047,268	0.084
2029	912	1,085,983	0.084
2030	945	1,125,534	0.084
2035	1,130	1,346,437	0.084
2040	1,341	1,597,232	0.084
2045	1,595	1,899,381	0.084
2050	1,892	2,253,547	0.084
2055	2,226	2,651,238	0.084
2060	2,602	3,099,531	0.084
2065	3,038	3,618,653	0.084
2070	3,562	4,242,605	0.084
2080	4,971	5,921,931	0.084
2090	6,950	8,278,334	0.084
2100	9,634	11,475,969	0.084

(1) CPPIB operating expenses are not included in base Plan operating expenses, but are accounted for separately in the investment expenses assumption.
(2) Total earnings used to project operating expenses include earnings from working beneficiaries

Table 102 Operating Expenses - Additional CPP [1]

Year	Operating Expenses ($ million)	Total Earnings [2] ($ million)	Operating Expenses as % of Total Earnings (%)
2022	224	823,656	0.027
2023	252	863,211	0.029
2024	279	899,943	0.031
2025	291	937,262	0.031
2026	302	972,783	0.031
2027	313	1,009,361	0.031
2028	325	1,047,268	0.031
2029	337	1,085,983	0.031
2030	349	1,125,534	0.031
2035	418	1,346,437	0.031
2040	496	1,597,232	0.031
2045	590	1,899,381	0.031
2050	700	2,253,547	0.031
2055	823	2,651,238	0.031
2060	962	3,099,531	0.031
2065	1,124	3,618,653	0.031
2070	1,317	4,242,605	0.031
2080	1,839	5,921,931	0.031
2090	2,570	8,278,334	0.031
2100	3,563	11,475,969	0.031

(1) CPPIB operating expenses are not included in additional Plan operating expenses, but are accounted for separately in the investment expenses assumption.

(2) Total earnings used to project operating expenses include earnings from working beneficiaries.

Appendix C – Financing the Canada Pension Plan

C.1 Historical and Legislative Background

The retirement system in Canada has been designed as a three-tier system. First, the Old Age Security (OAS) program provides a minimum floor benefit based on age and residence in Canada. Second, the CPP and QPP cover most individuals with employment earnings. Finally, individuals may be covered by registered pension plans (RPPs) as well as pooled registered pension plans (PRPPs), and can invest in individual registered retirement savings plans (RRSPs) and tax-free saving accounts (TFSAs) to supplement their retirement income.

Each tier is financed using a different approach: the OAS program is financed through general tax revenues on a pay-as-you-go basis, the CPP and QPP each consist of base and additional plans, which are, respectively, partially and fully funded based on contributions on employment earnings, and RPPs, PRPPs, RRSPs, and TFSAs are intended to be fully funded. The variety in both the sources and methods of financing enables the Canadian retirement income system to be more resilient to changes in demographic, economic, and investment conditions compared to systems that are less varied in their provision of retirement income.

The CPP was initially established as a pay-as-you-go plan with a small reserve fund worth about two years of benefits. At the time of the Plan's inception, demographic, economic, and investment conditions were characterized by a younger population (higher fertility rates and lower life expectancies), rapid growth in wages and labour force participation, and low rates of return on investments. These conditions made prefunding the scheme unattractive and pay-as-you-go financing more appropriate. Growth in total earnings of the workforce and thus contributions were sufficient to cover growing expenditures without requiring large increases in the contribution rate. The Plan's assets were invested primarily in long-term non-marketable securities of provincial governments at lower than market rates, thus providing the provinces with a relatively inexpensive source of capital to develop needed infrastructure.

However, changing conditions over time, including lower birth rates, increased life expectancies, and lower real wage growth led to increasing Plan costs. These factors, in combination with higher market returns, made fuller funding more attractive and appropriate. By the mid-1980s, the net cash flow (contributions less expenditures) had turned negative and part of the Plan's investment income was required to meet the shortfall. The shortfall continued to grow, which eventually caused the assets of the reserve fund to start to fall by the mid-1990s.

In the December 1993 (15th) Actuarial Report on the CPP, the Chief Actuary projected that the pay-as-you-go contribution rate (expenditures as a percentage of contributory earnings) would increase to 14.2% by 2030. It was further projected that if changes were not made to the Plan, the reserve fund would be exhausted by 2015. The Chief Actuary identified five factors responsible for the increasing costs of the Plan, namely: lower birth rates, higher life expectancies than projected, the effect of the early 1990s recession on the proportions of earners and average employment earnings, benefit enrichments, and increased numbers of Canadians claiming

disability benefits for longer periods.

In response to these developments, amendments were made in 1998 to gradually increase the level of CPP funding by increasing contribution rates over the short term, reducing the growth of benefits over the long term, and investing net cash flows in the private markets through the CPPIB to achieve higher rates of return. It was also decided that any future increases to benefits or additions of new benefits under the Plan should be fully funded. The reform package agreed to by the federal and provincial governments in 1997 thus included significant changes to the Plan's financing provisions:

- The introduction of *steady-state funding* to replace pay-as-you-go financing in order to build a reserve of assets and stabilize the ratio of assets to expenditures over time. Investment income on this pool of assets is projected to help pay benefits as the large cohort of baby boomers retires. This refers to paragraph 113.1(4)(c) of the *Canada Pension Plan*.
- The introduction of *full funding* that requires that changes to the CPP that increase benefits or add new benefits be fully funded, i.e. that their costs be paid as the benefits are earned and that any costs associated with benefits that have already been earned but not paid for must be amortized and paid for over a defined period of time consistent with common actuarial practice. This refers to paragraph 113.1(4)(e) of the *Canada Pension Plan*.

Both of the financing objectives (steady-state and full funding) were introduced to improve fairness across generations and improve the financial long-term sustainability of the base Plan. The move to steady-state funding eases some of the contribution burden on future generations, while under full funding each generation that will receive benefit enrichments is more likely to pay for such enrichments in full so that the associated costs are not passed on to future generations.

The steady-state and any full funding contribution rates in respect of the base CPP are determined by the Chief Actuary in accordance with paragraphs 115(1.1)(c) and (e) of the *Canada Pension Plan* and the prescribed regulations (discussed below).

In 2016, the federal and provincial governments agreed to expand the CPP by creating the additional CPP.

The full funding of the additional CPP is a result of the 1997 reforms to the Plan, specifically the requirement to fully fund any increased or new benefits. In accordance with paragraph 113.1(4)(d) of the *Canada Pension Plan*, the additional retirement, survivor, and disability benefits provided by the additional Plan are to be financed by additional contribution rates that (i) are no lower than the lowest constant rates that can be maintained over the foreseeable future, and (ii) result in projected revenues (contributions and investment income) that are sufficient to fully pay the projected expenditures of the additional CPP over the long term.

The rates referred to in paragraph 113.1(4)(d) of the CPP statute are the first and second additional minimum contribution rates (FAMCR, SAMCR), which apply, respectively, to the first

and second tier of the additional CPP. The AMCRs are determined by the Chief Actuary in accordance with paragraphs 115(1.1)(d) and (e) of the *Canada Pension Plan* and the prescribed regulations (discussed below). The AMCRs are calculated before and after accounting for any future increase in benefits or new benefits in accordance with the full funding requirements of paragraph 113.1(4)(e) of the CPP statute.

The regulations setting out the calculation of contribution rates for the base and additional are the *Calculation of Contribution Rates Regulations, 2021*.

C.2 Calculation of Base and Additional Minimum Contribution Rates

Base CPP

The financing objective of the base Plan is stated in the CPP statute in terms of the steady-state contribution rate and full funding rate for any increased or new benefits. The minimum contribution rate for the base CPP is the sum of the steady-state contribution rate and full funding rate as described below.

C.2.1 Steady-State Contribution Rate

The steady-state contribution rate calculation is specifically defined in the *Calculation of Contribution Rates Regulations, 2021* as the lowest level contribution rate, applicable after the end of the review period, to the nearest 0.01% that results in the projected assets/expenditures (A/E) ratio of the base Plan being the same in the 10th and 60th years following the end of the review period. For this report, the end of the review period is 2024. Therefore, the steady-state contribution rate is applicable for 2025 and thereafter and the relevant years for the determination of the steady-state contribution rate are 2034 and 2084. The corresponding A/E for those years is determined to be 8.5, and the steady-state contribution rate, which is rounded to the nearest 0.01%, is determined to be 9.53% for the year 2025 and thereafter for this report.

The steady-state contribution rate is calculated separately from the full funding rate for any increased or new benefits.

C.2.2 Full Funding Rate of Increased or New Benefits

Subparagraph 115(1.1)(c)(ii) and paragraph 115(1.1)(f) of the CPP statute require the Chief Actuary to specify, in the report, a contribution rate in respect of any increased or new benefits for the base CPP in accordance with the requirements of paragraph 113.1(4)(e). The amendments to the *Canada Pension Plan* introduced under the *Budget Implementation Act, 2018, No. 1*, which received Royal Assent on 21 June 2018, include amendments in respect of the base CPP that required the application of 113.1(4)(e). These amendments are described in the 29th CPP Actuarial Report.

The amendments under the *Budget Implementation Act, 2018, No. 1* invoke the full funding requirement for the base Plan. The temporary and permanent full funding contribution rate

calculations for the base CPP are defined in the *Calculation of Contribution Rates Regulations, 2021*.

The effect of the amendments under the *Budget Implementation Act, 2018, No. 1* on the long-term financial states of the base and additional CPP were first evaluated in the 29th CPP Actuarial Report, then were re-evaluated for the 30th CPP Actuarial Report and now for this 31st CPP Actuarial Report.

On the basis of this report, the full funding rates for the base CPP were determined as follows.

Temporary Full Funding Rate

Since amended base CPP survivor, disability, and death benefits that came into pay after 1 January 2019 are based on contributors' CPP participation both before and after the effective date of the proposed amendments, there is a portion of the projected increase in liabilities that relates to Plan participation prior to the effective date. The increase in liabilities for Plan participation prior to 2019 is determined as at the year following the triennial review period, or as at the effective date of the amendments if later. The triennial review period in respect of this report is 2022 to 2024. As such, this increase in liabilities is calculated as the present value as at 1 January 2025 of the projected increase in base CPP expenditures relating to Plan participation prior to 2019 and is estimated at $1.7 billion.

The net accumulated assets in respect of the past unfunded liabilities are determined at the end of year 2024 based on the:

- projected increase in expenditures relating to Plan participation prior to 2019 over the years 2019 to 2024, and
- contributions calculated using the temporary full funding rate of the previous (30th) report over the same period.

These net accumulated assets are equal to $270 million as at 31 December 2024.

The temporary full funding contribution rate in respect of the increase in liabilities is determined to be 0.0252%. The temporary full funding rate is equal to the ratio of:

- the difference of the increase in liabilities and the net accumulated assets to
- the present value as at 1 January 2025 of contributory earnings over the period 2025 through 2033.

The amortization of the past unfunded liabilities was initially over the 15-year period 2019-2033 in the 29th CPP Actuarial Report. As the valuation date of this 31st CPP Actuarial Report is six years later than the valuation date of the 29th Report, the remaining amortization period is the 9-year period 2025-2033. The amortization period under both reports is consistent with common actuarial practice, as provided in the legislation.

Permanent Full Funding Rate

As for past participation, the increase in liabilities for Plan participation on or after 1 January 2019 is determined as at the year following the triennial review period, or as at the effective date of the amendments if later.

As such, the increased liabilities due to the base CPP amendments in respect of participation on or after 1 January 2019 is determined as at 1 January 2025 and are estimated to be $3.2 billion, and the corresponding net accumulated assets are estimated to be $476 million as at 31 December 2024. The difference between these liabilities and assets is fully funded with a permanent contribution rate of 0.0094%.

Total Full Funding Rates

The sum of the temporary and permanent full funding rates for the years 2025-2033 is 0.0346% (0.0252% plus 0.0094%) and 0.0094% for 2034 and thereafter. The rounded full funding rate is 0.03% for years 2025 to 2033 and 0.01% for the year 2034 and thereafter. The calculations and results are summarized in Table 103.

The Chief Actuary will review the full funding rates on a periodic basis to account for actual experience and any change in assumptions.

Table 103 Full Funding Rates in Respect of the Amendments to the Base CPP

Present Value of Contributory Earnings (2025-2033) as at 1 Jan. 2025	(A) [1]	5,786	($ billion)
Increase in Liability after 2024 due to Participation prior to Effective Date (1 Jan. 2019) as at 1 Jan. 2025	(B) [2]	1,727	($ million)
Net Accumulated Assets over Period 2019-2024 for Service prior to 2019 as at 31 Dec. 2024	(C) [3]	270	($ million)
Temporary Full Funding Rate (2025-2033)	(D) = (B-C)/(A)	0.0252%	
Present Value of Contributory Earnings (2025+) as at 1 Jan. 2025	(E) [1]	29,111	($ billion)
Increase in Liability after 2024 due to Participation on or after Effective Date (1 Jan. 2019) as at 1 Jan. 2025	(F) [2]	3,206	($ million)
Net Accumulated Assets over Period 2019-2024 for Future Service from 2019 Onward as at 31 Dec. 2024	(G) [3]	476	($ million)
Permanent Full Funding Rate (2025+)	(H) = (F-G)/(E)	0.0094%	
Permanent and Temporary Rate (2025-2033)	(I) = (D) + (H)	0.0346%	
Permanent and Temporary Rate, after Rounding as per Regulations	(I), (H) after rounding applied as per Regulations	0.03%, 2025-2033 0.01%, 2034+	

(1) Present values based on contributory earnings as projected under this report and using a discount rate equal to the assumed overall rate of return on base CPP assets.
(2) Increase in liabilities resulting from increase in benefits due to participation prior to the effective date (B) and on or after the effective date (F), using a discount rate equal to the assumed overall rate of return on base CPP assets.
(3) Represents accumulation of assets net of expenditures over the period 2019-2024 in respect of amendments for participation prior to the effective date (C) and on or after the effective date (G), using the full funding rates determined under the 30th CPP Actuarial Report.

C.2.3 Minimum Contribution Rate

The minimum contribution rate (MCR) is the sum of the rounded steady-state contribution rate and the rounded full funding rate. For this report, the MCR is determined to be 9.56% for years 2025 to 2033 and 9.54% for 2034 and thereafter. This compares to the MCR under the 30th CPP Actuarial Report of 9.75% for years 2022 to 2033 and 9.72% for 2034 and thereafter. The MCR will be recalculated for the next triennial actuarial report to be prepared as at 31 December 2024. It may also be recalculated at any other date to reflect the cost impact of any proposed amendments to the CPP statute.

As the MCR determined for this 31st CPP Actuarial Report is less than the legislated contribution rate of 9.9%, the insufficient rates provisions in subsections 113.1(11.05) to (11.15) of the CPP statute do not apply. Therefore, in the absence of specific action by the federal and provincial governments, the legislated contribution rate will remain at 9.9% for the year 2022 and thereafter.

Additional CPP

C.2.4 Additional Minimum Contribution Rates

The financing objective of the additional Plan is stated in the CPP statute in terms of the AMCRs (FAMCR and SAMCR) that must be determined before and after taking into account the full funding of any increased or new additional benefits.

The AMCRs are defined specifically in the *Calculation of Contribution Rates Regulations, 2021* as the lowest level contribution rates, applicable after the end of the review period, to the nearest 0.0001 percentage points, such that the following conditions are met:

- the present value of projected additional open group obligations is less than or equal to the projected additional assets and present value of projected additional contributions (open group assets);
- the projected assets/expenditures (A/E) ratio of the additional Plan is the same in the 50th and 60th years following the end of the review period, but no earlier than in the years 2088 and 2098, respectively; and
- the SAMCR equals the FAMCR multiplied by the ratio of the earnings replacement rate of the second tier of the additional Plan to the replacement rate of the first tier (33.33% / 8.33%, which equals 4).

In regard to the first condition above, an open group is defined as one that includes all current and future participants of a plan, where the plan is considered to be ongoing into the future, that is, over an extended time horizon. This means that future contributions of current and new participants and their associated benefits are included in order to determine whether current assets and future contributions will be sufficient to pay for all future expenditures.

To determine the open group assets of the additional Plan, future additional contributions (using additional minimum contribution rates) of current and future contributors are projected using the best-estimate assumptions of this report. In order to determine their present value, the projected additional contributions are discounted using the assumed nominal rate of return on the additional CPP assets. This present value is added to the invested assets of the additional Plan to obtain the total open group assets.

To determine the actuarial obligations of the additional Plan on an open group basis, future additional expenditures with respect to current and future additional CPP participants are projected using the best-estimate assumptions of this report. The open group actuarial obligations are then the present value of these projected additional expenditures discounted using the assumed nominal rate of return on additional CPP assets.

Table 104 shows that the AMCRs satisfy the first condition above. The table shows that, as at 31 December 2021, the additional CPP open group assets are projected to be 105.2% of the open group actuarial obligations. There are $11 billion invested additional CPP assets as at

31 December 2021, and the total open group assets are equal to the present value of future additional contributions of current participants and future participants of the Plan plus the current invested assets. The open group actuarial obligations are equal to the sum of the present value of future additional benefits for current and future participants of the additional CPP and the benefits in pay, which amounts to $857 billion as at 31 December 2021.

Table 104 Additional CPP Balance Sheet (Open Group Basis)
(1.97%/7.88% First/Second Additional Minimum Contribution Rates, $ billion)

	As at 31 December 2021
Assets	
Current Assets	11.0
Future Contributions	889.7
Total Assets (a)	900.7
Actuarial Obligations (b) [1]	856.5
Asset Excess (Shortfall) (a) – (b)	44.2
Assets as percentage of Obligations (a)/(b)	105.2%

(1) Obligations include operating expenses.

For this report, the A/E ratio should be the same in 2088 and 2098, and the corresponding A/E ratio for those years is equal to about 24.

The current triennial review period of the CPP is 2022 to 2024, which is part of the initial phase-in period of the additional CPP. During the review period, the legislated first additional contribution rate applies: 1.5% for the year 2022, 2.0% for 2023 and 2024. The legislated second additional contribution rate is 8% for 2024 which is the first year of the second tier of the additional CPP.

The FAMCR and SAMCR are applicable for 2025 and thereafter. The FAMCR and SAMCR are rounded to the nearest 0.01%, and are determined for this report to be 1.97% and 7.88% for 2025 and thereafter.

As the AMCRs determined for this report do not deviate materially from the legislated additional contribution rates, the default provisions of the *Additional Canada Pension Plan Sustainability Regulations* do not apply. Therefore, in the absence of specific action by the federal and provincial governments, the legislated first additional contribution rate will remain at 1.5% for 2022 and 2.0% for 2023 and thereafter, and the legislated second additional contribution rate will remain at 8.0% for 2024 and thereafter.

C.3 Evolution of Assets to Expenditures Ratios

An important measure of the base and additional Plans' financial states is the ratio of assets at the end of one year to the expenditures of the next year (the A/E ratio).

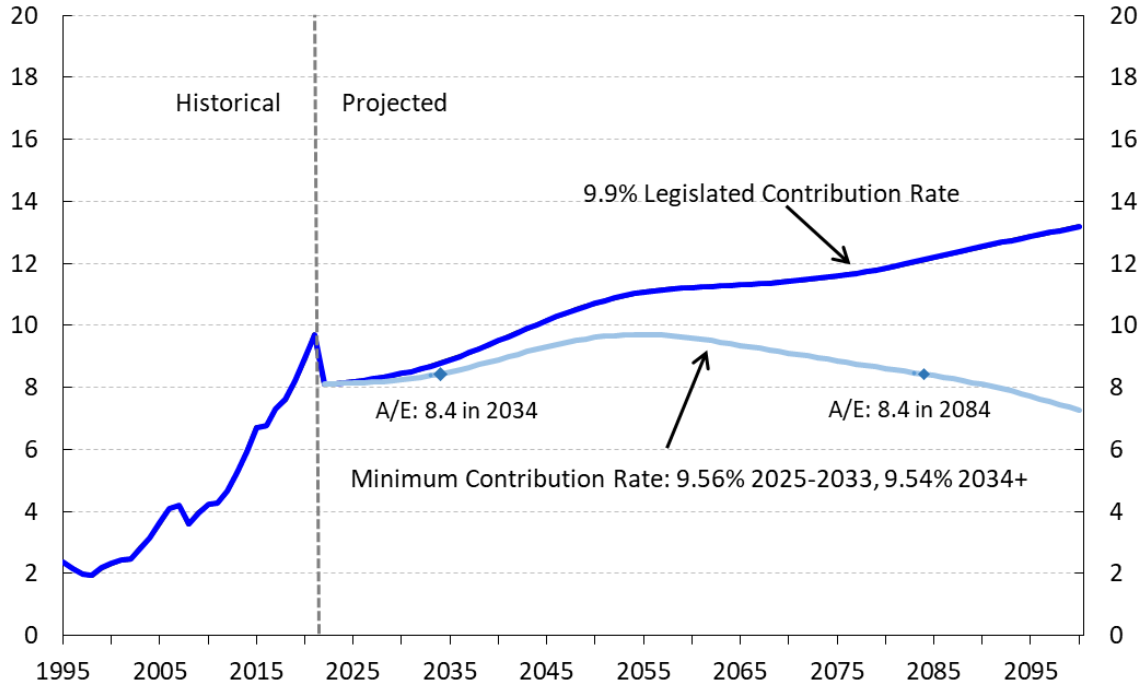
Base CPP

As can be seen in Chart 15, under the legislated contribution rate of 9.9%, the A/E ratio for the base Plan is projected to remain relatively stable at a level slightly above 8.0 over the period 2022 to the early 2030s. Thereafter, it continues to rise overall to a value of 13.2 in 2100.

As the legislated rate of 9.9% is greater than the MCR of 9.56% for years 2025-2033 and 9.54% thereafter, the A/E ratios under the legislated rate are higher than the ratios under the MCR. The A/E ratios under the MCR for years 2025 and thereafter are shown in Chart 15 for comparison. The ratios under the MCR in years 2034 and 2084 are nearly equal, at a value of about 8.4, as indicated in the chart. This is because the years 2034 and 2084 are the target years for the steady-state contribution rate of 9.55%, under which the A/E ratios are equal for those years at a value 8.4.

The projected initial slowdown in the growth of the A/E ratio until the early 2030s under the legislated rate of 9.9% is caused by the retirement of the baby boom generation, which increases the cash outflows of the Plan. The existence of a large pool of assets enables the base Plan to absorb the increased outflow and maintain the contribution rate at 9.9%.

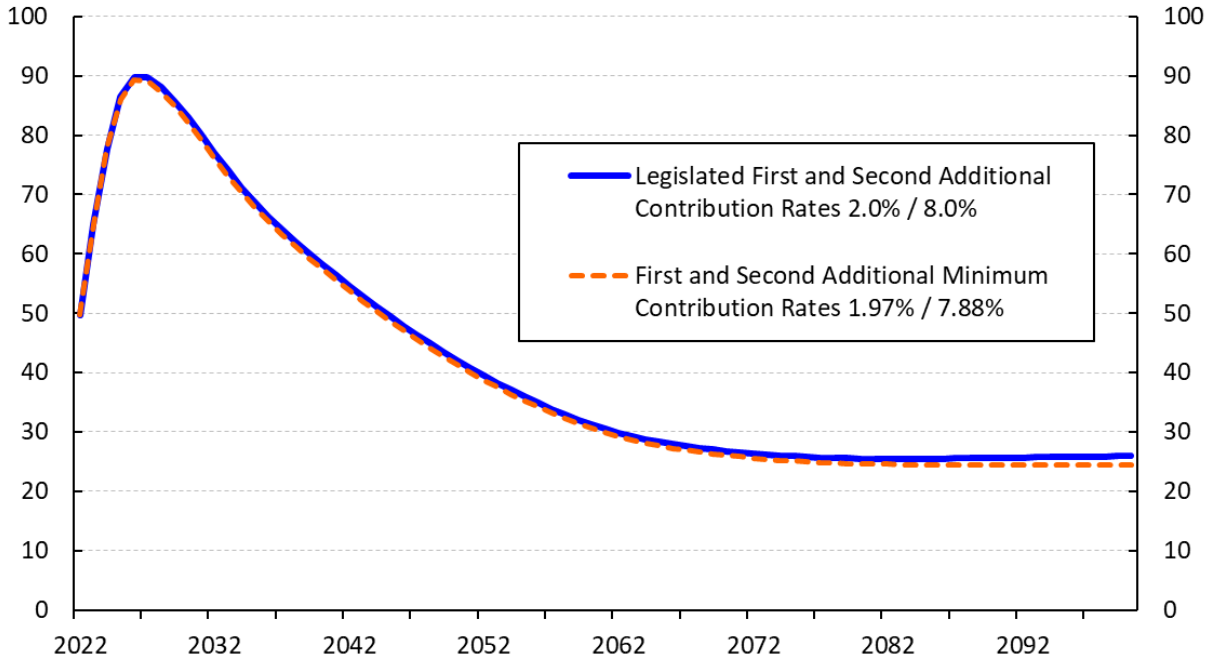
Chart 15 Assets/Expenditures Ratio – Base CPP
(legislated and minimum contribution rates)



Additional CPP

As shown in Chart 16, under the legislated additional contribution rates of 2.0% and 8.0%, the A/E ratio of the additional CPP is projected to increase significantly during the early years of the additional Plan and remain high as assets rapidly accumulate and benefit expenditures are low. As the additional Plan matures and benefit expenditures increase, the A/E ratio decreases and stabilizes at a level of about 26 by 2075. The A/E ratio under the AMCRs, also shown in Chart 16, is projected to be slightly lower than under the legislated rates, since the AMCRs are close to the legislated rates. The target years of 2088 and 2098, which are used in the determination of the AMCRs, are marked in the chart, and the corresponding A/E ratio is 24.

Chart 16 Assets/Expenditures Ratio – Additional CPP
(legislated and additional minimum contribution rates)



C.4 Open Group Balance Sheets under the Legislated Contribution Rates

The base and additional CPP balance sheets presented in this section are prepared using an open group approach and the legislated contribution rates of each component. The open group balance sheet methodology is described earlier, in section C.2.4 of this appendix.

The choice of the methodology used to produce a social security system's balance sheet needs to be consistent with the financing objectives of the system.

The base CPP is partially funded. Partially funded plans like the base CPP represent a social contract where, in any given year, current contributors allow the use of their contributions to pay

current beneficiaries' benefits. This social contract creates claims for current and past contributors to contributions of future contributors. As such, the proper assessment of the financial sustainability of partially funded plans by means of their balance sheets should reflect these claims. The open group approach to the balance sheet does account explicitly for these claims by considering the benefits and contributions of both current and future participants.

As discussed in section C.2, the legislated financing objectives of the base CPP are stated in terms of the MCR, which is determined using future projections of revenues and expenditures that consider both current and future CPP participants. In other words, the legislated financing objectives of the base CPP rely on open group projections.

The additional CPP is a fully funded plan. However, as discussed in section C.2.4, the legislated financing objectives of the additional CPP are stated in terms of the AMCRs which are determined using open group projections.

The actuarial balance sheets of the base and additional Plans under their respective legislated rates are complementary to the MCR and AMCRs in assessing the long-term financial sustainability of the two components of the CPP. That is to say that although the key legislatively prescribed financial measures for evaluating the components of the CPP are the MCR and AMCRs, specifically, their adequacy and stability over time, other indicators such as the open group balance sheets under the legislated rates could be used in combination with the minimum rates to assess the sustainability of the base and additional Plans.

It is worth emphasizing that none of the other individual financial indicators provide an absolute measure of the base or additional Plan's sustainability. In particular, the base and additional Plans can tolerate fluctuations in the ratio of assets to obligations, both below and above 100%, without affecting the base or additional Plan's financial sustainability.

Base CPP

The actuarial position of the base Plan as at 31 December 2021 and 31 December 2030 under the open group approach and the legislated contribution rate of 9.9% is presented in Table 105. The open group actuarial assets and obligations of the base CPP are determined similarly as for the additional CPP, as described earlier in section C.2.4, but using the base CPP projected contributions and expenditures and the expected rate of return on base CPP assets as a discount rate. To obtain the asset excess (shortfall) of the base CPP, the base Plan's actuarial obligations are deducted from the open group assets at the valuation date. [1]

[1] As at 31 December 2021, under the closed group approach, the actuarial obligations of the base Plan are equal to $1,686.1 billion, the assets are $543.7 billion, and the assets shortfall is equal to $1,142.4 billion.

Table 105 Base CPP Balance Sheet (Open Group Basis)
(9.9% Legislated Contribution Rate, $ billion)

	As at 31 December 2021	As at 31 December 2030
Assets		
Current Assets	543.7	791.2
Future Contributions	3,039.7	3,554.1
Total Assets (a)	3,583.4	4,345.3
Actuarial Obligations (b) (1)	3,523.0	4,268.0
Asset Excess (Shortfall) (a) – (b)	60.4	77.4
Assets as percentage of Obligations (a)/(b)	101.7%	101.8%

(1) Obligations include operating expenses.

Additional CPP

The prescribed regulations set out the determination of the ratio of the actuarial assets to obligations of the additional Plan on an open group basis in order to determine the AMCRs.[1] In this section, the open group additional CPP balance sheet is prepared under the legislated additional contribution rates.

The actuarial position of the additional Plan as at 31 December 2021 under the open group approach and additional minimum contribution rates is presented in Table 104. The figures shown in Table 104 differ from those shown in Table 106, since different contribution rates are used. The legislated additional contribution rates are used for Table 106, whereas the AMCRs are used for Table 104.

To obtain the asset excess (shortfall) of the additional Plan, the additional Plan's actuarial obligations are deducted from the open group assets at the valuation date. As shown in Table 106, the ratio of the additional Plan's assets to its obligations using the legislated additional contribution rates is determined for this report to be 106.7% as at 31 December 2021 and 105.8% as at 31 December 2030.

[1] As at 31 December 2021, under the closed group approach, the actuarial obligations of the additional Plan are equal to $12.2 billion, the assets are $11.0 billion, and the assets shortfall is equal to $1.2 billion.

Table 106 Additional CPP Balance Sheet (Open Group Basis)
(2.0%, 8.0% Legislated First and Second Additional Contribution Rates, $ billion)

	As at 31 December 2021	As at 31 December 2030
Assets		
Current Assets	11.0	199.6
Future Contributions	902.7	1,056.8
Total Assets (a)	913.7	1,256.4
Actuarial Obligations (b) [1]	856.5	1,188.0
Asset Excess (Shortfall) (a) – (b)	57.2	68.4
Assets as percentage of Obligations (a)/(b)	106.7%	105.8%

(1) Obligations include operating expenses.

Appendix D – Detailed Reconciliations with Previous Report

D.1 Base CPP

The results presented in this report differ from those previously projected for a variety of reasons. Differences between the actual experience for 2019 through 2021 and that projected in the 30th CPP Actuarial Report for the same period were addressed in the Reconciliation with Previous Triennial Reports – Base CPP section 7.1 of this report. Since historical results provide the starting point for the projections shown in this report, these differences have an effect on the projections. This section provides more details on the impact of the experience update and changes in the assumptions and methodology.

A reconciliation of the change in the MCR of 9.75% for years 2022 to 2033 and 9.72% thereafter as presented in the 30th CPP Actuarial Report to the MCR of 9.56% for years 2025 to 2033 and 9.54% thereafter determined for this report is provided in Table 107.

The experience over the period 2019 to 2021 was better than anticipated overall, which lowered the MCR. In particular:

- The main contributing factor for the decrease in the MCR was the better than expected investment experience, which lowers the MCR by 0.35 percentage points.
- Higher than anticipated growth in total employment earnings decreases the MCR by 0.04 percentage points.
- Overall lower than expected benefit expenditures, which resulted from lower retirement benefits (due to lower retirement benefit take-up at age 60 compared to expected), disability benefits (lower disability incidence rate compared to expected), survivor benefits, children benefits and operating expenses outweighing higher death benefits than expected decreases the MCR by 0.15 percentage points.

Changes made to the key best-estimate assumptions since the previous triennial report were outlined in Table 1 of section 4 of this report. The effects of these changes on the MCR are also shown in Table 107 and are summarized below.

- The assumed total fertility rates are lower than those assumed in the previous triennial report, and as such, increase the MCR by 0.08 percentage points.
- The initial lower mortality rates and mortality improvement rates assumed for this report decrease the MCR by 0.06 percentage points.
- The assumed level of net migration is higher over the projection period than in the previous triennial report, and this decreases the MCR by 0.13 percentage points. This is a result of higher growth in total contributory earnings outweighing the ultimate increase in benefit expenditures.
- The higher assumed labour force participation and employment rates decrease the MCR by 0.07 percentage points.

- The higher assumed level of price increases (inflation) over the short term compared to the previous report decreases the MCR by 0.04 percentage points.
- The change in the real wage increase assumption increases the MCR by 0.18 percentage points due to the lower increase in contributory earnings compared to the previous triennial report.
- Several changes were made in respect of real rate of return assumptions compared to the previous triennial report. These changes include a different initial and ultimate asset mix, different ultimate rates of return for certain asset classes, as well as adjustments made in order to reflect the impact of the subsequent event described in section 2.3. These changes increase the MCR by 0.37 percentage points.
- Changes in retirement benefit-related assumptions increase the MCR by 0.07 percentage points. Changes to the disability benefit assumptions decrease the MCR by 0.05 percentage points.

Some other assumptions, which are described in Appendix B, were also changed. Overall, the changes in these other assumptions had the effect of slightly decreasing the MCR.

The impacts on the MCR resulting from changes in assumptions include revisions to reflect the subsequent event disclosed in section 2.3. Overall, changes to the assumptions to reflect the subsequent event resulted in an increase in the MCR of 0.31 percentage points. A large portion of this increase is due to reductions in the 2022 assumed nominal rate of return. The reduction in MCR of 0.35 percentage points due to 2019-2021 investment experience is therefore partially offset by lower assumed returns in 2022.

A progression of the MCR over time based on the steady-state contribution rate target years of future triennial valuation reports and using the best-estimate assumptions of this report is shown in Table 15 of the Results – Base CPP section 5.5 of this report. As shown in that table, the MCR is projected to remain relatively stable over time.

Table 107 Reconciliation of Changes in Minimum Contribution Rate - Base CPP [1],[2]
(% of contributory earnings)

		Full Funding		MCR	
	Steady-State Rate	2025-2033	2034+	2025-2033	2034+
30th CPP Actuarial Report - After Rounding	9.71	0.04	0.01	9.75	9.72
30th CPP Actuarial Report - Before Rounding	9.708	0.035	0.007	9.743	9.715
I. Improvements in Methodology	0.048	(0.001)	(0.001)	0.046	0.046
II. Experience Update (2019-2021)					
Demographic	(0.005)	0.001	0.000	(0.004)	(0.004)
Economic	(0.037)	(0.001)	0.000	(0.037)	(0.037)
Benefits	(0.149)	(0.006)	(0.001)	(0.155)	(0.150)
Investments	(0.354)	0.000	0.000	(0.353)	(0.354)
Subtotal:	(0.544)	(0.005)	(0.001)	(0.550)	(0.545)
III. Changes in Assumptions					
Fertility	0.076	0.000	0.000	0.076	0.076
Mortality	(0.063)	0.002	0.001	(0.060)	(0.062)
Net Migration	(0.134)	(0.001)	0.000	(0.135)	(0.134)
Labour Market	(0.070)	(0.001)	0.000	(0.071)	(0.070)
Price Increases	(0.040)	0.000	0.000	(0.041)	(0.040)
Real Wage Increase	0.175	0.002	0.001	0.177	0.175
Real Rates of Return	0.373	0.001	0.000	0.373	0.373
Retirement	0.066	0.000	0.000	0.066	0.066
Disability	(0.050)	0.003	0.002	(0.047)	(0.048)
Other Assumptions	(0.009)	0.001	0.000	(0.008)	(0.009)
Subtotal:	0.323	0.008	0.004	0.331	0.327
IV. Others (Change in Funding Targets from 2031-2081 to 2034-2084)	(0.009)	(0.002)	0.000	(0.011)	(0.008)
Total of I to IV	(0.182)	(0.001)	0.002	(0.183)	(0.180)
Rates before Rounding	9.526	0.035	0.009	9.560	9.535
Rounded Rate, in Accordance with the Calculation of Contribution Rates Regulations, 2021	9.53	0.03	0.01	9.56	9.54
31st CPP Actuarial Report	9.53	0.03	0.01	9.56	9.54

(1) Components may not sum to totals due to rounding.
(2) For each triennial CPP actuarial report, the MCR is determined for all years following the three-year review period in which the report is prepared, with the legislated contribution rate applied during the review period. For the 30th CPP Actuarial Report, the MCR was determined for the year 2022 and thereafter, with the legislated rate of 9.9% applied for the 2019-2021 review period. For the 31st CPP Actuarial Report, the MCR is determined for 2025 onward, with 9.9% applied for 2022-2024.

D.2 Additional CPP

Differences between the actual experience for 2019 through 2021 and that projected in the 30th CPP Actuarial Report for the same period were addressed in the Reconciliation with Previous Triennial Reports –Additional CPP section 7.2 of this report. Since historical results provide the starting point for the projections shown in this report, these differences have an effect on the projections. This section provides more details on the impact of the experience update and changes in the assumptions and methodology.

A reconciliation of the change in the FAMCR of 1.98% and SAMCR of 7.92%, as presented in the 30th CPP Actuarial Report, to the FAMCR of 1.97% and SAMCR of 7.88% for this report is provided in Table 108.

The experience update had the effect of reducing the FAMCR and SAMCR by 0.006 percentage points and 0.025 percentage points respectively due to better than anticipated economic and investment experience compared to the 30th CPP Actuarial Report.

Changes made to the key best-estimate assumptions since the previous triennial report were outlined in Table 1 of section 4 of this report. The main effects of these changes on the AMCRs are also shown in Table 108 and are summarized below.

- The initial lower mortality rates and mortality improvement rates assumed for this report decrease the FAMCR and SAMCR by 0.01 percentage points and 0.039 percentage points respectively.
- The higher assumed labour force participation and employment rates increase the FAMCR and SAMCR by 0.009 percentage points and 0.038 percentage points respectively. The AMCRs increase instead of decreasing as for the base Plan MCR due to the different financing approaches of the two components of the CPP. The higher employed population results in eventual higher benefit expenditures, which, for the additional benefits, must be fully funded under the additional Plan.
- The change in the real wage increase assumption causes the FAMCR and SAMCR to decrease by 0.032 percentage points and 0.128 percentage points respectively due to the lower increase in contributory earnings compared to the previous triennial report. The AMCRs decrease instead of increasing as for the base Plan MCR for the same reason cited in the bullet point above in respect of the assumed labour force participation and employment rates.
- Regarding the real rates of return assumptions, changes compared to the 30th CPP Actuarial Report include a new Credit asset class in the Supplementary Pool and a different initial asset mix to reflect the CPPIB's investment strategy in respect of the additional CPP. The assumed relative allocation to these asset classes over the projection period result in a higher ultimate portfolio real rate of return. As such, the FAMCR and SAMCR decrease by 0.016 percentage points and 0.062 percentage points respectively.

As mentioned for the base CPP, some other assumptions were also changed. Overall, the changes in these other assumptions had the effect of increasing the FAMCR and SAMCR by 0.019 percentage points and 0.075 percentage points respectively. These increases are mostly attributable to higher assumed operating expenses.

The impacts on the AMCRs resulting from changes in assumptions include revisions to reflect the subsequent event disclosed in section 2.3. Overall, changes to the assumptions to reflect the subsequent event resulted in decreases of less than 0.005 percentage points and 0.02 percentage points in the FAMCR and SAMCR, respectively.

Table 108 Reconciliation of Changes in Additional Minimum Contribution Rates [1]
(% of additional CPP contributory earnings)

	First Additional Minimum Contribution Rate	Second Additional Minimum Contribution Rate
30th CPP Actuarial Report - After Rounding	1.98	7.92
30th CPP Actuarial Report - Before Rounding	1.977	7.907
I. Improvements in Methodology	0.027	0.108
II. Starting Environment (2019-2021)		
Demographic	0.000	(0.001)
Economic	(0.004)	(0.016)
Benefits	0.000	0.000
Investments	(0.002)	(0.008)
Subtotal:	(0.006)	(0.025)
III. Changes in Assumptions		
Fertility	(0.006)	(0.023)
Mortality	(0.010)	(0.039)
Net Migration	0.006	0.024
Labour Market	0.009	0.038
Price Increases	(0.002)	(0.009)
Real Wage Increase	(0.032)	(0.128)
Real Rates of Return	(0.016)	(0.062)
Retirement	0.003	0.013
Disability	0.000	0.001
Other Assumptions	0.019	0.075
Subtotal:	(0.028)	(0.110)
Total of I to III	(0.007)	(0.028)
Rates before Rounding	1.970	7.879
Rounded Rates, in Accordance with the Calculation of Contribution Rates Regulations, 2021	1.97	7.88
31st CPP Actuarial Report	1.97	7.88

(1) Components may not sum to totals due to rounding.

Appendix E – Uncertainty of Results

E.1 Introduction

This actuarial report on the Canada Pension Plan is based on the projection of its revenues and expenditures for both of its components, the base and additional CPP, over a long period of time. The information required by statute, which is presented in the Results sections 5 and 6 of this report, has been derived using best-estimate assumptions regarding future demographic, economic, and investment trends. Given the length of the projection period and the number of assumptions required, it is unlikely that actual future experience will develop precisely in accordance with the best-estimate projections. The objective of this section of the report is to illustrate the sensitivity of the long-term projected financial states of the base and additional Plans to changes in the future demographic, economic, and investment outlooks, and to illustrate potential downside risks due to emerging trends.

The future revenues and expenditures, or income and outgo of the CPP, both for the base and additional Plans, depend on many demographic, economic, and investment factors, including fertility, mortality, migration, the labour force, average earnings, inflation, retirement patterns, disability incidence rates, and investment returns. On the other hand, future demographic, economic, and investment environments are affected by both domestic and global forces, such as climate change, how globalization or protectionism influence world economic growth, geopolitical situations, etc. The income will depend on how all these factors change the size and composition of the working-age population,the level and distribution of earnings and financial markets. Similarly, the outgo will depend on how these factors change the size and composition of the beneficiary population and the general level of benefits. Although both the base and additional CPP are affected by the aforementioned factors, the degree to which the two components of the CPP are affected differs.

For the additional CPP, there is a stronger link between contributions paid by individuals and the benefits they will receive. As a result, while some assumptions regarding factors such as fertility, migration, and labour force participation affect the cash flows and amount of assets of the additional Plan, they, in general, do not have a major impact on the AMCRs. In comparison, these assumptions could have a significant impact on the MCR of the base CPP. Other assumptions have a more significant impact on the AMCRs for the additional CPP, the real rate of return is such an example. This again is attributable to the different financing approaches of the base and additional CPP.

Section E.2 examines the sensitivity of the base and additional CPP minimum contribution rates to intervaluation investment experience, while section E.3 presents sensitivity tests on individual long-term assumptions derived based on judgment or stochastic modeling techniques. Next, sections E.4 builds on the individual sensitivity tests performed in section E.3 by combining various assumptions of the individual tests to create scenarios of higher and lower long-term economic growth. The combination of the individual sensitivity test assumptions is not meant to

necessarily create probable scenarios, but rather to show the possible impacts from different economic environments.

Finally, section E.5 is a new section that focuses on understanding and assessing downside risks due to three potential or emerging trends. Since the additional CPP is still at its early stages, it focuses on the base CPP only. Furthermore, given the purpose of the section, only adverse scenarios are presented; results should therefore be interpreted with caution.

E.2 Sensitivity to Intervaluation Investment Experience

Context

The CPPIB was created in 1997 with the objective, as stated in the *Canada Pension Plan Investment Board Act*, "to invest its assets with a view to achieving a maximum rate of return, without undue risk of loss, having regard to the factors that may affect the funding of the Canada Pension Plan and the ability of the Canada Pension Plan to meet its financial obligations on any given business day". The assets of the CPP are invested by the CPPIB through a diversified portfolio.

Historically, equities have shown greater volatility than fixed income instruments (such as bonds), volatility being a measure of the magnitude of fluctuation in returns. Higher volatility of a security's returns implies a greater risk, since the range of possible outcomes of returns widens. Hence, equities are viewed as being riskier than bonds.

As a result, the higher volatility of equities compared to bonds has been rewarded with higher returns. This describes the key risk-reward relationship, whereby investors seek a higher level of return over the long term, in exchange for assuming a higher level of risk. Nevertheless, over the short term, the potential for lower returns exists along with that for higher returns due to the higher level of volatility.

To express the desired risk target of its investment portfolio, the CPPIB uses a simple two-asset class (fixed income and equity) portfolio called the "reference portfolio". The greater the proportion of equities in the reference portfolio, the greater the risk target. The reference portfolio applicable to the base CPP as at 31 December 2021 is 85% global equity and 15% Canadian government nominal bonds, whereas, the reference portfolio applicable to the additional CPP as at 31 December 2021 consists of 55% global equity and 45% Canadian government nominal bonds. The different risk targets for each component of the plan reflect each component's distinct nature and financing approach. More information on how the CPPIB invests assets of the base and additional CPP according to their respective reference portfolios can be found in Appendix B.

In settings its risk targets and making investment decisions, the CPPIB adopts a long-term approach. However, given the level of risk reflected in the CPPIB's portfolios, short-term returns can be quite volatile and affect the starting value of assets used to calculate the MCRs and AMCRs

every three years. The starting value of assets, and therefore the intervaluation investment experience, can have a significant impact on the Plan's minimum contribution rates.

The purpose of this section is to highlight the sensitivity of the Plan's minimum contribution rates to intervaluation investment experience.

Base CPP

Table 109 shows what the MCR of this report would have been based on different levels of assets as at 31 December 2021, while maintaining the same best-estimate assumptions. It is meant to provide a simple illustration of the sensitivity of the MCR to the starting value of assets.

Based on the actual assets as at 31 December 2021 of $544 billion, the MCR for years 2034 and thereafter is 9.54%. However, if assets as at 31 December 2021 had been 10% lower, the MCR would have increased by 0.16 percentage points to 9.70%, and if they had been 10% higher, the MCR would have decreased by 0.17 percentage points to 9.37%. Assets would have had to be at least 22% lower for the MCR to be above the legislated rate of 9.9%.

Table 109 Base CPP MCR as at December 31, 2021 based on Different Levels of Starting Assets

Assets at 31 December 2021 ($ billion)		Average Nominal Return, 2019-2021 (%)	MCR at 31 December 2021 (1) (%)	Difference with Actual (%)
20% lower	435	4.7	9.87	0.33
10% lower	489	8.8	9.70	0.16
Actual	544	12.7	9.54	0.00
10% higher	598	16.4	9.37	(0.17)
20% higher	652	19.8	9.20	(0.34)

(1) The MCR in this table refers to the rate applicable for 2034 and thereafter.

Even though the base CPP relies more heavily on contributions than on investment income, the MCR can change significantly from one valuation to the next due to investment experience alone.

In order to put the variability in MCR due to intervaluation investment experience into context, a stochastic analysis of investment returns was performed. It is used to determine the distribution of MCR as a function of intervaluation investment experience. For this purpose, 10,000 paths of returns were generated and probability distributions of the resulting MCR were determined. The fluctuation in the rate of return on investments is based on a normal distribution[1] of returns and is projected using the assumed asset allocation and correlations between asset classes, as well as the standard deviations and expected returns for each asset class.

Based on the best-estimate assumptions of this report and as shown in Table 15, the MCR at the next valuation as at 31 December 2024 is expected to be 9.55% for years 2034 and after. Table 110 presents the estimated probability of the MCR as at 31 December 2024 falling into certain ranges based on the stochastic analysis of investment returns during the three-year

[1] A normal distribution was assumed for simplicity as it adequately reflects most investment outcomes.

intervaluation period 2022-2024. All other assumptions are in line with the best-estimate assumptions of this report.

Table 110 Probability Distribution of MCR as at 31 December 2024 based on 2022-2024 Intervaluation Investment Experience

MCR at 31 December 2024 (percentages) (1)	Difference relative to best-estimate MCR of 9.55%	Probability (percentages)
Less than 9.20	Decrease of more than 35 percentage points	20
9.20 - 9.39	Decrease between 16 and 35 percentage points	16
9.40 - 9.70	Within 15 percentage points	30
9.71 - 9.90	Increase between 16 and 35 percentage points	18
Above 9.90	Increase of more than 35 percentage points	16

(1) The MCR in this table refers to the rate applicable for 2034 and thereafter.

Based on the results, there is a 70% probability that the MCR at the next valuation as at 31 December 2024 will have a difference of more than 15 percentage points relative to the best-estimate MCR of 9.55% (i.e. MCR outside of the 9.40% to 9.70% range) due to investment experience alone. Furthermore, there is a 16% probability that the MCR at the next valuation as at 31 December 2024 will exceed the legislated rate of 9.9% due to investment experience alone.

The probability of the MCR at a given valuation date exceeding the legislated rate of 9.9% due to investment experience alone also depends on the level of the MCR of the previous valuation. All else being equal, the higher the best-estimate MCR of the previous valuation, the higher the probability of exceeding the legislated rate at the next valuation and vice-versa.

As shown in Table 111, if the MCR in this valuation were 9.70% instead of 9.54%, then the probability that it would exceed the legislated rate of 9.9% as at 31 December 2024 due to investment experience alone would be 30%. If the MCR in this valuation were 9.37% instead of 9.54%, then the probability that it would exceed the legislated rate of 9.9% as at 31 December 2024 due to investment experience alone would be 8%.

Table 111 Probability of MCR exceeding legislated rate of 9.9% as at 31 December 2024 based on 2022-2024 Investment Experience and Different Levels of MCRs at the Previous Valuation
(percentages)

MCR at 31 December 2021 (previous valuation) (1)	Probability
9.37 (Low Scenario)	8
9.54 (Best-Estimate)	16
9.70 (High Scenario)	30

(1) The MCR in this table refers to the rate applicable for 2034 and thereafter.

Additional CPP

Since the additional CPP is still in its early years, the intervaluation investment experience doesn't currently have a material impact on the AMCRs.

However, given its financing approach and the fact that the additional CPP assets are expected to grow rapidly over the next decades, investment experience is expected to eventually become one of the main drivers behind additional Plan surpluses or deficits. The impact of investment experience on the AMCRs will therefore become more pronounced over time.

This subsection illustrates sensitivities similar to those presented in the previous subsection on the base CPP, but instead focuses on dates in the future when the additional Plan will be more mature. For this purpose, dates of 31 December 2045 and 31 December 2048 were selected, which are close to thirty years after the introduction of the additional Plan.

Table 112 shows the estimated impact on the FAMCR of different levels of assets as at 31 December 2045, while maintaining all other assumptions in line with the best-estimate assumptions of this report. As the SAMCR is four times the value of the FAMCR, the table shows only the FAMCR.

Based on the best-estimate assumptions of this report, the additional CPP assets as at 31 December 2045 are expected to be $956 billion, and the FAMCR as at 31 December 2045 is expected to be 1.94%. However, if assets as at 31 December 2045 were 10% lower, the FAMCR would increase by 0.11 percentage points to 2.05%. If starting assets as at 31 December 2045 were 10% higher, the FAMCR would decrease by 0.11 percentage points to 1.83%.

Compared to Table 109 in the previous subsection, it can be seen that, on a relative basis, the additional Plan is much more sensitive to the level of assets than the base CPP. For example, assets that are 20% lower result in a relative increase of 3.5% in the base CPP MCR (9.54% to 9.87%) compared to a relative increase of 11% for the additional CPP FAMCR (1.94% to 2.16%). This is line with the additional Plan's financing approach that relies more heavily on investment income than the base CPP.

Table 112 Additional CPP FAMCR as at December 31, 2045 based on Different Levels of Starting Assets

Assets at 31 December 2045 ($ billion)		Average Nominal Return, 2043-2045 (%)	FAMCR at 31 December 2045 [1] (%)	Difference with Best-Estimate (%)
20% lower	765	(2.2)	2.16	0.22
10% lower	861	1.9	2.05	0.11
Best-Estimate	956	5.6	1.94	0.00
10% higher	1,052	9.2	1.83	(0.11)
20% higher	1,147	12.5	1.72	(0.22)

(1) The FAMCR in this table refers to the rate applicable for 2025 and thereafter. The SAMCR is equal to four times the FAMCR.

For the additional CPP, investment experience could cause the AMCRs to deviate from their legislated rates of 2.0% and 8.0% into various ranges. As per the *Additional Canada Pension Plan*

Sustainability Regulations, the FAMCR may fall between 1.7% and 2.2% without requiring immediate action from 2024 to 2038. From 2039 onward, this "No Action Required" range is reduced to between 1.8% and 2.1%. The corresponding ranges for the SAMCR are those of the FAMCR with the boundary values multiplied by four.

As the additional Plan assets are relatively low over the inter-valuation period 2022-2024, it is very unlikely that short-term investment experience would cause the AMCRs to fall outside the "no action" ranges prescribed by the proposed *Additional Canada Pension Plan Sustainability Regulations*. However, as mentioned previously, the impact of intervaluation investment experience will become more important as the plan matures.

To put this into context, a stochastic analysis similar to the one described in the previous subsection on the base CPP was performed. As mentioned above, based on the best-estimate assumptions of this report, the FAMCR as at 31 December 2045 is expected to be 1.94%. The FAMCR in the following valuation report as at 31 December 2048 is expected to be 1.93%, but it could deviate from this level due to the 2046-2048 investment experience alone. Based on the stochastic analysis, the probability of the FAMCR as at 31 December 2048 falling outside the 1.8% to 2.1% range due to investment experience during the 2046-2048 period is 32%.

Similar to the base CPP, the probability of the FAMCR falling outside of certain ranges at a given valuation date also depends on the level of the FAMCR of the previous valuation. Table 113 below shows the distribution of the FAMCR at the valuation as at 31 December 2048 due to intervaluation investment experience alone, based on different levels of FAMCRs at the previous valuation. As the SAMCR is four times the value of the FAMCR, the table shows only the FAMCR.

For example, if the FAMCR as at 31 December 2045 were 1.83% instead of 1.94%, then the probability of the FAMCR as at 31 December 2048 falling outside the 1.8% to 2.1% range due to investment experience during the 2046-2048 period is 50%, with most of this probability falling into the below 1.8% ranges. If the FAMCR as at 31 December 2045 were 2.05% instead of 1.94%, then the probability of the FAMCR as at 31 December 2048 falling outside the 1.8% to 2.1% range due to investment experience during the 2046-2048 period is 40%, with most of this probability falling into the above 2.1% ranges.

Table 113 Probability Distribution of FAMCR as at 31 December 2048 based on 2046-2048 Investment Returns Experience and Different Levels of FAMCRs at the Previous Valuation
(percentages)

FAMCR at 31 December 2048 (1)	2045 FAMCR of 1.94% (Best-Estimate)	Lower 2045 FAMCR of 1.83%	Higher 2045 FAMCR of 2.05%
Below 1.70	7	26	1
1.70 – 1.79	13	22	3
1.80 – 2.10	68	50	60
2.11 – 2.20	9	2	24
Above 2.20	3	0	13

(1) The FAMCR in this table refers to the rate applicable for 2025 and thereafter. The SAMCR is equal to four times the FAMCR.

E.3 Individual Sensitivity Tests

The key best-estimate assumptions used for the projections in this report are described in Appendix B. Individual sensitivity tests have been performed that consist of projecting the financial states of the base and additional CPP using alternative assumptions to illustrate a reasonable range of how experience could vary from the best-estimate projections.

All individual sensitivity tests, except the one for the real rate of return, are deterministic and are based on judgment. The tests for the real rate of return for the base and additional CPP are developed using a stochastic approach. The ranges analyzed for each assumption are described below.

The sensitivity tests were performed by varying most of the key assumptions individually and by keeping the remaining assumptions at their best-estimate levels. Each sensitivity test was categorized as either a lower-cost scenario or a higher-cost scenario. In the lower-cost scenarios for the base and additional CPP, the alternative assumptions have the effect of reducing the MCR and AMCRs. Conversely, the assumptions for the higher-cost scenarios for each component of the CPP increase the minimum contribution rates.

It is possible that a lower-cost scenario for the base CPP may be a higher-cost scenario for the additional CPP, and vice versa. This is the case, for example, for the tests regarding the real wage increase, described below. The opposite effects for the base and additional CPP are attributable to the different financing approaches of the two components.

For both components of the CPP, higher contributions mean eventually higher benefits. However, the impact of changing the factors affecting the amount of contributions (e.g. fertility, immigration, labour markets, real wage, inflation, etc.) on the cost of the Plan differs between the base CPP and the additional CPP depending on:

- The design of benefits, and in particular, the link between contributions and benefits.
- Whether the impact of these factors on the resulting benefits outweigh the impact on contributions.

For the base CPP, due to the nature of steady-state funding, the impact of higher contributions on the cost of the base Plan outweighs the eventual impact of higher resulting benefits.
For the additional CPP, given that it is fully funded, there is a stronger link between contributions paid by individuals and the benefits they will receive. As a result, the impact of increased benefits on the cost of the additional Plan outweighs the impact of higher additional contributions.

Finally, although investment income is an important source of revenues for both components of the CPP, the additional CPP relies more heavily on investment income than the base CPP due to its full funding financing. Thus, the cost of the additional Plan is more sensitive to the assumption on the rate of return on investments.

The alternative assumptions selected are intended to represent a wide range of potential long-term experience. However, the individual results cannot simply be combined, because a change in any one particular assumption may have an impact on other assumptions to various degrees. It should also be noted that for both the base and additional Plans, once the lower- and higher-cost assumptions reach their ultimate values, they are held constant for the rest of the 75-year projection period and both components of the CPP are assumed to remain in their current forms.

Table 114 summarizes the alternative assumptions used in the individual sensitivity tests. It is followed by a brief discussion of these tests.

Table 114 Individual Sensitivity Test Assumptions

	Canada	Lower Cost		Best Estimate		Higher Cost	
1	Total Fertility Rate (1)	1.84		1.54		1.24	
2	Mortality:						
	Canadian Life Expectancy	Males	20.9	Males	23.1	Males	25.2
	At Age 65 in 2050 with Future Improvements	Females	23.3	Females	25.4	Females	27.4
3	Net Migration Rate (1)	0.84%		0.64%		0.44%	
4	Rate of Increase in Prices	3.0%		2.0%		1.0%	
5	Real Wage Increase						
	Base CPP	1.5%		0.9%		0.3%	
	Additional CPP	0.3%		0.9%		1.5%	
6	75-Year Average Real Rate of Return						
	Base CPP	5.29%		3.69%		2.09%	
	Additional CPP	4.47%		3.27%		2.07%	
7	CPP Disability Incidence Rates (1)	Males	1.90	Males	2.90	Males	3.90
	(per 1,000 eligible)	Females	2.60	Females	3.60	Females	4.60

(1) These tests do not significantly impact the AMCRs.

The following provides some observations on the selection of assumptions for lower- and higher-cost scenarios and their impacts on the base and additional CPP.

- Fertility Rates: This test is presented only for the base CPP since there is no significant impact on the additional CPP. Experience of Group of 7 (G7) countries (Canada, France, Germany, Italy, Japan, the United Kingdom, and the United States) was used to generate the lower- and higher-cost scenarios over the projection period.

- Mortality Rates: Under the lower-cost scenario, mortality is assumed to improve at a slower rate than under the best-estimate scenario, with ultimate values of the mortality improvement rates gradually reduced to 0% for all ages in 2039. Under the higher-cost scenario, mortality is assumed to improve at a faster pace than under the best-estimate scenario with the ultimate mortality improvement rates being doubled compared to their best-estimate values.

- Net Migration Rate: This test is presented only for the base CPP since there is no significant impact on the additional CPP. The lower-cost and higher-cost assumptions were selected by analyzing historical data and trends.

- Price Increases: Higher price increases result in lower minimum contribution rates for both the base and additional CPP. For both Plans, a higher rate of increase in prices produces higher CPP expenditures, but these increases in costs are outweighed by higher nominal contributory earnings and thus, higher contributions along with higher investment income from higher nominal returns. Conversely, lower price increases results in higher minimum contribution rates for each component of the CPP, with a larger effect observed for the base Plan. The higher-cost and lower-cost scenarios are chosen to represent the lower and upper bounds of the 1% to 3% inflation-control target range of the Bank of Canada and Government.

- Real Wage Increases: Wage increases affect the financial balance of the base and additional CPP in two ways. In the short-term, an increase in the average wage translates into higher contribution income with little immediate impact on benefits. Over the longer term, higher average wages produce higher benefits. Higher real wages have the effect of decreasing the MCR of the base CPP. However, higher real wages result in the AMCRs increasing for the additional Plan. Conversely, lower real wages increase the MCR of the base CPP, but decrease the AMCRs of the additional Plan. The reason for the opposite effects is due to the different financing approaches of the two CPP components that creates a stronger link between contributions and expenditures for the additional Plan. As there is no change in the assumed level of price increases, there is a greater relative impact on the AMCRs compared to the MCR from a change in real wages. Analysis of the aggregate experience of G7 countries was used to generate the lower- and higher-cost scenarios over the 75-year projection period.

- Rate of Return on Investments: These tests were devoped using a stochastic approach. For both CPP components, the lower and higher-cost assumptions represent the ranges such that the averages of the projected rates of return over 75 years for the base and additional Plans will be within these ranges with 80% probability. These ranges differ for the base and additional Plans, since they are based on different asset allocations.

- Disability Incidence Rates: This test is presented only for the base CPP since there is no significant impact on the additional CPP. In addition, sensitivity tests for the assumed disability incidence rates were performed in respect of the disability pension only, since there is limited experience data available regarding the new base CPP post-retirement disability benefit. Based on the disability incidence rate experience since the mid-1990s, lower- and higher-cost scenarios over the 75-year projection period for the Plan were generated.

Results for the Base CPP

Under each sensitivity test, the contribution rate was projected to follow the current legislated rate of 9.9% through 2024, and a new minimum contribution rate (MCR) for the base Plan was determined for 2025 and thereafter. Table 115 summarizes the base Plan MCR and pay-as-you-go rates under each of the sensitivity tests.

Table 115 Sensitivity of Base CPP Minimum Contribution Rate
(percentages)

	Assumption	Scenario	Minimum Contribution Rate (1)	Change in MCR relative to Best Estimate	Pay-As-You-Go Rates 2025	Pay-As-You-Go Rates 2060
		Best Estimate	9.54	0.00	9.76	12.06
1	Total Fertility Rate	Lower Cost	9.24	-0.30	9.76	11.41
		Higher Cost	9.83	0.29	9.76	12.78
2	Mortality Rates	Lower Cost	9.17	-0.37	9.76	11.65
		Higher Cost	9.86	0.32	9.76	12.44
3	Net Migration Rate	Lower Cost	9.20	-0.34	9.75	11.12
		Higher Cost	9.84	0.30	9.76	13.04
4	Price Increases	Lower Cost	9.32	-0.22	9.71	11.74
		Higher Cost	9.79	0.25	9.82	12.45
5	Real Wage Increase	Lower Cost	9.26	-0.28	9.76	11.02
		Higher Cost	9.81	0.27	9.76	13.25
6	Real Rate of Return on Investments	Lower Cost	7.89	-1.65	9.76	12.06
		Higher Cost	11.22	1.68	9.76	12.06
7	Disability Incidence Rates	Lower Cost	9.31	-0.23	9.72	11.79
		Higher Cost	9.76	0.22	9.80	12.34

(1) The minimum contribution rate in this table refers to the rate applicable for 2034 and thereafter.

Given how the alternative scenarios were developed, it is difficult to draw conclusions about their relative sensitivities by comparing them with each other. However, it can be seen that the rate of return assumption can have a significant impact on the base Plan MCR. If the average annual real rate of return over the next 75 years is assumed to be 5.29%, then the MCR decreases to 7.89%. However, if the average annual real rate of return over the next 75 years is assumed to be 2.09%, the MCR increases to 11.22%.

Furthermore, a decrease of 100 basis points in the assumed average annual nominal 75-year rate of return would result in the MCR increasing to 10.58%, which on a relative basis, is 11% higher than under the best-estimate assumption. An increase of 100 basis points would result in the MCR decreasing to 8.51%, which on a relative basis, is 11% lower than under the best-estimate assumption.

Unlike the MCR, the pay-as-you-go rates are not affected by the assumed rates of returns on investments. For all other assumptions, the MCR and pay-as-you-go rates do tend to move in the same direction.

Table 116 shows the projected impact on the ratio of the assets to the following year's expenditures under each of the alternative sets of assumptions if the current legislated contribution rate of 9.9% for the base CPP continues to apply for the year 2022 and thereafter.

Table 116 Sensitivity of Base CPP Assets/Expenditures Ratio
(9.9% legislated contribution rate)

Assumption		Scenario	Asset/Expenditure Ratio		
			2025	2060	2095
		Best Estimate	8.2	11.2	12.9
1	Total Fertility Rate	Lower Cost	8.2	11.7	17.1
		Higher Cost	8.2	10.8	8.3
2	Mortality Rates	Lower Cost	8.2	12.3	19.5
		Higher Cost	8.2	10.3	8.1
3	Net Migration Rate	Lower Cost	8.2	12.5	16.8
		Higher Cost	8.2	10.1	8.8
4	Price Increases	Lower Cost	8.2	12.2	15.9
		Higher Cost	8.2	10.2	9.4
5	Real Wage Increase	Lower Cost	8.2	12.3	15.4
		Higher Cost	8.2	10.1	9.2
6	Real Rate of Return on Investments	Lower Cost	8.7	22.1	67.0
		Higher Cost	7.7	5.2	N/A (1)
7	Disability Incidence Rates	Lower Cost	8.2	12.4	16.4
		Higher Cost	8.1	10.1	9.5

(1) Assets depleted by 2081.

Results for Additional CPP

As for the base Plan, under each scenario, the contribution rates for the additional Plan were projected to follow the current schedule of legislated rates through 2024, and new AMCRs were determined for 2025 and thereafter. Table 117 summarizes the additional Plan AMCRs under each of the scenarios.

Table 117 Sensitivity of Additional CPP Minimum Contribution Rates
(percentages)

	Assumption	Scenario	First Additional Minimum Contribution Rate (FAMCR) (1)	Second Additional Minimum Contribution Rate (SAMCR) (1)	Change in AMCRs relative to Best Estimate
		Best Estimate	1.97	7.88	–
1	Total Fertility Rate (2)	Lower Cost	N/A	N/A	N/A
		Higher Cost	N/A	N/A	N/A
2	Mortality Rates	Lower Cost	1.79	7.16	(0.18)/(0.72)
		Higher Cost	2.12	8.48	0.15/0.60
3	Net Migration Rate (2)	Lower Cost	N/A	N/A	N/A
		Higher Cost	N/A	N/A	N/A
4	Price Increases	Lower Cost	1.94	7.76	(0.03)/(0.12)
		Higher Cost	2.00	8.00	0.03/0.12
5	Real Wage Increase	Lower Cost	1.79	7.16	(0.18)/(0.72)
		Higher Cost	2.18	8.72	0.25/1.00
6	Real Rate of Return on Investments	Lower Cost	1.38	5.52	(0.59)/(2.36)
		Higher Cost	2.86	11.44	0.89/3.56
7	Disability Incidence Rates (2)	Lower Cost	N/A	N/A	N/A
		Higher Cost	N/A	N/A	N/A

(1) The first and second additional minimum contribution rates in this table refer to the rates applicable for 2025 and thereafter.
(2) These tests do not significantly impact the AMCRs.

When comparing with results from the base CPP, on a relative basis, the AMCRs are significantly more sensitive to changes in mortality, real-wage and investment assumptions than the base CPP MCR. On the other hand, on a relative basis, the AMCRs are not as sensitive to changes in the CPI assumption, and unlike the base CPP MCR, they are not very sensitive to changes in fertility and migration assumptions. Further, the impact of changing the real-wage assumption on the AMCRs is in the opposite direction than for the base CPP MCR.

The differences in relative sensitivities between the AMCRs and the base CPP MCR, as well as the opposite impact of changing the real-wage assumption is due to the different financing approaches of each component of the Plan, as explained at the beginning of this section.

Given how the alternative scenarios were developed, it is difficult to draw conclusions about their relative sensitivities by comparing them with each other. However, it can be seen that the rate of return assumption can have a significant impact on the AMCRs. If an average annual real rate of return of 4.47% is assumed for the 75-year projection period, the FAMCR decreases to 1.38% and the SAMCR to 5.52%. On the other hand, if an average annual real rate of return of 2.07% is assumed over the period, the FAMCR increases to 2.86% and the SAMCR to 11.44%.

Furthermore, a decrease of 100 basis points in the assumed average annual nominal 75-year rate of return would result in the FAMCR and SAMCR increasing to 2.68% and 10.72% respectively, which on a relative basis, is 36% higher than under the best-estimate assumption. An increase of 100 basis points would result in the FAMCR and SAMCR decreasing to 1.46% and 5.84% respectively, which on a relative basis, is 26% lower than under the best-estimate assumption.

Table 118 shows the projected impact on the ratio of the assets to the following year's expenditures under each of the alternative sets of assumptions if the legislated first additional contribution rate of 2.0% from 2023 onward and the legislated second additional contribution rate of 8.0% from 2024 onward apply for the additional CPP.

Table 118 Sensitivity of Additional CPP Assets/Expenditures Ratio
(2.0%, 8.0% legislated additional contribution rates)

	Assumption	Scenario	Asset/Expenditure Ratio 2025	2060	2095
		Best Estimate	86.5	31.3	25.8
1	Total Fertility Rate (1)	Lower Cost	N/A	N/A	N/A
		Higher Cost	N/A	N/A	N/A
2	Mortality Rates	Lower Cost	86.5	32.4	32.3
		Higher Cost	86.5	30.4	21.3
3	Net Migration Rate (1)	Lower Cost	N/A	N/A	N/A
		Higher Cost	N/A	N/A	N/A
4	Price Increases	Lower Cost	86.3	32.1	27.2
		Higher Cost	86.6	30.4	24.2
5	Real Wage Increase	Lower Cost	86.6	33.2	33.2
		Higher Cost	86.3	29.6	20.4
6	Real Rate of Return on Investments	Lower Cost	88.7	42.6	65.9
		Higher Cost	84.3	23.0	7.0
7	Disability Incidence Rates (1)	Lower Cost	N/A	N/A	N/A
		Higher Cost	N/A	N/A	N/A

(1) These tests do not significantly impact the AMCRs.

E.4 Higher and Lower Economic Growth

While the best-estimate assumptions in this report reflect moderate sustained economic growth in the future, there is significant uncertainty and volatility surrounding the economic environment. Many factors could lead to long-term economic growth in Canada being different than assumed under the best-estimate scenario. These factors could stem from both domestic and global forces, and include geopolitical conflicts such as the current conflict in Ukraine, health crisis such as the COVID-19 pandemic, extreme weather events due to climate change, the timing and pace of transition to a green economy, the pace of technological advances and innovation, worldwide policies on protectionism vs. globalisation as well as demographic pressures from an aging population.

Given the high level of uncertainty, scenarios of higher and lower economic growth were considered in this report. These alternative economic growth scenarios comprise combinations of individual assumptions according to two cases. For the first case, alternative changes pertaining only to the labour market are considered. The second case builds on the first with alternative assumptions for the real wage increase also considered.

In respect of the labour market, employment levels are reflected in the actuarial projection model through the assumptions made regarding the level of labour force participation and job creation rates by year, age and sex. These rates vary not only with the rate of unemployment, but also

reflect trends in increased workforce participation by women, longer periods of formal education among young adults, and trends in the retirement patterns of older workers.

Under the best-estimate scenario, the job creation rate assumption is determined on the basis of expected moderate economic growth and an unemployment rate that is expected to decrease from 7.5% in 2021 to 6.0% in 2022, 5.7% in 2023 and then increase to reach an ultimate level of 6.1% by 2027. Furthermore, the participation rates for all age groups are expected to increase due to the projected increase in labour force participation rates of women, continuing trends toward longer working lives, and the attractive employment opportunities resulting from labour shortages. Under the best-estimate scenario, the participation rate of those aged 18 to 69 for Canada is expected to increase from 76.7% in 2022 to 80.0% in 2035.

For cohorts reaching age 60 in 2022 and thereafter, the retirement benefit take-up rates at age 60 are assumed to be 26.0% and 28.0% for males and females, respectively, and the take-up rates at age 65 are assumed to be 42.5% for males and 43.8% for females in 2031 and thereafter. These rates result in projected average ages at retirement pension take-up in 2031 of 63.6 for males and 63.4 for females.

The best-estimate assumption for the real wage increase is that it reaches an ultimate level of 0.9% by the year 2026. The ultimate real wage increase assumption together with the price increase assumption of 2.0% leads to an ultimate nominal wage increase of 2.9% for 2026 and thereafter.

E.4.1 Higher Economic Growth

Under the higher economic growth scenario, for the labour market, the job creation rate is robust resulting in a lower unemployment level, higher labour force participation rates, and later retirement pension take-up due to the availability of employment and unwillingness to incur early retirement penalties. In addition to the assumed labour market changes, the real wage increase is assumed to be higher than the best estimate.

For this higher economic growth scenario, the job creation rate is assumed to increase at a faster pace than under the best-estimate scenario, resulting in an unemployment rate of 4.1% in 2030 and thereafter. In addition, the assumed ultimate participation rates in 2035 are set to increase to higher levels than the best estimates, and the assumed ultimate gap between male and female participation rates in 2035 for those aged 18 to 69 is set equal to 3.6% as opposed to 6.3% under the best-estimate scenario. This results in an overall participation rate of 85.1% for those aged 18 to 69 in 2035.

The lower unemployment rate and higher participation rate are assumed to encourage individuals to ask for their CPP retirement pension at a later age. Therefore, by 2038, retirement pension take-up rates at age 60 are assumed to gradually decrease to levels that are 20 percentage points lower than the best estimates, i.e. to 6.0% and 8.0% for males and females, respectively. This results in an increase in the projected average age at retirement pension take-

up for both sexes combined, from 63.4 years to 64.4 years in 2040. The proportions of working beneficiaries were adjusted to reflect the shift in retirement pension take-up to later ages.

Finally, for the second case, in addition to the assumed changes in the labour market, the real wage increase is assumed to be 1.5% as opposed to 0.9% under the best-estimate scenario. Under this second case, the higher economic growth scenario results in total employment earnings in 2035 being 15% higher compared to the best estimate.

E.4.2 Lower Economic Growth

Under the lower economic growth scenario, for the labour market, the job creation rate increases at a slower pace, resulting in a higher unemployment level and lower labour force participation rates. Insufficient employment opportunities are likely to cause individuals to ask for their CPP retirement pension at an earlier age regardless of the early retirement reduction. In addition to the assumed labour market changes, the real wage increase is assumed to be lower than the best estimate.

For this lower economic growth scenario, the job creation rate is assumed to increase at a slower pace than the best estimate, resulting in an unemployment rate of 8.1% in 2030 and thereafter. In addition, male and female participation rates are assumed to remain constant at their 2021 levels. This results in an overall participation rate of 77.3% for those aged 18 to 69 in 2035.

The higher unemployment rate and lower participation rate are assumed to encourage individuals to ask for their CPP retirement pension at an earlier age. Therefore, retirement pension take-up rates at age 60 are assumed to gradually increase to levels in 2035 that are 20 percentage points higher than the best estimates, i.e. to 46.0% and 48.0% for males and females, respectively. This results in a decrease in the projected average age at retirement pension take-up for both sexes combined, from 63.4 years to 62.5 years in 2040. The proportions of working beneficiaries were adjusted to reflect the shift in retirement pension take-up to earlier ages.

Finally, for the second case,in addition to the assumed changes in the labour market, the real wage increase assumption is assumed to be 0.3% compared to 0.9% under the best-estimate scenario. Under this second case, the lower economic growth scenario results in total employment earnings in 2035 being 11% lower compared to the best estimate.

E.4.3 Results

Table 119 presents a summary of the assumptions used in the sensitivity analysis of economic growth and the resulting minimum contribution rates under the first case where only labour market changes are assumed and the second case where, in addition, real wage increase changes are also assumed.

Under the first case, where only changes to the labour market assumptions are considered, the base Plan MCR is 9.31% under the higher economic growth scenario and 9.80% under the lower economic growth scenario compared to the best-estimate scenario. For the additional Plan, the

impact is opposite. AMCRs increase under assumed higher economic growth and decrease under lower economic growth compared to the best estimates. The FAMCR and SAMCR are 2.09% and 8.36%, respectively, under the higher economic growth scenario, and 1.89% and 7.56%, respectively, under the lower economic growth scenario.

Under the second case, where changes to the assumed real wage increase are also considered, the base Plan MCR is 9.11% under the higher economic growth scenario and 10.12% under the lower economic growth scenario. Similar to the first case, the impact on the additional Plan AMCRs is opposite to that for the base Plan MCR. Under the higher economic growth scenario, the FAMCR and SAMCR increase respectively to 2.34% and 9.36%, while under the lower economic growth scenario, the FAMCR and SAMCR decrease respectively to 1.73% and 6.92%.

The AMCRs move in the opposite direction compared to the base Plan MCR due to the differing effects of the real wage increase assumption on the base and additional Plans, which is attributable to their different financing approaches as explained in section E.3.

Table 119 Higher and Lower Economic Growth Sensitivity Tests

Canada	Higher Economic Growth	Best-Estimate	Lower Economic Growth
Case #1: Changes to Labour Market Only			
Participation Rate (age group 18-69) (2035)	85.1%	80.0%	77.3%
Unemployment Rate (2030)	4.1%	6.1%	8.1%
Average CPP Retirement Benefit Take-up Age (2040)	64.4 years	63.4 years	62.5 years
Minimum Contribution Rate (MCR) [1]	9.31%	9.54%	9.80%
Additional Minimum Contribution Rates (AMCRs) [2]	2.09% / 8.36%	1.97% / 7.88%	1.89% / 7.56%
Case #2: Changes to Labour Market and Real Wage Increase			
Participation Rate (age group 18-69) (2035)	85.1%	80.0%	77.3%
Unemployment Rate (2030)	4.1%	6.1%	8.1%
Average CPP Retirement Benefit Take-up Age (2040)	64.4 years	63.4 years	62.5 years
Real Wage Increase	1.5% (2026+)	0.9% (2026+)	0.3% (2024+)
Minimum Contribution Rate (MCR) [1]	9.11%	9.54%	10.12%
Additional Minimum Contribution Rates (AMCRs) [2]	2.34% / 9.36%	1.97% / 7.88%	1.73% / 6.92%

(1) The MCR in this table refers to the rate applicable for 2034 and thereafter.
(2) The AMCRs in this table refer to the FAMCR and SAMCR applicable for 2025 and thereafter.

E.5 Assessing and Illustrating Downside Risks

This section focuses on assessing and illustrating downside risks due to potential or emerging trends. It illustrates the potential impacts on the base CPP MCR of a widening gap in earnings between lower and higher earners, of three hypothetical transition scenarios to a green economy, as well as of a stagflation scenario. Since the additional CPP is still at its early stages, this section focuses on the base CPP only. Furthermore, given the purpose of the section, only adverse scenarios are presented. The section is not meant to represent forecasts or predictions, and should be interpreted with caution.

E.5.1 Change in Earners and Earnings Distributions

Earners and earnings distribution have an impact on the amounts of contributions paid to the CPP, and eventually the amount of benefits paid from the Plan. The best-estimate scenario assumes a stable distribution of earners and earnings by level over time. In particular, the same nominal wage increase (real wage increase plus inflation) is applied to all earners independent of their level of earnings.

In the future, the pattern of increase in earnings by level may change as the profile of the labour force evolves. New technologies, automatization, labour shortages and evolving skills requirements are among the factors that can influence earnings and earners distributions. These factors could lead to widening the earnings gap between lower and higher earners. A scenario was developed for this report in order to illustrate the potential impact on the base CPP MCR of a widening earnings gap between lower and higher earners.

Under the considered scenario, instead of having uniform wage increases for all earners over the projection period, different wage increases are assumed until 2045 based on the level of earnings. After 2045, uniform wage increases in line with the best-estimate assumption are applied. Under this scenario, earners were split into three categories as follows:

- Lower level earners with earnings between 0% and 75% of the average earnings: the nominal growth in their earnings until 2045 is assumed to be 1.5% pear year.
- Middle level earners with earnings between 75% and 150% of the average earnings: the nominal growth in their earnings until 2045 is assumed to be 2.6% per year.
- Higher level earners with earnings above 150% of the average earnings: the nominal growth in their earnings until 2045 is assumed to be 3.5% per year.

Despite different increases by earnings level until 2045, the overall increase in nominal earnings is consistent with the nominal increase in wages assumed under the best-estimate scenario. Projected total earnings for the scenario are therefore the same as under the best-estimate assumptions over the entire projection period.

While the projected total earnings are the same as under the best-estimate assumptions, this alternative scenario would result in both lower total contributory earnings (total earnings

between YBE and YMPE), as well as lower average contributory earnings due to the different earnings distributions. Under the alternative scenario, in 2050, the total contributory earnings are projected to be about 7.0% lower than under the best-estimate scenario. The corresponding decrease in average contributory earnings is 6.8%. Although the corresponding expenditures are also expected to decrease over time, the impact of the immediate decrease in contributions outweighs the impact of the deferred and gradual decrease in expenditures, resulting in a higher base CPP MCR under the considered alternative scenario. As a result, the MCR for the base CPP would increase by 0.34 percentage points, leading to an MCR of 9.88% for year 2034 and thereafter.

E.5.2 Stagflation

Stagflation is characterized by a simultaneous economic stagnation and increase in inflation. During the 1970s and 1980s, the Canadian economy went through a period of stagflation that was partly caused by oil price increases as a result of supply shocks. This led to rising consumer prices and wages. The stagflation period ended when the Bank of Canada increased interest rates in the early 1980s, which led the economy to a recession.

The COVID-19 pandemic caused supply chain disruptions, shortages of labour and products, higher energy prices and led to higher consumer prices in 2021. Moreover, the escalation of the conflict in Ukraine exerts an additional pressure on the global economy and adds to the price pressures. This concurrence of events could lead to unanchored inflation, and actions aimed at containing inflation could lead to increases in unemployment rates.

While under the best-estimate assumptions, it is assumed that a stagflation scenario will not occur, this subsection presents the impact of a hypothetical stagflation scenario on the MCR.

Under the assumed stagflation scenario, inflation is projected to be high and above the Bank of Canada's target for ten years, which is consistent with the length of period of higher inflation that followed the first oil price shock in the 1970s. The inflation is projected to increase from 6.9% in 2022 to 10.0% in 2023 and stay at that level in 2024. It is then projected to decrease gradually to reach an ultimate value of 2.0% in 2032.

Under this scenario, firms are expected to raise their prices to offset the increase in expenses. Higher prices will eventually slow household spending and result in an economic slowdown. As such, it is assumed that unemployment rates will be higher than under the best-estimate assumptions for a period of 10 years from 2024. The unemployment rate is assumed to reach 8.0% in 2024 and increase to 10.0% by 2026. Afterward, it is assumed to decrease gradually to an ultimate value of 6.1% in 2034.

It is assumed that 50% of the inflation is integrated in nominal wage increases from 2023 to 2025. That percentage is assumed to increase gradually to an ultimate of 100% in 2030. The real-wage increases over the period 2023-2029 are therefore lower than under the best-estimate assumption. Furthermore, it is assumed that two thirds of inflation increases are integrated in

base CPP returns up until 2031, leading to lower real rates of return than under the best-estimate assumptions.

Under the stagflation scenario, the base CPP MCR increases by 0.31 percentage points to 9.85% for year 2034 and thereafter. Under the base CPP, higher inflation normally leads to lower MCRs given that the impact of higher nominal wages (i.e. more contributions) and investment returns outweigh the impact of higher expenditures. However, in the stagflation scenario, only part of the inflation is reflected in nominal wage increases and returns, while it is fully reflected in expenditures. The increase in the MCR is therefore mainly the result of the fact that the projected expenditures reflect the full inflation while the projected revenues (both contributions and investment earnings) do not.

E.5.3 Climate Change

Context

Based on the World Economic Forum's Global Risk Report 2022[1], five of the top ten most severe global risks over the next ten years are related to climate change. Climate change risks are generally classified into two categories: physical risks, which are linked to the increase in the frequency and severity of climate events and transition risks, which are linked to efforts undertaken for a transition towards a lower carbon economy.

Physical and transition risks are strongly interconnected. Transitioning to a green economy may create short- and medium-term economic and financial disruptions while reducing physical risks in the longer term. On the other hand, if insufficient actions are taken to transition to a lower carbon economy, physical risks may compound and increase significantly.

It is also important to note that regardless of the transition path, full elimination of physical risks is not realistic[2] at this point given that a certain level of physical risk is already embedded from past global warming. However, physical risks may be reduced or mitigated if new technologies are developed that reduce and/or capture carbon emissions.

Since such technologies are not readily available yet, there is general consensus that climate change will have an overall negative impact on society and the economy worldwide. Given the magnitude of the potential socio-economic impacts, climate change may also have an impact on social programs such as the CPP.

Climate change can affect the CPP through various channels. The demographic, economic and investment environments can all be affected by climate change in the future. However, there is a lot of uncertainty on the direction and magnitude of these potential impacts, and the risk is evolving constantly. In addition, research and data to quantify the full impact of climate change

[1] The Global Risks Report 2022, 17th Edition - Insight report (weforum.org)
[2] Summary for Policymakers (ipcc.ch) (Section 8B.5)

on the demographic, economic and investment environments are incomplete and, in certain cases, somewhat conflicting.

In view of the high level of uncertainty, the current best practice is to conduct scenario analysis rather than incorporate future climate policy and the potential impact of technology into best-estimate assumptions. Given the potential implications of climate change on the CPP, this section uses information from publicly available sources to illustrate a range of potential impacts on the base CPP MCR.

It important to note that this section focuses on assessing downside risk only, and that the analysis is based on scenarios that are intentionally adverse. New technologies and business opportunities related to a transition to a lower carbon economy may also create positive outcomes that are outside the scope of this section. The section is therefore not meant to represent forecasts or predictions.

Illustrative Scenarios

Over the last few years, many global organizations and regulators have been conducting climate scenario analysis in order to assess risk, and they have been publishing the results of their findings. The risk assessments focus on a range of variables under various climate path scenarios. The climate path scenarios are normally broadly based on the Representative Concentration Pathways or Shared Socio-Economic Pathways used in the Intergovernmental Panel on Climate Change's Fifth and Sixth Assessment Reports. [1, 2]

One important variable that is often analysed in these publications is the gross domestic product (GDP). It has the advantage of being a well understood and broadly used measure. Conceptually, it is also an overarching macro-economic variable that can be used to adjust the future economic and investment environment.

After reviewing various published articles and research papers on climate change scenario analysis, three scenarios with different pathways of Canadian GDP growth rates relative to a baseline scenario[3] are selected to assess the impact on the base CPP MCR.

Scenario 1 can be generally classified in the 'orderly transition' category of scenarios. It therefore assumes that successful climate policies are introduced early and gradually in order to limit global warming. Canadian GDP growth rates are lower relative to the baseline scenario starting in 2020, mainly caused by disruption in the economy from implementation of climate change policies. The cumulative difference in GDP projections relative to the baseline scenario grows to -10% by 2050, then stay constant until 2100.

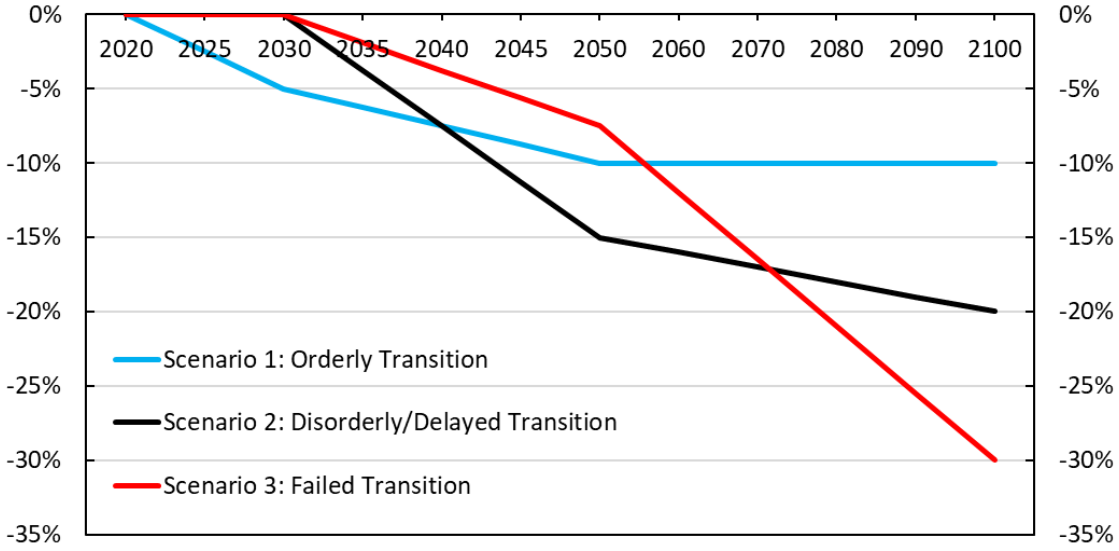
[1] AR5 Synthesis Report - Climate Change 2014, Synthesis Report (ipcc.ch)
[2] Synthesis report of the IPCC sixth assessment report (AR6)
[3] The baseline scenarios in publicly available reports can vary and are not defined; therefore, they can't be assessed against the best-estimate assumptions of this report. For illustration purposes only, the differences relative to the baseline scenarios were applied to the best-estimate assumptions of this report.

Scenario 2 can be generally classified in the 'disorderly/delayed transition' category of scenarios. It assumes that climate change policies only start in 2030. There is therefore no impact on GDP relative to the baseline scenario until 2030. However, late action leads to a stronger impact than scenario 1 after 2030. The cumulative difference relative to the baseline scenario is 0% by 2030, -15% by 2050 and -20% by 2100.

Scenario 3 can be generally classified in the 'failed transition' category of scenarios. It assumes that no further climate change policies are implemented. Although the difference relative to the baseline scenario is lower than the other scenarios through 2050, the compound physical risks resulting from no further climate action creates severe impacts between 2050 and 2100. The cumulative difference relative to the baseline scenario is 0% by 2030, -8% by 2050 and -30% by 2100.

Chart 17 shows the difference in Canadian GDP growth rates relative to the baseline scenario for each scenario.

Chart 17 Illustrative Climate Scenarios – Cumulative Canadian GDP Impact Relative to Baseline Scenario



Methodology

The scenarios above are translated into potential impacts on the base CPP MCR, using the following simplified approach:

- Changes in Canadian GDP growth are translated one-for-one into changes in total employment earnings growth through the real wage assumption.

- Changes in global GDP growth are also incorporated in the assumed investment returns through the growth in earnings component which is proxied by global GDP growth per capita. The growth in earnings is used to develop the assumption on rates of return on public equities, private equities and real assets. In 2030, these three asset classes are expected to represent about 73% of the CPP investment portfolio. For simplicity, changes in global GDP growth were proxied by the changes in Canadian GDP growth shown in the Chart 17. Table 120 shows the assumed average annual real rate of return for each scenario for the 75-year period 2022-2096.

Table 120 Climate Change Scenario - Real Annual Rate of Return on Base CPP assets
(percentages)

Scenario	2022-2096
Best-Estimate	3.69
Scenario 1: Orderly Transition	3.60
Scenario 2: Disorderly/Delayed Transition	3.52
Scenario 3: Failed Transition	3.38

This simplified model allows for an initial assessment of climate change risk on the CPP. The OCA will conduct further research in the future and collaborate with other professionals on the topic with the objective of refining the model as well as incorporating more relevant variables and their dynamics.

Results

The impact on the base CPP MCR for each scenario is shown in Table 121. It is important to note that these hypothetical scenarios are intentionally adverse. They are meant to illustrate downside risks only and are not meant to be forecasts or predictions.

Table 121 Climate Change Scenario - Base CPP MCR for 2034 and thereafter
(percentages)

Scenario	MCR	Change Relative to Best-Estimate
Best-Estimate	9.54	-
Scenario 1: Orderly Transition	9.75	0.21
Scenario 2: Disorderly/Delayed Transition	9.94	0.40
Scenario 3: Failed Transition	10.06	0.52

Appendix F – Acknowledgements

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The Canada Life Tables (CLT) created by Statistics Canada have been used for the historical mortality data for years 2011 to 2020

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