RETRAITE QUÉBEC
Québec Pension Plan

Actuarial Valuation

of the Québec Pension Plan as at 31 December 2021

Votre gouvernement

Québec

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This document is available on Retraite Québec's website:
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The totals in the tables in this document may not correspond to the sum of the separate parts because the numbers have been rounded off.

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Eric Girard
Minister of Finance
Gouvernement du Québec

Dear Mr. Minister:

I am honoured to be sending you the actuarial valuation as at 31 December 2021 commissioned by Retraite Québec in accordance with section 216 of the *Act respecting the Québec Pension Plan*.

Sincerely,

René Dufresne
President and Chief Executive Officer
Retraite Québec

René Dufresne
President and Chief Executive Officer
Retraite Québec

Dear Mr. President and Chief Executive Officer:

Under the mandate entrusted to us, we are enclosing the actuarial valuation of the Québec Pension Plan as at 31 December 2021.

This actuarial valuation was conducted in accordance with section 216 of the *Act respecting the Québec Pension Plan*. It provides a projection of cash inflows and outflows, along with their effect on the base plan's and the additional plan's reserve for the next 50 years. It also evaluates the base plan's steady-state contribution rate and the additional plan's reference contribution rate.

Sincerely,

Jean-François Therrien, FCIA, FSA
Chief Actuary

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Actuary

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Actuary

Highlights

Actuarial Valuation of the Québec Pension Plan as at 31 December 2021

The Québec Pension Plan is financially sound.

- ✔ The steady-state contribution rate and the reference contribution rate are lower than the statutory contribution rates.
- ✔ Under both the base plan and the additional plan, **cash inflows are sufficient** to fund cash outflows for each of the 50 years in the projection period.

	Actuarial valuation as at 31 December **2018**	Report modifying the actuarial valuation as at 31 December 2018* **2021**	Actuarial valuation as at 31 December **2021**
Base plan Steady-state contribution rate	**10.61%**	**10.67%** ▲ 0.06%	**10.54%** ▼ 0.13%
Additional plan Reference contribution rate	**1.84%**	**1.85%** ▲ 0.01%	**1.85%** › 0.00%

Main observations

Limited effect of the COVID-19 pandemic in the short-term
The contributions collected were comparable to the projections for 2020, and higher by one billion dollars for 2021.

Postponement of applications for a retirement pension
Less applications for a retirement pension were filed at age 60 (pensions reduced for being paid early), which means that the amounts paid to new retirement pension beneficiaries will be higher.

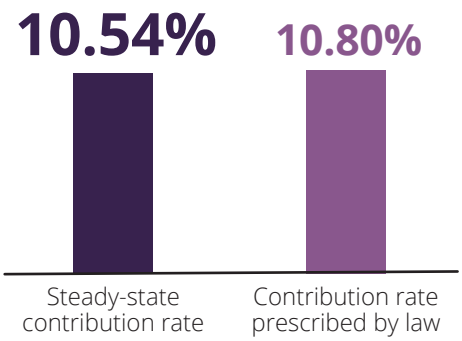
The reserve as at 31 December 2021 is greater than expected
The reserve is greater than expected mainly due to investment gains of 14 billion dollars.

Update to the projections

- ✔ Increase in the short-term projection of the indexation of pensions
- ✔ More non-permanent residents
- ✔ Lower expectations regarding future returns

* This report evaluated the cost of the amendments suggested in Bill 17. The amendments mainly concern the benefits paid to disabled persons.

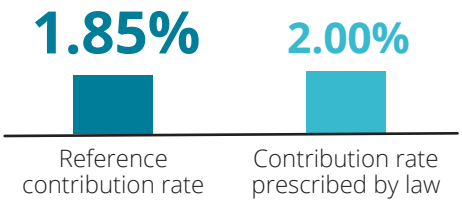
Base plan



- ✔ **The reserve as at 31 December already has 103 billion dollars.** This level was projected for 2025 only.
- ✔ The funding depends mainly on the contributory payroll: **over 60% of cash inflows result from contributions**.

	In 2021	In 25 years	In 50 years
Beneficiaries Retirement pension	**2.0**M	**2.6**M	**2.9**M
Total **Benefits**	$**16**B	$**43**B	$**100**B
Reserve	$**103**B	$**303**B	$**847**B

Additional plan



- ✔ **The additional plan's reserve is increasing quickly.** It surpasses the base plan's reserve in 2055.
- ✔ The funding depends mainly on financial assets. In the long-term, **70% of cash inflows result from investment income.**

	In 2021	In 25 years	In 50 years
Beneficiaries Retirement pension	**0.2**M	**1.9**M	**2.8**M
Total **Benefits**	$**5**M	$**5**B	$**32**B
Reserve	$**3**B	$**250**B	$**954**B

To monitor in the long-term

- Economic and geopolitical instability
- Changes in the labour force
- Climate change
- Evolution of longevity

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Main Definitions and Abbreviations

- **Basic exemption**

  Applicable to the base plan and the first component of the additional plan, the basic exemption is the limit below which a person's employment earnings for a given year are not subject to Québec Pension Plan contributions. The basic exemption is set at $3500.

- **Contributory earnings**
  - Base plan and first component of the additional plan: employment earnings between the basic exemption of $3500 and the MPE
  - Second component of the additional plan: employment earnings between the MPE and the YAMPE

- **Act**

  Act respecting the Québec Pension Plan (CQLR, c. R-9).

- **Additional amount for disability**

  Benefit intended for retirement pension beneficiaries. The additional amount for disability is applicable under the base plan only and is set at $524.61 a month in 2022.

- **Maximum pensionable earnings (MPE)**

  Upper limit applicable to pensionable earnings in the base plan and the first component of the additional plan. The MPE is the upper limit beyond which a worker's employment earnings for a given year are not subject to Plan contributions. Earnings that exceed the upper limit are not used to calculate pensions. The MPE is $64 900 in 2022.

- **Additional maximum pensionable earnings (YAMPE)**

  Upper limit applicable to pensionable earnings in the second component of the additional plan. The YAMPE is equal to 107% of the MPE in 2024 and 114% of the MPE as of 2025. The result of the YAMPE is rounded down to the nearest $100.

- **Plan**

  Québec Pension Plan, including the base plan and the additional plan.

- **Base plan**

  The part of the Québec Pension Plan that came into effect in 1966. The retirement pension in the base plan aims to replace 25% of a person's employment earnings, up to the maximum pensionable earnings, once that person begins receiving the pension at age 65.

- **Additional plan**

  The part of the Québec Pension Plan that came into effect in 2019 after the enhancement of the Plan. With this enhancement, the income replacement rate will gradually increase to 33.33% of pensionable earnings based on the new upper limit, the additional maximum pensionable earnings.

  The additional plan has two components.

  - First component: The part of the additional plan related to the pensionable earnings limited to the MPE
  - Second component: The part of the additional plan related to the pensionable earnings that fall between the MPE and the YAMPE.

- **Reserve**

  Assets of the base plan or additional plan of the Québec Pension Plan. The two reserves are separate.

- **Steady-state contribution rate**

  Funding measure for the base plan. The steady-state contribution rate is the contribution rate that would be required to ensure that the ratio of the reserve to annual cash outflows remains constant over the long term.

- **Reference contribution rate**

  Funding measure for the additional plan. The reference contribution rate is the rate that makes it possible to accumulate a reserve at least equal to the reference value.

- **Reference value**

  Value of the costs after 2041 related to contributions paid before the end of the 20th projection year (2041). As a result, it takes into account contributions until the end of the 20th projection year without considering the effect of new contributions after that year.

Abbreviations for the base plan and the additional plan

- **B** Base plan
- **A** Additional plan
- **A1** First component of the additional plan
- **A2** Second component of the additional plan

Other abbreviation

- **$M** millions of dollars

1. Introduction

1.1 Context

Pursuant to section 216 of the *Act respecting the Québec Pension Plan* (the Act), Retraite Québec must prepare an actuarial valuation of the Québec Pension Plan (the Plan) at least once every three years. This valuation was carried out as at 31 December 2021. The previous valuation was carried out as at 31 December 2018 and tabled in the National Assembly in December 2019.

Uncertainty related to recent events

This actuarial valuation was prepared under extraordinary circumstances (COVID-19 pandemic, economic and geopolitical instability, changes in the labour market, etc.). As a result, the projections, in particular the short-term projections, are more uncertain than they have been in the past. However, the projection period for this actuarial valuation covers a 50-year period, and the Plan's funding takes a long-term view. Appendix VI addresses the risks related to Plan funding and the uncertainty of results.

1.2 Amendments to Plan provisions since the previous actuarial valuation

In November 2021, Bill 17, the *Act respecting the implementation of certain provisions of the Budget Speech of 25 March 2021 and amending other provisions*, was tabled in the Québec National Assembly. The Bill was accompanied by an actuarial report measuring the effects of the proposed amendments on the projections of the actuarial valuation of the Québec Pension Plan as at 31 December 2018. In February 2022, the National Assembly adopted the bill, thus formalizing the implementation of the amendments.

These amendments are primarily related to disability benefits. Appendix I provides a breakdown of the amendments made to the Plan. The report on the actuarial valuation of these amendments indicates a steady-state contribution rate of 10.67%, 0.06% higher than the rate calculated in the actuarial valuation as at 31 December 2018. The reference contribution rate was valued at 1.85%, 0.01% higher than in the previous valuation.

Although these amendments were adopted after the valuation date, their adoption is a subsequent event, which was taken into account in the valuation, in accordance with Canadian accepted actuarial practice.

1.3 Mandate's objectives

The actuarial valuation serves to inform the government, contributors and beneficiaries of financial changes in the Plan by projecting the cash inflows and outflows of both the base plan and the additional plan for the next 50 years (from 2022 to 2071). It also includes a projection of the reserves of both plans and valuates the steady-state and reference contribution rates. The contribution rates correspond to the base plan and additional plan funding measures.

The data are updated in each actuarial valuation, and the demographic, economic and Plan-specific assumptions are adjusted in accordance with any changes that have occurred within the Plan environment.

1.4 Structure of the report

This document is the report on the actuarial valuation. It discusses the valuation methodology, the main assumptions and the results obtained. It includes seven appendices that:

I. summarize the main provisions of the Plan
II. provide specific information on the methodology used for the actuarial valuation
III. provide a detailed description of the demographic and economic assumptions used
IV. provide a description of the Plan-specific assumptions used
V. summarize findings related to Plan funding
VI. provide an analysis of the risks related to Plan funding and the uncertainty of results
VII. reconcile the results with those of the previous actuarial valuation.

2. Methodology

The purpose of this actuarial valuation is to project cash inflows and outflows under each plan for the next 50 years, which is the minimum projection period prescribed in the Act. The projections make it possible to estimate future changes in each of the reserves and valuate the steady-state contribution and reference rates of each plan.

The valuation uses a demographic and economic projection model to estimate cash inflows and outflows. The model requires a wide range of data, as well as the establishment of numerous assumptions, several are which are common to both plans.

The method used projects the **population of Québec** based on assumptions for fertility, migration and mortality. The economic assumptions and the assumptions related to Plan experience are then applied to the projected population, which makes it possible to calculate the number of contributors and beneficiaries, as well as the benefits paid. Contributions and investment income in both plans' reserves make up the Plan's **cash inflows**. **Cash outflows** are made up of the benefits paid out and administration costs.

The actuarial analysis was carried out in accordance with the provisions of the Plan as at 31 December 2021 and the amendments adopted in February 2022. The contribution rates used for the entire projection period in the actuarial valuation are those prescribed by law. They take into account the gradual implementation of the additional plan. The Plan provisions are described in Appendix I, with a detailed description of the methodology given in Appendix II.

2.1 Funding measures

The unique funding characteristics of each plan justify different funding measures.

Base plan

The base plan came into effect on 1 January 1966. At that time, a partially funded approach was chosen. Under section 216 of the Act, the **steady-state contribution rate** must be calculated in the actuarial valuation. The steady-state contribution rate is the contribution rate that would be required to ensure that the ratio of the reserve to annual cash outflows remains constant over the long term. This rate helps ensure that base plan funding remains stable during the projection period. The base plan results are shown in Section 4.1.

Additional plan

The funding of the additional plan relies more on its financial assets. Under section 216 of the Act, the **reference contribution rate** must be calculated in the actuarial valuation. The reference contribution rate makes it possible to attain, at the end of the 20th projection year, a reserve that is at least equal to the value of the expenses linked to contributions paid up prior to the end of the 20th year. It is applied to pensionable earnings stemming from the first component of the additional plan, taking into account that the applicable contribution rate for the second component is four times higher. This rate makes it possible to reach the target level of the reserve by the end of the 20th projection year. The additional plan's results are shown in Section 4.2.

3. Main assumptions

In preparing an actuarial valuation, numerous assumptions have to be made: those regarding the demographic and economic environment are detailed in Appendix III, whereas Appendix IV shows the assumptions related to Plan benefits. This section describes the main assumptions used for this valuation.

Since the projection period of this actuarial valuation is 50 years, the assumptions must take a **long-term view**. Recent situations resulting from a specific set of circumstances must be taken into consideration, without assigning them undue importance.

This actuarial valuation uses assumptions that provide for **no margins for adverse deviation**. The assumptions are intended to be reasonable on an individual basis and coherent on an overall basis. Since many assumptions are interrelated, they must form a logical whole that provides a reasonable projection over the long term.

Several factors are taken into account in establishing assumptions, including Plan experience, historical trends related to the main demographic, financial and economic factors, the opinion and forecasts of experts, comparisons with the assumptions made by other public plans at the national and international levels, and public policies on inflation and immigration.

As Appendix VII shows, differences occurred between the assumptions made in the previous actuarial valuation and the results obtained over the past three years. This is the case with each actuarial valuation. Future differences will also occur. These differences may have an upward or downward effect compared with the results of this actuarial valuation. They will be analyzed and taken into account in subsequent actuarial valuations.

3.1 Demographic assumptions

The number of Plan contributors and beneficiaries is determined by projecting the Québec population. The projection uses the population estimated by Statistics Canada as at 1 July 2021, to which are applied the fertility, migration and mortality assumptions. The demographic assumptions are common to both the base plan and the additional plan.

The main demographic assumptions used in this valuation can be summarized as follows:

- The **total fertility rate** is used to estimate the number of children that would be born to each woman in a generation during all of her child-bearing years in accordance with the fertility rates observed in a given year. The rate is 1.57 children per woman in 2022. It gradually decreases to 1.55 in 2051 and remains constant thereafter.
- **Total net migration** is the number of immigrants for a given year, minus the number of emigrants. It takes into consideration both international and interprovincial immigration and emigration.
    - International immigration was lower in the last three years than in the past because of special circumstances. The assumption retained is the average number of immigrants and emigrants from 2009 to 2018. For 2022, the assumption corresponds to the target set by the Ministère de l'Immigration, de la Francisation et de l'Intégration (MIFI) in its immigration plan, which forecasts an upturn due to the deficit observed in 2020 and 2021.
    - The total percentage of emigrants decreases over the projection period as a result of the aging population.
    - Total net migration is 0.61% in 2022, 0.45% in 2023, and 0.48% in 2071. Expressed as the number of persons, it will be 52 800 persons in 2022, 39 400 persons in 2023, and 48 000 persons in 2071.
- The proportion of **non-permanent residents** in the population remains constant at the 2021 level of 2.99%.
- Improvement in **life expectancy** increases continuously over the entire projection period: life expectancy at age 65 rises from 19.8 to 23.4 years for men, and from 22.2 to 25.5 years for women.
    - Although life expectancy at the beginning of the projection period is slightly lower than forecasted in the previous valuation because of the COVID-19 pandemic, long-term life expectancy is comparable to the estimate in the previous valuation.
    - The life expectancy gap between men and women is expected to shrink from 2.4 years in 2022 to 2.1 years in 2071.
    - A gradual shift in mortality improvement to the oldest age groups is projected.

3.2 Economic assumptions

The economic assumptions concern changes in the labour market, inflation rates, employment earnings and the MPE. The assumptions are the same for both plans. The economic assumptions also include the returns on both plans' reserves based on their respective asset allocation.

With regard to the labour market, the influence of social and economic factors partially offsets the impact of an aging population. These factors include improved labour market conditions stemming from labour shortages and a higher level of education among workers. These factors should enable workers to work longer.

Consideration of high inflation rates

Like many other countries, Canada is seeing high inflation rates in 2022. The economic scenario developed at the beginning of the year reflects this situation. However, the inflation rates observed after the valuation date remained high rather than gradually decreasing to meet the Bank of Canada's target. As a result, the projected rate of indexation for pensions for 1 January 2023 and 1 January 2024 has been revised upward to take into account the impact of this exceptional situation on Plan funding.

The main economic assumptions used in this valuation can be summarized as follows:

- The **participation rate** is the number of persons of a given age who are employed or looking for employment in relation to the total population of that age. Participation rates are expected to increase gradually, particularly for persons aged 55 and over. The overall participation rate for the population aged 20 to 64 increases from 82.1% in 2022 to 85.8% in 2071.
- The **unemployment rate** shows the proportion of persons without employment among the active population. The current labour shortage fosters employment. The projected unemployment rate for 2022 is 5.00%. It increases gradually to 6.25% in 2051 and remains stable until 2071. On the whole, the employed population increases from 4.3 million in 2022 to 4.8 million in 2071.
- The **pension indexation rate** is higher in the short term because of high inflation rates. The pension indexation rate assumption is 5.8% for 1 January 2023 and 3.4% for 1 January 2024. As of 1 January 2025, the indexation rate is 2.1%.
- In the short term, the increase in **employment earnings** is mainly tied to higher inflation rates and the economic situation. In the longer term, the assumption also takes into account the expected labour market situation. The nominal rate of increase in employment earnings (including the effect of inflation) is 3.6% in 2022. It is 2.3% in 2023 and 2024, then increases gradually to 2.9% as of 2027.
- The maximum pensionable earnings and the additional maximum pensionable earnings fluctuate based on changes in employment earnings.
- The **rate of return** assumption is used to project the investment income generated by each reserve. Table 1 shows the overall nominal rates of return (including the effect of inflation), net of management fees, for each plan. The overall nominal rates of return depend on the projected allocation of assets.
    - The economic disruption at the beginning of 2022 led to negative returns for the first months of the year, and some uncertainty remains. The nominal rate of return for the entire year is expected to be near zero.
    - For the next nine years, from 2023 to 2031, the rate of return for each asset class will be lower than the rate of return for subsequent years. This represents 0.6% on average and can be explained by the presence of several headwinds: the climate change transition; the central banks' efforts to fight inflation, which could cause an economic slowdown (higher borrowing costs); the uncertainty surrounding changes in the labour market; the slow re-establishment of supply chains, etc.
    - The asset allocation assumption remains stable throughout the projection period for the base plan, whereas it changes after 10 years for the additional plan.

Table 1
Nominal rates of return, net of management fees – Base plan and additional plan

Period	Base plan	Additional plan
2022	0.0%	0.2%
2023 to 2031	5.8%	5.7%
2032 and after	6.4%	5.9%
50-year average (2022 to 2071)	**6.1**%	**5.8**%

3.3 Plan-specific assumptions

Assumptions are used to project each benefit paid under the Plan, particularly retirement, disability and surviving spouse's pensions, along with the death benefit. These sums are determined on the basis of the projected population and the eligibility rate and incidence rate assumptions.

The eligibility requirements under the additional plan are the same as those under the base plan, with pension payments beginning at the same time under both plans. Therefore, the eligibility rate and incidence rate assumptions are the same for both plans.

The main assumptions concerning benefits used in this actuarial valuation can be summarized as follows:

- **Retirement rates** represent the age distribution of new beneficiaries when payment of their retirement pensions begins. The retirement rate at age 60 has considerably decreased since 2014. This decrease is maintained in the projection, but at a slower rate. The average age at which contributors apply for their retirement pension will increase gradually to reach 63.6 years in the next 10 years.

  Retirement rates influence retirement pension amounts because of the adjustment factors for early or delayed retirement. Since, on average, payment of the retirement pension begins later, the adjustment factors for early retirement are lower. As a result, the average amount of the retirement pension paid out to new retirees is higher.

- The **total disability incidence rate** corresponds to the ratio of the number of new disability pension beneficiaries to the number of persons who have contributed sufficiently to qualify for a disability pension. The disability incidence rate has been dropping for several years. The decrease was especially significant in 2020 and 2021, but this is expected to be temporary. The projection shows that the rate will continue to drop from 2019 levels, but at a slower pace than in the past.

3.4 Summary of main assumptions

Table 2 shows the summary of the main assumptions used in this actuarial valuation and the previous actuarial valuation as at 31 December 2018.

Table 2
Summary of main assumptions used in this actuarial valuation and in the previous actuarial valuation

	Assumption	Actuarial valuation as at 31 December 2021	Actuarial valuation as at 31 December 2018
Demographics	**Total fertility rate**	1.57 children/woman in 2022, decreasing to 1.55 in 2051	1.60 children/woman in 2019, increasing to 1.65 in 2048
	Net migration (in percentage of the population)	0.61% in 2022, 0.45% in 2023, increasing to 0.48% in 2071	0.27% in 2019, increasing to 0.44% in 2022, then to 0.46% in 2068
	Non-permanent residents (in percentage of the population)	2.99% as of 2022	2.2% in 2019, increasing to 2.4% in 2028
	Life expectancy at birth[a]	*2022 to 2071:* Men: 81.1 to 85.7 years Women: 84.6 to 88.5 years	*2019 to 2068:* Men: 80.9 to 85.8 years Women: 84.5 to 88.6 years
	Life expectancy at age 65[a]	*2022 to 2071:* Men: 19.8 to 23.4 years Women: 22.2 to 25.5 years	*2019 to 2068:* Men: 19.7 to 23.6 years Women: 22.3 to 25.6 years
Economy	**Participation rate** (age 20 to 64)	82.1% in 2022, increasing to 85.8% in 2071	81.6% in 2019, increasing to 86.7% in 2068
	Unemployment rate	5.0% in 2022, increasing to 6.25% in 2051	5.4% in 2019, increasing to 6.0% in 2048
	Pension indexation rate	5.8% in 2023, 3.4% in 2024, and 2.1% thereafter	1.9% in 2020, 2.0% from 2021 to 2029, and 2.1% thereafter
	Nominal increase in average employment earnings	3.6% in 2022, 2.3% in 2023 and 2024, increasing to 2.9% in 2027	2.6% in 2019, 2.7% from 2020 to 2028, and 3.0% thereafter
	Base plan's nominal rate of return	0% in 2022, 5.8% from 2023 to 2031, and 6.4% thereafter	5.6% in 2019, 5.7% from 2020 to 2028, and 6.3% thereafter
	Additional plan's nominal rate of return	0.2% in 2022, 5.7% from 2023 to 2031, and 5.9% thereafter	5.6% in 2019, 5.7% from 2020 to 2028, and 5.9% thereafter
Benefits	**Average age at which pension payments begin**	*As of 2031:* Men: 63.7 years Women: 63.5 years	*As of 2019:* Men: 62.3 years Women: 61.8 years

a) The life expectancies shown in this table do not take into account any reductions in mortality after the year shown.

4. Results

The main results of the actuarial valuation correspond to the projections for contributions, benefits and the reserve, as well as the calculation of the steady-state contribution and reference rates.

Given the uncertainty of any projection, sensitivity tests and a stochastic analysis were carried out. The results are shown in Appendix VI. These analyses help identify Plan risks and assess the volatility of the actuarial valuation results. Appendix VII reconciles the results of this actuarial valuation with those of the previous valuation.

Section 4.1 shows the base plan's results, whereas Section 4.2 shows those of the additional plan. In accordance with the provisions of the Act, the results are shown separately for each plan and are compared in Section 4.3.

4.1 Base plan

4.1.1 Base plan contributions

The number of contributors, the contributory earnings and the contribution rate determine future contributions. Section 3 of Appendix IV provides further details on the assumptions used to project contributions.

In general, persons whose annual employment earnings exceed the basic exemption of $3500 contribute to the Plan. The number of contributors is expected to increase gradually until the end of the projection period, from 4.3 million in 2022 to 5.0 million in 2071.

Contributory earnings under the base plan correspond to employment earnings between the basic exemption ($3500) and the MPE. The average annual contributory earnings in 2022 are $39 600 for men and $35 300 for women.

Table 3 shows the base plan's projected contributions until 2071 based on a contribution rate of 10.80% over the entire projection period. Contributions increase only as the total contributory payroll increases. The base plan's total annual contributions rise from $17.7 billion in 2022 to $83.4 billion in 2071.

Table 3
Projected contributions – Base plan

Year	Statutory contribution rate	MPE	Number of contributors (in thousands)	Total contributory payroll (in millions of dollars)	Contributions[a] (in millions of dollars)
2022	10.80%	64 900	4307	161 902	17 699
2023	10.80%	66 900	4306	166 374	18 176
2024	10.80%	68 800	4309	170 832	18 649
2025	10.80%	70 300	4314	175 097	19 104
2026	10.80%	72 000	4321	179 930	19 627
2027	10.80%	73 800	4330	185 259	20 205
2028	10.80%	75 900	4341	191 170	20 847
2029	10.80%	78 100	4354	197 411	21 524
2030	10.80%	80 400	4368	203 985	22 237
2031	10.80%	82 700	4386	210 870	22 984
2036	10.80%	95 400	4478	249 668	27 195
2041	10.80%	110 100	4570	295 400	32 159
2046	10.80%	127 000	4648	347 864	37 853
2051	10.80%	146 500	4716	408 559	44 439
2056	10.80%	169 000	4761	476 848	51 850
2061	10.80%	195 000	4819	557 756	60 631
2066	10.80%	225 000	4894	654 615	71 143
2071	10.80%	259 600	4967	767 701	83 416

a) Contributions calculated on the basis of the total contributory payroll and the contribution rate were increased because some contributions are not refunded to employers. Expenses related to bad debts reduce the amount of contributions.

4.1.2 Benefits under the base plan

The Plan provides financial protection in the event of retirement, disability and death. Appendix I summarizes the benefits paid under each plan. Section 4 of Appendix IV provides a detailed explanation of the assumptions used to determine the number of beneficiaries and the average amount of benefits.

Table 4 shows the projected number of beneficiaries per type of benefit under the base plan for 2022 to 2071.

The transition toward retirement of the generations of persons from the baby boom is well under way. The number of **retirement pension** beneficiaries continues to increase by approximately 16% by 2030. This will result in a decrease in the ratio between the number of contributors and the number of retirement pension beneficiaries. In 2022, there are 2.1 contributors for each retirement pension beneficiary. By 2025, this ratio drops to fewer than 2.0 contributors and stabilizes thereafter to around 1.7 contributors as of 2057.

The number of **disability pension** beneficiaries continues to fall, from 58 000 in 2022 to 50 000 in 2071. This drop is due mainly to a reduction in disability incidence rates.

The number of **surviving spouse's pension** beneficiaries increases by approximately 35% throughout the projection period as a result of an increase in the number of deaths.

Table 4
Projected number of beneficiaries as at 31 December of a given year – Base Plan
(in thousands)

Year	Retirement pension[a, b]	Disability pension	Surviving spouse's pension[a]	Death benefit[c]	Orphan's pension and pension for a disabled contributor's child	Additional amount for disability[d]
2022	2025	58	385	59	20	2
2023	2058	56	389	61	20	1
2024	2120	55	393	62	19	1
2025	2160	54	397	63	19	0
2026	2201	52	402	65	18	0
2027	2240	51	407	66	17	0
2028	2276	49	412	68	17	0
2029	2310	48	417	70	16	0
2030	2340	47	422	71	16	0
2031	2364	46	428	73	16	0
2036	2455	46	456	82	14	0
2041	2531	47	481	91	13	0
2046	2602	47	498	97	13	0
2051	2656	47	508	101	12	0
2056	2720	47	510	102	12	0
2061	2775	47	510	102	12	0
2066	2812	48	512	103	12	0
2071	2857	50	519	105	12	0

a) A person who is receiving both a retirement pension and a surviving spouse's pension is counted in the two corresponding columns of the table.

b) The number given in this table for retirement pension beneficiaries does not take into account that, as of 1 January 1994, the retirement pension can be shared between spouses.

c) Number of contributors whose death gives entitlement to a death benefit in the year indicated.

d) Number of retirement pension beneficiaries receiving the additional amount for disability.

Table 5 shows the projected benefits paid under the base plan from 2022 to 2071. Benefits increase from $16.8 billion in 2022 to $99.6 billion in 2071. Retirement pensions account for 84% of all benefits paid under the base plan in 2022 and reach 91% of all benefits paid in 2071.

Table 5
Projected benefits – Base plan
(in millions of dollars)

Year	Retirement pension[a]	Disability pension	Surviving spouse's pension	Death benefit	Orphan's pension and pension for a disabled contributor's child	Additional amount for disability	Total benefits
2022	14 111	677	1797	148	49	10	**16 791**
2023	15 258	692	1895	151	50	10	**18 056**
2024	16 166	634	1957	155	51	7	**18 969**
2025	17 098	550	1997	158	50	3	**19 856**
2026	17 936	548	2041	162	49	1	**20 739**
2027	18 813	547	2088	166	49	0	**21 663**
2028	19 707	546	2139	170	48	0	**22 611**
2029	20 613	547	2194	174	48	0	**23 576**
2030	21 518	549	2254	178	48	0	**24 547**
2031	22 406	556	2320	183	47	0	**25 512**
2036	26 893	625	2724	206	48	0	**30 495**
2041	32 099	714	3235	227	49	0	**36 324**
2046	38 514	801	3825	244	50	0	**43 434**
2051	45 930	910	4467	254	53	0	**51 614**
2056	54 902	1020	5120	257	57	0	**61 355**
2061	65 425	1143	5787	256	62	0	**72 673**
2066	76 871	1329	6565	258	68	0	**85 090**
2071	90 114	1545	7565	264	74	0	**99 561**

a) Retirement pension amounts paid include amounts paid for the retirement pension supplement.

4.1.3 Base plan's reserve

The base plan's reserve is the accumulated difference between cash inflows and outflows since the plan's inception in 1966. It is distinct from the additional plan's reserve. Both are deposited in the Caisse de dépôt et placement du Québec (CDPQ) in separate funds. In addition, pursuant to the Act, the cash inflows and outflows of each plan are subject to separate accounting procedures.

At the plan's inception, it was decided that the plan would be funded partially instead of on a pay-as-you-go basis.[1] In other words, to meet its funding needs, the base plan relies in part on its financial assets (the reserve), with the balance of its funding coming from future contributors and their contributions.

Compared with a pure pay-as-you-go funding scheme, the base plan has the following advantages:

- It diversifies plan risk, since the plan's financial situation does not depend solely on the Québec labour market situation, but also on the return from the reserve's financial assets.
- It increases the anticipated plan returns and lowers the cost of plan funding, with the return on assets generally higher than contributory payroll growth.
- It helps stabilize the contribution rate by reducing the impact of certain demographic effects.

[1] In a pure pay-as-you-go funding scheme, the contributions of a given year are used to pay the benefits of the same year.

Table 6 shows the base plan's projected cash inflows, cash outflows and reserve for 2022 to 2071.

The initial base plan reserve is $102.8 billion as at 31 December 2021. The results show greater contributions than cash outflows until 2023. Thereafter, a portion of the investment income will be used in conjunction with contributions to cover cash outflows. However, cash inflows remain greater than cash outflows for each of the years in the projection period. As a result, the reserve grows annually to reach $847 billion in 2071.

Furthermore, **contributions are the main source of funding for the base plan**. During the projection period, contributions represent more than 60% of the plan's cash inflows. Appendix V provides further information on funding sources for cash outflows and Plan funding in general.

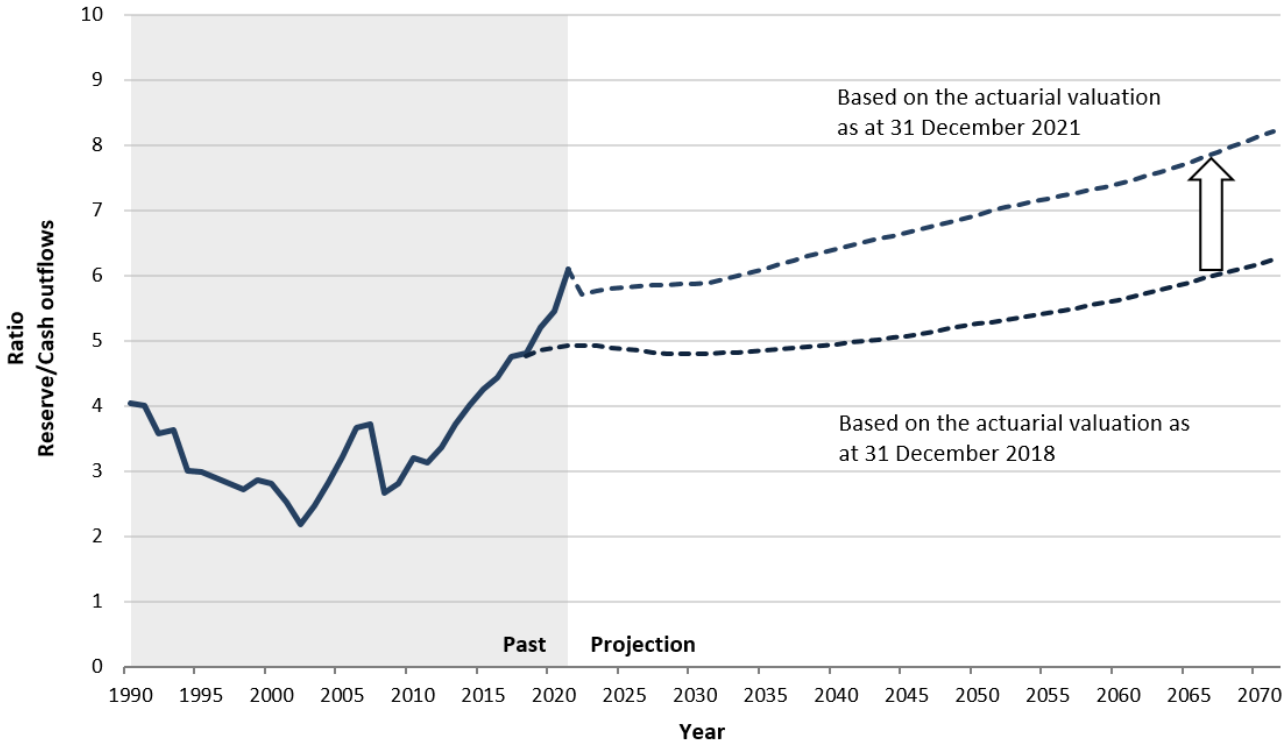
Table 6
Projected reserve based on the contribution rate of 10.80% prescribed by law – Base plan
(in millions of dollars)

Year	Cash inflows			Cash outflows			Reserve	
	Contributions	Investment income	Total	Benefits	Administration costs	Total	As at 31 December	Ratio to cash outflows for the following year
2022	17 699	0	17 699	16 791	76	16 866	103 621	5.7
2023	18 176	6037	24 213	18 056	78	18 134	109 699	5.8
2024	18 649	6203	24 852	18 969	79	19 048	115 503	5.8
2025	19 104	6552	25 656	19 856	80	19 936	121 223	5.8
2026	19 627	6907	26 534	20 739	82	20 820	126 937	5.8
2027	20 205	7273	27 478	21 663	83	21 747	132 669	5.8
2028	20 847	7645	28 492	22 611	85	22 696	138 465	5.9
2029	21 524	8026	29 550	23 576	86	23 662	144 353	5.9
2030	22 237	8401	30 638	24 547	88	24 635	150 356	5.9
2031	22 984	8760	31 744	25 512	90	25 602	156 498	5.9
2036	27 195	11 845	39 041	30 495	99	30 594	195 318	6.2
2041	32 159	14 782	46 941	36 324	110	36 433	243 725	6.5
2046	37 853	18 369	56 222	43 434	122	43 556	302 655	6.7
2051	44 439	22 708	67 148	51 614	137	51 750	373 995	7.0
2056	51 850	27 931	79 780	61 355	153	61 509	459 642	7.2
2061	60 631	34 121	94 751	72 673	173	72 847	561 281	7.5
2066	71 143	41 735	112 878	85 090	196	85 286	686 983	7.8
2071	83 416	51 407	134 823	99 561	222	99 783	846 751	8.2

Ratio of the reserve at the end of a given year to the cash outflows for the following year

The ratio of the reserve at the end of a given year to the cash outflows for the following year can be used to measure the relative size of the reserve. Chart 1 shows that this ratio was 4.8 as at 31 December 2018 and increased to 6.1 as at 31 December 2021. This level is higher than the projection in the previous actuarial valuation, mainly because of the favorable growth of the reserve in the past three years. The ratio drops to 5.7 in 2022, since the projected rate of return is zero for that year. It then increases gradually to reach 8.2 in 2071.

Chart 1
Ratio of the reserve at the end of a given year to cash outflows for the following year based on the actuarial valuations as at 31 December 2018 and 31 December 2021, 1990 to 2071 – Base plan



4.1.4 Steady-state contribution rate under the base plan

a) Definition

The base plan's funding measure is the steady-state contribution rate. Under section 216 of the Act, the steady-state contribution rate must be calculated in the actuarial valuation.

> The **steady-state contribution rate** is the lowest constant contribution rate that, when applied as of the third projection year (2024), ensures that the ratio of the reserve to cash outflows for the 50th year of the projection period (2071) is at least equal to the ratio for the 30th year (2051).

The steady-state contribution rate is the contribution rate required to ensure that the ratio of the reserve to annual cash outflows remains constant over the long term. This rate helps ensure that the funding of the base plan **remains stable** during the projection period. The automatic adjustment mechanism is applied in situations where the steady-state contribution rate exceeds the statutory contribution rate by at least 0.10%.

b) Results of the projection

- The steady-state contribution rate is 10.54%.
- No automatic adjustment of the contribution rate is required because the steady-state contribution rate is lower than the contribution rate of 10.80% prescribed by law.

c) Inherent uncertainty of the projection's results

The projections are based on the best-estimate scenario used in the actuarial valuation. Appendix VI provides sensitivity and stochastic analyses of the risks related to the base plan's funding. The stochastic distributions have been adjusted since the previous actuarial valuation to reflect the higher level of uncertainty. The main observations are the following:

- The steady-state contribution rate is especially sensitive to the rate of increase in average employment earnings.
- The following variations over a 50-year period would increase the steady-state contribution rate to 10.80%, which is the statutory rate:
  - an increase in average employment earnings that is 0.3% lower than the projection;
  - a rate of return that is 0.35% lower than the projection.
- The steady-state contribution rate in 20 years is lower than 10.80% in 56% of the stochastic analysis simulations. However, it is greater than or equal to 10.80% in 44% of the simulations.

d) Results observed since the previous actuarial valuation

The results from 2019 to 2021 were more favourable than those projected in the previous actuarial valuation. The reconciliation shown in Appendix VII demonstrates that a higher than expected return on investments is the main reason why the steady-state contribution rate is lower.

Given that these results are more favourable than expected, the reserve as at 31 December 2021 is $16.6 billion more than projected in the actuarial valuation as at 31 December 2018. Therefore, the ratio of the reserve at the end of a given year to cash outflows for the following year is 6.1 as at 31 December 2021, compared with 4.9 in the previous actuarial valuation's projection.

e) Projections based on the steady-state contribution rate

Table 7 shows the projections described in the previous sections, but this time uses the steady-state contribution rate of 10.54% as of 2024. These new projections have no impact on cash outflows. They project that the reserve will begin increasing in 2023 to reach 6.1 times the annual cash outflows by 2050 and remain around that level until the end of the projection period.

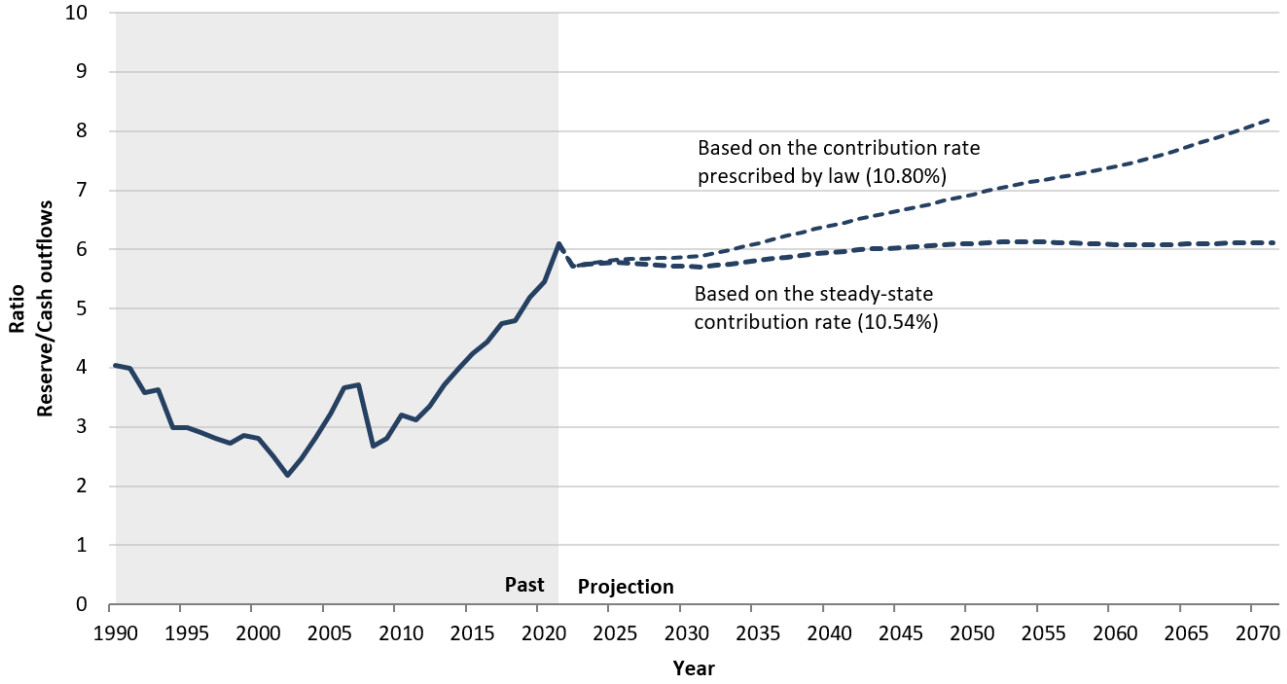
Table 7
Projected reserve based on a 10.54% steady-state contribution rate – Base plan
(in millions of dollars)

Year	Cash inflows			Cash outflows			Reserve	
	Contributions	Investment income	Total	Benefits	Administration costs	Total	As at 31 December	Ratio to cash outflows for the following year
2022	17 699	0	17 699	16 791	76	16 866	103 621	5.7
2023	18 176	6037	24 213	18 056	78	18 134	109 699	5.8
2024	18 201	6191	24 392	18 969	79	19 048	115 044	5.8
2025	18 645	6514	25 159	19 856	80	19 936	120 267	5.8
2026	19 156	6840	25 996	20 739	82	20 820	125 443	5.8
2027	19 720	7174	26 894	21 663	83	21 747	130 591	5.8
2028	20 346	7512	27 857	22 611	85	22 696	135 753	5.7
2029	21 006	7854	28 860	23 576	86	23 662	140 952	5.7
2030	21 703	8187	29 889	24 547	88	24 635	146 207	5.7
2031	22 432	8501	30 933	25 512	90	25 602	151 539	5.7
2036	26 542	11 247	37 788	30 495	99	30 594	185 000	5.8
2041	31 386	13 709	45 095	36 324	110	36 433	225 450	6.0
2046	36 943	16 603	53 546	43 434	122	43 556	272 778	6.0
2051	43 371	19 944	63 315	51 614	137	51 750	327 434	6.1
2056	50 604	23 745	74 349	61 355	153	61 509	389 349	6.1
2061	59 173	27 928	87 101	72 673	173	72 847	457 492	6.1
2066	69 433	32 724	102 157	85 090	196	85 286	536 165	6.1
2071	81 411	38 453	119 864	99 561	222	99 783	630 209	6.1

Chart 2 compares the ratio of the reserve to cash outflows established based on the statutory contribution rate and the steady-state contribution rate. Long-term stability is reached with the steady-state contribution rate, whereas, with the statutory contribution rate, the ratio of the reserve to cash outflows increases. The gap between the two curves grows over the years, with a difference of 2.1 in the ratio of reserve to cash outflows in 2071, which is similar to the growth between 2014 and 2021.

Chart 2

Ratio of the reserve at the end of a given year to cash outflows for the following year based on the contribution rate prescribed by law and the steady-state contribution rate, 1990 to 2071 – Base plan



4.2 Additional plan

4.2.1 Contributions to the additional plan

Pursuant to the Act, a person who contributes to the base plan also contributes to the additional plan. As a result, the projected number of contributors is the same for both plans. This number gradually increases until the end of the projection period, growing from 4.3 million in 2022 to 5.0 million in 2071.

With regard to the additional plan, the total contributory payroll has two pensionable earnings brackets. The first bracket applies to the first component and refers to employment earnings between the basic exemption of $3500 and the MPE. The second bracket applies to the second component and corresponds to employment earnings between the MPE and the YAMPE.

Table 8 shows a projection of the additional plan's contributions until 2071. In 2023, the first component's contribution rate peaks, with contributions under the second component beginning in 2024. In 2025, the gradual introduction of the additional plan finishes with a final increase in the YAMPE. After 2025, total contributions remain stable. Contributions increase only as the total contributory payroll increases. The additional plan's total annual contributions rise from $2.5 billion in 2022 to $19.1 billion in 2071.

Table 8
Projection of contributions – Additional plan

Year	Contribution rate A1	Contribution rate A2	MPE	YAMPE[a]	Number of contributors (in thousands)	Total contributory payroll (in millions of dollars)		Contributions[b] (in millions of dollars)
						1st bracket Pensionable earnings	2nd bracket Pensionable earnings	
2022	1.50%	0.00%	64 900	0	4307	161 902	0	2461
2023	2.00%	0.00%	66 900	0	4306	166 374	0	3367
2024	2.00%	8.00%	68 800	73 600	4309	170 832	5639	3894
2025	2.00%	8.00%	70 300	80 100	4314	175 097	10 968	4405
2026	2.00%	8.00%	72 000	82 000	4321	179 930	11 279	4525
2027	2.00%	8.00%	73 800	84 100	4330	185 259	11 722	4667
2028	2.00%	8.00%	75 900	86 500	4341	191 170	12 111	4817
2029	2.00%	8.00%	78 100	89 000	4354	197 411	12 493	4972
2030	2.00%	8.00%	80 400	91 600	4368	203 985	12 867	5134
2031	2.00%	8.00%	82 700	94 200	4386	210 870	13 267	5304
2036	2.00%	8.00%	95 400	108 700	4478	249 668	15 562	6265
2041	2.00%	8.00%	110 100	125 500	4570	295 400	18 286	7399
2046	2.00%	8.00%	127 000	144 700	4648	347 864	21 360	8 695
2051	2.00%	8.00%	146 500	167 000	4716	408 559	25 059	10 207
2056	2.00%	8.00%	169 000	192 600	4761	476 848	29 108	11 899
2061	2.00%	8.00%	195 000	222 300	4819	557 756	34 032	13 913
2066	2.00%	8.00%	225 000	256 500	4894	654 615	39 761	16 312
2071	2.00%	8.00%	259 600	295 900	4967	767 701	46 389	19 107

a) The YAMPE is calculated by multiplying the MPE for the year by 114% (107% in 2024). The result is then rounded down to the nearest $100.

b) Contributions calculated on the basis of the total contributory payroll and the contribution rate were increased because some contributions are not refunded to employers. Expenses related to bad debts reduce the amount of contributions.

4.2.2 Benefits paid under the additional plan

Appendix I summarizes the benefits paid under the additional plan. Appendix IV provides a detailed explanation of the methodology used to determine the number of beneficiaries and the average amount of benefits. Table 9 shows the projected number of beneficiaries under the additional plan for 2022 to 2071.

The number of beneficiaries takes into account the fact that, in the first years of the additional plan's existence, few beneficiaries have contributed to the plan or, consequently, received a pension under the plan. The number of beneficiaries increases over the entire projection period as the additional plan matures. At the end of the projection period, both the additional and base plans have approximately the same number of beneficiaries.

The number of **retirement pension** beneficiaries increases to 2.8 million in 2071 and quadruples between 2022 and 2031, with the rate climbing more slowly thereafter.

From 2022 to 2071, the number of surviving spouse's pension beneficiaries increases from 10 000 to 466 000. During the first years of the additional plan, few persons will receive a **surviving spouse's pension** because the majority of deaths will be the elderly, who will not have contributed to the additional plan.

Table 9
Projected number of beneficiaries as at 31 December of a given year – Additional Plan
(in thousands)

Year	Retirement pension[a, b, c]	Disability pension	Surviving spouse's pension[a]
2022	197	12	10
2023	234	15	13
2024	280	18	16
2025	348	21	19
2026	419	23	23
2027	492	25	27
2028	565	26	31
2029	640	27	36
2030	716	28	41
2031	789	30	47
2036	1151	36	82
2041	1518	41	131
2046	1868	43	194
2051	2159	46	265
2056	2394	47	334
2061	2562	47	390
2066	2672	48	433
2071	2768	50	466

a) A person who is receiving both a retirement pension and a surviving spouse's pension is counted in the two corresponding columns of the table.

b) The number given in this table for retirement pension beneficiaries does not take into account that the retirement pension can be shared between spouses.

c) Unlike the table in the previous valuation, this number excludes beneficiaries who receive the retirement pension supplement only. This situation applies to beneficiaries under the base plan who worked after the creation of the additional plan.

Table 10 shows the projected benefits paid under the additional plan from 2022 to 2071. Benefits increase from $20 billion in 2022 to $32.5 billion in 2071. The growth in benefits paid is due to an increase in the number of beneficiaries, as well as the average monthly amount of new pensions. Since few years of contributions to the additional plan are possible over the first years of its existence, the monthly amounts payable are relatively small. After that period, new beneficiaries contribute to the additional plan for a greater number of years, thus increasing the monthly amounts beneficiaries receive.

Retirement pensions account for 93% of all benefits paid under the additional plan in 2071.

Table 10
Projection of benefits – Additional plan
(in millions of dollars)

Year	Retirement pension[a]	Disability pension	Surviving spouse's pension	Total benefits
2022	19	0	0	**20**
2023	38	1	1	**40**
2024	63	2	1	**66**
2025	97	2	2	**100**
2026	139	3	3	**145**
2027	190	4	4	**198**
2028	248	5	6	**260**
2029	317	7	8	**332**
2030	400	8	11	**419**
2031	496	10	14	**520**
2036	1208	22	42	**1272**
2041	2499	36	99	**2634**
2046	4625	53	201	**4879**
2051	7697	72	371	**8140**
2056	11 920	88	632	**12 641**
2061	17 241	106	1005	**18 352**
2066	23 278	128	1512	**24 919**
2071	30 134	151	2168	**32 454**

a) Retirement pension amounts paid include amounts paid for the retirement pension supplement.

4.2.3 Additional plan's reserve

The additional plan is funded primarily through its financial assets. In recent decades, the return on financial assets has generally been higher than contributory payroll growth. Funding through financial assets reduces the cost of the plan, compared with a plan that is funded entirely through contributions.

As mentioned in Section 4.1.3, the additional plan and the base plan have separate reserves. The additional plan's reserve consists of the accumulated difference between cash inflows and outflows since the plan's inception on 1 January 2019.

Table 11 shows the projected cash inflows and cash outflows, including administration costs, as well as the additional plan's reserve until 2071, based on the statutory contribution rate. The results show that cash inflows are sufficient to fund cash outflows for each year in the projection period. The results show greater contributions than cash outflows until 2054. Thereafter, a portion of the investment income will be used in conjunction with contributions to cover cash outflows.

Furthermore, investment income is a growing part of the additional plan's funding. In 2071, investment income will account for $54 billion, or more than 70%, of the plan's $73 billion in cash inflows.

In the case of a mature plan such as the base plan, the ratio of the reserve at the end of a given year to the cash outflows for the following year can be used to measure the relative size of the reserve. Given that the additional plan is in its growth phase, the ratio of the reserve to cash outflows increases at the beginning of the projection period, only later stabilizing as the plan matures.

Table 11
Projected reserve based on the statutory contribution rate – Additional plan
(in millions of dollars)

Year	Cash inflows			Cash outflows			Reserve	
	Contributions	Investment income	Total	Benefits	Administration costs	Total	As at 31 December	Ratio to cash outflows for the following year
2022	2461	9	2470	20	50	70	5666	61.2
2023	3367	408	3775	40	53	93	9348	77.6
2024	3894	614	4508	66	55	120	13 736	87.2
2025	4405	876	5281	100	57	158	18 858	92.3
2026	4525	1173	5699	145	59	204	24 353	94.0
2027	4667	1496	6164	198	61	259	30 257	93.7
2028	4817	1848	6664	260	63	323	36 599	92.0
2029	4972	2229	7201	332	65	398	43 402	89.2
2030	5134	2635	7769	419	67	487	50 684	85.9
2031	5304	3061	8365	520	70	590	58 459	82.8
2036	6265	5768	12 032	1272	81	1352	105 977	67.6
2041	7399	9300	16 699	2634	94	2728	169 105	54.5
2046	8695	13 820	22 516	4879	110	4989	249 533	44.9
2051	10 207	19 402	29 609	8140	127	8267	348 537	38.5
2056	11 899	26 096	37 994	12 641	146	12 787	466 866	33.7
2061	13 913	33 922	47 836	18 352	167	18 519	605 007	30.6
2066	16 312	43 037	59 348	24 919	191	25 110	765 942	28.9
2071	19 107	53 709	72 816	32 454	218	32 671	954 469	27.8

4.2.4 Additional plan's reference contribution rate

a) Definition

The additional plan's funding measure is the reference contribution rate. Under section 216 of the Act, the reference contribution rate must be calculated in the actuarial valuation.

> The **reference contribution rate** is the lowest constant contribution rate that, when applied as of the third year of the projection period (2024), makes it possible to attain a reserve at least equal to the **reference value** at the end of the 20th projection year (2041).

The reference contribution rate is applied to earnings under the first component. The calculation takes into account the fact that the rate applicable to earnings under the second component is four times higher.

The **reference value** is the value of expenses following the 20th year of projections (2041), which are related to the contributions paid before the end of that year. As a result, it takes into account contributions until the end of the 20th projection year without considering the effect of new contributions after that year.

In the event of a possible financial imbalance, the 20-year period used in the calculation of the reference contribution rate limits the transfer of costs to future contributors.

b) Results of the projection

- The reference contribution rate is 1.85%.
- The reference contribution rate is lower than the 2.00% statutory contribution rate.
- The reference value is **$156.5 million in 2041.** In Table 11, the projection based on the statutory contribution rate shows a reserve of $169.1 billion in 2041, which is 8% higher than the reference value.

c) Inherent uncertainty of results

The projections are based on the best-estimate scenario used in the actuarial valuation. Appendix VI provides sensitivity and stochastic analyses of the risks related to additional plan funding. The stochastic distributions have been adjusted since the previous actuarial valuation to reflect the higher level of uncertainty. The main observations are the following:

- The reference contribution rate is especially sensitive to the real rate of return on the reserve.
- The following variations over a 50-year period would increase the reference contribution statutory rate to 2.00%:
  - a real rate of return that is 0.24% lower than the actual projection;
  - an increase in average employment earnings that is 0.4% higher than the actual projection.
- The sensitivity of the results to the rate of return increases as the plan matures and the portion of investment income in plan funding increases. A 10% decrease in the reserve is equal to 0.4 years of contributions in 2025, but 5.0 years of contributions in 2071.
- In 67% of the simulations used in the stochastic analysis, the reference contribution rate in 20 years is lower than 2.00%. However, it is greater than or equal to 2.00% in 33% of the simulations.

d) Projection based on the reference contribution rate

Table 12 shows the projected cash inflows and cash outflows, including administration costs, as well as the additional plan's reserve until the 20th projection year (2041), based on the statutory reference contribution rate. This projection shows that the reserve will reach the reference value, that is, $156.5 billion, in 2041.

Table 12
Projection of the reserve based on a reference contribution rate of 1.85% – 2022 to 2041 – Additional plan
(in millions of dollars)

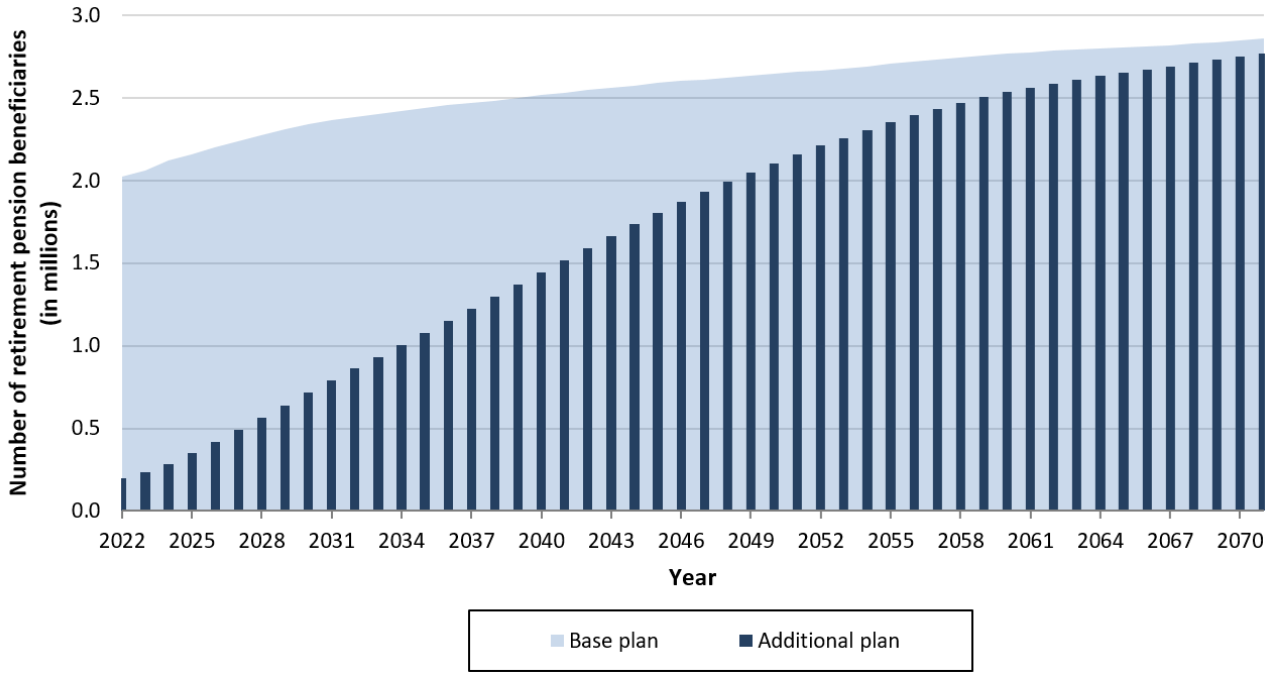
Year	Cash inflows			Cash outflows			Reserve	
	Contributions	Investment income	Total	Benefits	Administration costs	Total	As at 31 December	Ratio to cash outflows for the following year
2022	2461	9	2470	20	50	70	5666	61.2
2023	3367	408	3775	40	53	93	9348	77.6
2024	3602	606	4209	66	55	120	13 436	85.3
2025	4075	851	4925	100	57	158	18 204	89.1
2026	4186	1128	5314	145	59	204	23 314	90.0
2027	4317	1428	5746	198	61	259	28 801	89.2
2028	4456	1755	6211	260	63	323	34 688	87.2
2029	4600	2109	6709	332	65	398	40 999	84.2
2030	4749	2486	7235	419	67	487	47 748	81.0
2031	4906	2880	7786	520	70	590	54 944	77.9
2036	5795	5379	11 174	1272	81	1352	98 760	63.0
2041	6844	8613	15 457	2634	94	2728	**156 497**	50.4

4.3 Comparing the results of each plan

4.3.1 Number of contributors and beneficiaries

Both plans have the same number of contributors, whereas the number of beneficiaries differs. As shown in Chart 3, as the plan matures, the number of beneficiaries in the additional plan increases over the entire projection period to reach approximately the base plan's number of beneficiaries by the end of the projection period.

Chart 2
Projected number of retirement pension beneficiaries at 31 December of a given year – Base plan and additional plan



4.3.2 Cash inflows and outflows

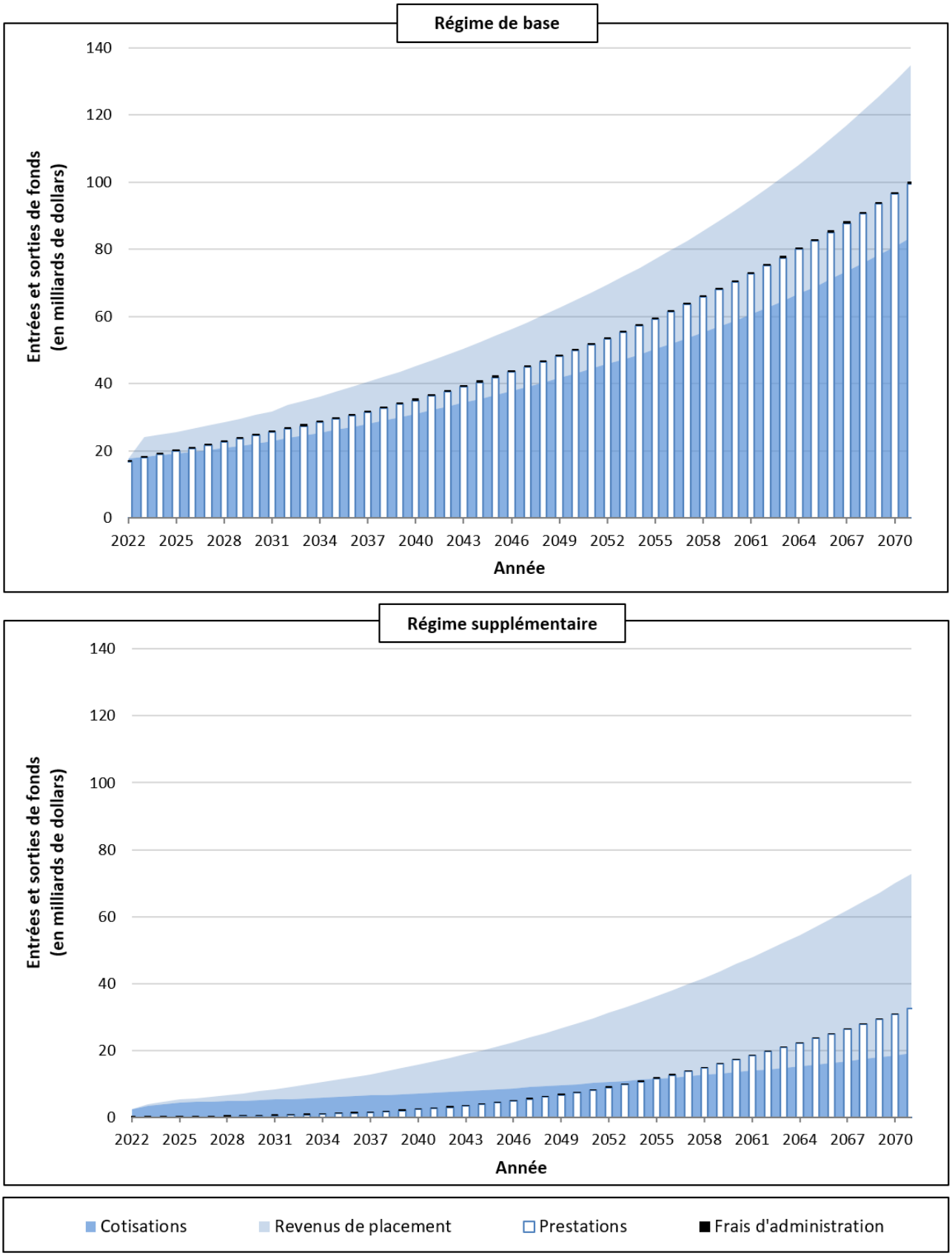
Chart 4 shows the changes in cash inflows and cash outflows for each plan based on the statutory contribution rate.[2] The main observations are the following:

- **Cash outflows** for each plan increase over the entire projection period. For the base plan, this increase results in particular from the aging of the population. For the additional plan, the growing maturity of the plan is the reason for the majority of the increase.
- **Contributions** are greater than cash outflows until 2023 for the base plan and 2054 for the additional plan.
- **Investment income** makes up the main source of cash inflows for the additional plan, with contributions remaining the main source of cash inflows for the base plan. In the long term, around 70% of cash inflows for the additional plan will come from investment income, versus 40% for the base plan.

[2] Tables 6 and 11 of the above sections show the data illustrated in the chart.

Chart 3

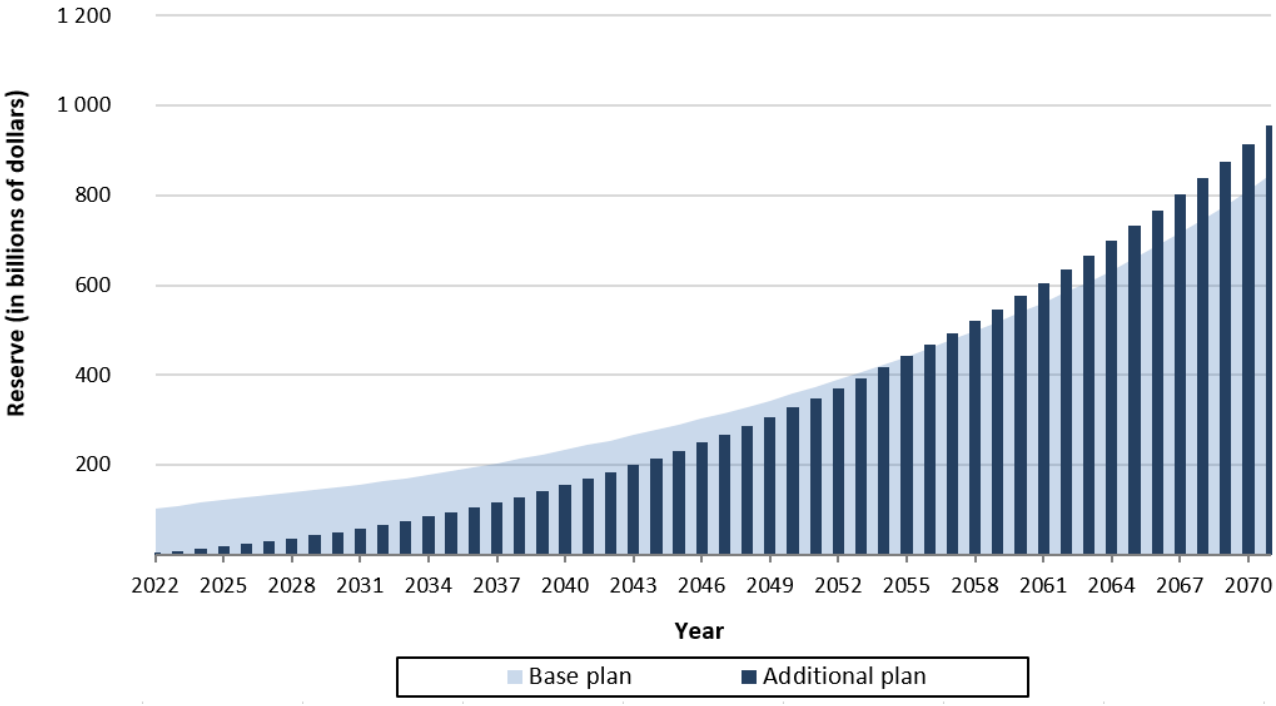
Projected cash inflows and outflows – Base plan and additional plan



4.3.3 Reserves

Chart 5 illustrates the increase in the base plan's and the additional plan's reserves. The chart shows that the additional plan's reserve exceeds that of the base plan in 2055. The base plan's projected reserve is higher than in the previous valuation because of the higher than expected initial level of $17 billion.

Chart 4
Projection of reserves based on the statutory contribution rate – Base plan and additional plan



The results of the base plan are more sensitive to changes in the contributory payroll, whereas the results of the additional plan are mainly sensitive to the rate of return. This allows for the diversification of risks for the Plan as a whole. For example, the same variation in the growth of employment earnings will have opposite effects on each plan.

Furthermore, a same variation in the rate of return affects the additional plan's contribution rate five times more than it affects the base plan's contribution rate. In 2071, a 10% decrease in the additional plan's reserve represents 5.0 years of contributions to that plan, but a 10% decrease in the base plan's reserve represents only 1.0 year of contributions.

5. Conclusion

Base plan

- **The steady-state contribution rate is 10.54%.**
  - The steady-state contribution rate is lower than the 10.80% statutory contribution rate.
  - The steady-state contribution rate takes into account the amendments made to disability benefits in 2022.
- **Cash inflows are sufficient to fund cash outflows for each of the 50 years in the projection period.**
- **The reserve as at 31 December 2021 was $103 billion.**
  - That is more than was expected in the previous actuarial valuation, mainly because returns on investment were $14 billion higher in the past three years.
- **Base plan funding depends mainly on growth in the contributory payroll**.
  - More than 60% of the base plan's cash inflows are generated through contributions.
  - The results of the valuation are particularly sensitive to wage growth.
    - A wage growth assumption 0.3% lower for each year in the projection period brings the steady-state contribution rate to 10.80%.

Additional plan

- **The reference contribution rate is 1.85%.**
  - This rate is less than the 2.00% statutory contribution rate for the first component.
  - The reference contribution rate takes into account the amendments made to disability benefits in 2022.
- **Cash inflows are sufficient to fund cash outflows for each of the 50 years in the projection period.**
- **The sensitivity of the results increases as the plan matures.**
- **Additional plan funding relies mainly on the plan's financial assets.**
  - In the long term, 70% of cash flows are generated by investment income.
  - The results of the valuation are particularly sensitive to the reserve's return.
    - A rate of return assumption 0.24% lower for each year in the projection period brings the reference contribution rate to 2.00%.

Next actuarial valuation

The Plan's actuarial valuations are prepared at least once every three years in order to regularly assess the Plan's financial situation. As a result, the steady-state and reference contribution rates will be recalculated as part of the actuarial valuation as at 31 December 2024, to be prepared in 2025.

In the meantime, we will continue to monitor long-term changes in emerging risks, including economic and geopolitical instability, climate change, the transformation of the labour market, and the evolution of longevity. Furthermore, the Act provides for automatic adjustment mechanisms making it possible to restore each plan's funding if need be.

6. Actuarial opinion

In our opinion, this actuarial valuation:

- is based on data that are sufficient and reliable;
- uses reasonable and appropriate assumptions, both individually and in aggregate;
- uses appropriate methods.

This actuarial valuation was prepared in accordance with section 216 of the *Act respecting the Québec Pension Plan*.

It shows that:

- the base plan's steady-state contribution rate is 10.54%;
- the additional plan's reference contribution rate is 1.85%.

We produced this report and the opinions given in it in accordance with Canadian accepted actuarial practice.

A bill amending the Québec Pension Plan was adopted in February 2022. These amendments are a subsequent event that was taken into account in this actuarial valuation.

Canada is seeing high inflation rates in 2022. The economic scenario developed at the beginning of the year reflects this situation. At the end of the process, we revised the short-term pension indexation upward in order to better take into account the evolution of inflation since the valuation date.

As of the date of signing of the report, we have not learned of any other event that would materially change the Plan's financial situation as at 31 December 2021.

The next actuarial valuation is scheduled as at 31 December 2024 and should be available by late 2025.

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Chief Actuary

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Actuary

October 2022

7. Acknowledgments

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Appendix I

Summary of the main provisions of the Plan

1. Dates of plan's inception

- Base plan: 1 January 1966
- First component of the additional plan: 1 January 2019
- Second component of the additional plan: 1 January 2024

2. Amendments to Plan provisions since the previous actuarial valuation

In November 2021, Bill 17, the *Act respecting the implementation of certain provisions of the Budget Speech of 25 March 2021 and amending other provisions*, was tabled in the Québec National Assembly. In February 2022, the National Assembly adopted the bill, thus formalizing the implementation of the amendments. In accordance with Canadian accepted actuarial practice, the actuarial valuation takes these amendments into account, despite the fact that they were adopted after the valuation date.

These amendments are primarily related to disability benefits:

- **As of age 60, a person can receive both a disability pension and a retirement pension.** The adjustment factor for an early retirement pension is lower for persons who are already receiving a disability pension or who become disabled when they begin receiving their retirement pension.
- **The eligibility criteria are more relaxed and streamlined.** One of the amendments in the above-mentioned bill changes the criterion concerning contributions for persons aged 60 to 64 years from "four of the last six years" to "three of the last six years."
- The calculation of the surviving spouse's pension payable to persons who are receiving a disability pension **will allow these persons to receive both pensions** up to the maximum of the combined pension.

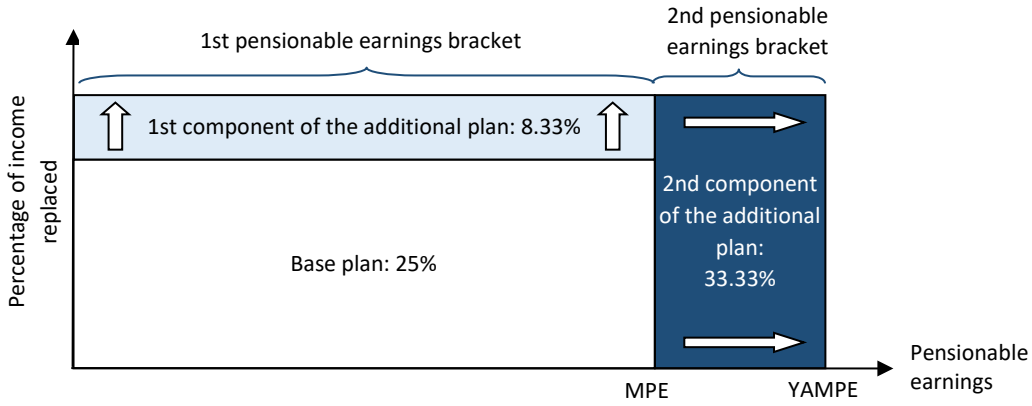
Some amendments took effect on 1 January 2022, and some will take effect on 1 January 2024.

3. Main characteristics of the additional plan

In 2019, the additional plan was added to the base plan, which was implemented in 1966.

The additional plan will gradually accrue benefits over 40 years. During the transition, the income replacement rate will increase from 25% to 33.33%. The Act also provides for a gradual increase in the contribution rate to fund the additional benefits. The base plan and the additional plan have separate accounting for crediting and debiting benefits and contributions.

The additional plan has two components. The first increases the current level of income replacement to the maximum pensionable earnings (MPE); the second raises the pensionable earnings cap, which is called the additional maximum pensionable earnings (YAMPE). The target rate at which income is replaced by a retirement pension once the additional plan has been implemented is illustrated below.



The additional plan entitles contributors to **additional benefits**: retirement pension, retirement pension supplement, disability pension and surviving spouse's pension. These additional benefits have a variable portion only, which is calculated based on additional pensionable earnings. Benefits under the additional plan do not have a fixed portion: fixed-portion benefits are paid under the base plan.

The **eligibility requirements** for various benefits under the additional plan are the same as those for benefits under the base plan. In other words, contributors are deemed eligible for benefits under the additional plan if they are eligible for the corresponding benefits under the base plan. However, under the additional plan, the amount of the benefit is determined in proportion to the number of years during which contributions were made.

Table 13 shows the key characteristics of the Plan.

Table 13
Key characteristics of the Plan

	Base plan	Additional plan	
		1st component	2nd component
Date of inception	1 January 1966	1 January 2019	1 January 2024
Earnings subject to contributions	$3500 up to the maximum pensionable earnings (MPE)	$3500 up to the MPE	From the MPE to the additional maximum pensionable earnings (YAMPE)[a]
Statutory contribution rate	10.80%	2.00% (rate gradually increases from 2019 to 2023)	8.00%
Income replacement rates[b]	25% of average pensionable earnings	8.33% of the average of the contributor's 40 highest annual pensionable earnings	33.33% of the average of the contributor's 40 highest annual pensionable earnings
Variable benefits	Yes	Yes	Yes
Fixed benefits	Yes	No	No
Funding	Base plan's fund	Additional plan's fund	Additional plan's fund

a) The YAMPE is equal to 107% of the MPE in 2024 and 114% of the MPE as of 2025.
b) For the additional plan, these are the income replacement rates at the end of the transition.

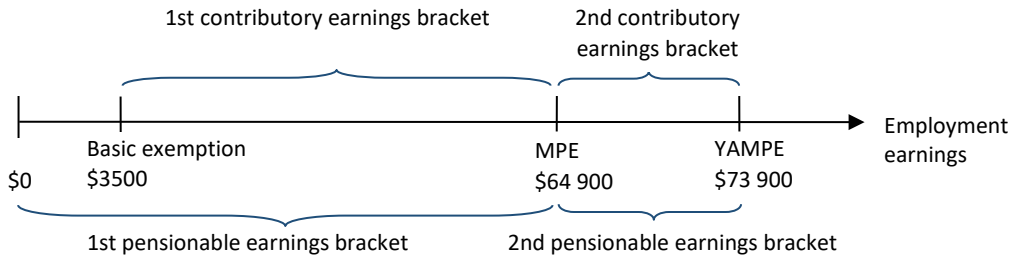
4. Plan contributions

4.1 Clients concerned

With certain exceptions, every person 18 years of age or older who receives employment earnings for work done in Québec must contribute to the Plan if their earnings are greater than the basic exemption, unless they are receiving a disability pension under the Québec Pension Plan or a similar plan. Retirement pension beneficiaries who are still working must also contribute to the Plan.

4.2 Contributory earnings and pensionable earnings

Contributory earnings and pensionable earnings are determined based on an individual's employment earnings and the Plan parameters. The diagram below shows the various types of earnings based on the Plan parameters in 2022. The first earnings' bracket applies to the base plan and the first component of the additional plan, whereas the second applies to the second component of the additional plan.



Pensionable earnings are defined for each part of the Plan and are used to determine the benefits associated with them.

- **B pensionable earnings** apply under the base plan, and are the worker's pensionable earnings up to the amount of the MPE.
- **A1 pensionable earnings** apply under the first component of the additional plan, and are the worker's pensionable earnings up to the amount of the MPE. As of 2019, A1 and B pensionable earnings are identical.
- **A2 pensionable earnings** apply under the second component of the additional plan, and are pensionable earnings between the MPE and the YAMPE.

4.3 Contribution rates

Following the implementation of the additional plan, pensionable earnings under the Plan are gradually subject to three contribution rates:

- **B contribution rate**: This rate applies to earnings from the basic exemption ($3500) to the MPE on which contributions must be made to the base plan. It is 10.8%.
- **A1 contribution rate**: This rate applies to earnings from the basic exemption to the MPE on which contributions must be made to the first component of the additional plan. It is 2.0% as of 1 January 2023.
- **A2 contribution rate**: This rate applies to earnings from the MPE to the YAMPE on which contributions must be made to the second component of the additional plan. It is 8.0% as of 1 January 2024.

Employers and employees pay an equal amount of Plan contributions, whereas self-employed workers must pay both the employer and employee portion. Table 14 shows the gradual increase in contribution rates following the implementation of the additional plan.

Table 14
Statutory contribution rates – Base plan and additional plan

Year	1st contributory earnings bracket		2nd contributory earnings bracket
	B contribution rate	A1 contribution rate	A2 contribution rate
2022	10.8%	1.5%	–
2023	10.8%	2.0%	–
2024	10.8%	2.0%	8.0%[a]
As of 2025	10.8%	2.0%	8.0%[b]

a) In 2024, the YAMPE is 107% of the MPE for that year.

b) As of 2025, the YAMPE is 114% of the MPE for that year.

4.4 Contributory periods

A contributory period is defined for each component of the Plan, and is used to determine the benefits payable under the component with which it is associated.

- **B contributory period**: Period beginning on the first day of the month following a person's 18th birthday or on 1 January 1966 if the person turned 18 before that date. The B contributory period applies under the base plan and for eligibility for benefits.
- **A1 contributory period**: Period beginning on the first day of the month following a person's 18th birthday or on 1 January 2019 if the person turned 18 before that date. The A1 contributory period applies under the first component of the additional plan.
- **A2 contributory period**: Period beginning on the first day of the month following a person's 18th birthday or on 1 January 2024 if the person turned 18 before that date. The A2 contributory period applies under the second component of the additional plan.

The three contributory periods end at the end of the first of the following months:

- the month preceding the one in which payment of a retirement pension under the Plan begins;
- the month of the person's 70th birthday;
- the month of the person's death.

For the base plan only, the following periods are excluded from the B contributory period:

- the three months preceding the start date of a disability pension (if the date of disability is after 30 June 1993) and all the months in which a person received a disability pension under the Plan;
- all the months for which family benefits were paid for a child under the age of seven, provided those months fall within a year in which the person's employment earnings were less than the basic exemption;
- certain months for which an unreduced income replacement indemnity was paid pursuant to the *Act respecting industrial accidents and occupational diseases.*

5. Retirement pension

5.1 Eligibility requirements

The retirement pension is paid to a person age 60 or over who contributed to the Plan and who files an application. A person can receive their retirement pension while continuing to work.

A person who applies for a retirement pension after age 65 is entitled to a retroactive retirement pension that can cover a maximum of 12 months but cannot include any months prior to their 65th birthday.

5.2 Calculation of the retirement pension

Accrued retirement pension

An accrued retirement pension is the pension amount established based on the pensionable earnings made within the contributor's contributory period for the base plan and both components of the additional plan.

The accrued retirement pension corresponds to the sum of the following three elements:

Base plan	Additional plan	
	Component 1	**Component 2**
25% of average B pensionable earnings in the B contributory period	**8.33%** of the average of the contributor's 40 highest A1 annual pensionable earnings in the A1 contributory period	**33.33%** of the average of the contributor's 40 highest A2 annual pensionable earnings in the A2 contributory period

Initial amount of the retirement pension

The initial amount is adjusted to take into account:

- the date on which payment of the retirement pension begins, using the adjustment factor described in Section 5.3;
- monthly payments, by multiplying the amount by a factor of 1/12;
- **for the base plan only**, the period of participation in the Plan in relation to the contributory period:
  - up to 15% of the months in which earnings were low or nil can be excluded from the contributory period;
  - months for which a person was eligible to receive federal or provincial family benefits for a child under the age of seven and those during which they received an unreduced income replacement indemnity in accordance with the *Act respecting industrial accidents and occupational diseases* can be excluded for the contributory period.

Adjusted earnings

a) MPE for the year in question
For the calculation of the averages shown in the diagram above, the pensionable earnings are adjusted based on the ratio between the average MPE for the last five years and the MPE for the year in question.

b) Gradual implementation of the additional plan
A1 pensionable earnings are also adjusted, since the A1 contribution rate for 2019 to 2022 is less than the target rate of 2%. Table 15 shows the adjustments.

Table 15
Adjustment applied to pensionable earnings during the gradual implementation of the additional plan

	2019	2020	2021	2022	2023 and after
Adjustment applied	15%	30%	50%	75%	100%

Additional information on the calculation of pensions

Although pension amounts under the base plan are calculated based on average earnings and the exclusion of months in which a contributor's earnings were lowest, benefits under the additional plan are calculated more directly based on participation in the additional plan. As such, each year of contributions to the additional plan makes it possible to accrue 1/40 of the income replacement rate expected for the pensionable earnings bracket for the retirement pension. Years in which earnings were low can be excluded in cases where the person has contributed to the additional plan for more than 40 years. Consequently, after the first 40 years of contributions, additional contributions can increase the average pensionable earnings.

5.3 Adjustment factor – Age at which retirement pension payments begin

The amount of a retirement pension (Section 5.2) is adjusted to take into account the age at which pension payments begin. The adjustment factor applicable to retirement pensions is the same for both plans.

Early retirement (before age 65)

If payment begins before age 65, the amount of the pension is reduced using an adjustment factor that varies according to the amount of the pension under the base plan and the number of months before the person's 65th birthday. The adjustment factor is 0.5% per month for a person receiving a very small pension and 0.6% for a person receiving the maximum amount.

Delayed retirement (after age 65)

If pension payments begin after age 65, the pension is increased using an adjustment factor that varies according to the number of months the pension was delayed after the person's 65th birthday. The adjustment factor is 0.7% per month delayed, up to a maximum of 60 months (142%).

Adjustment factor for the retirement pension of beneficiaries receiving the disability pension

The adjustment factor for early retirement is lower for beneficiaries receiving a disability pension where the legal start date of their disability falls before or during the month in which they begin receiving their retirement pension. This factor varies between 0.3% and 0.4% per month of early retirement, according to the amount of the pension .

5.4 Retirement pension supplement for beneficiaries who continue to work

A person who is receiving a retirement pension while continuing to work must also contribute to the Plan if his or her earnings are greater than the basic exemption. However, he or she will receive a yearly supplement equal to:

- 0.50% of the earnings on which he or she contributed at the B contribution rate, plus
- 0.16% of the earnings on which he or she contributed at the A1 contribution rate, plus
- 0.66% of the earnings on which he or she contributed at the A2 contribution rate.

The supplement for a given year is calculated based on pensionable earnings for the previous year. The adjustment shown in Table 15 also applies to A1 pensionable earnings giving entitlement to a retirement pension supplement.

6. Disability benefits

6.1 Eligibility requirements

Under the *Act respecting the Québec Pension Plan*, a person is disabled if he or she has a severe and prolonged physical or mental disability. A disability is severe if it makes the person unable to regularly do any type of substantially gainful work. In such a case, the disability is considered to be total. In addition, for a person aged 60 to 65, the disability is severe if the impairment renders him or her unable to do his or her usual gainful work. In such a case, the disability is considered to be flexible.

The disability is prolonged if it will result in death or is likely to be permanent.

A person age 60 years or under[3] may be entitled to a disability pension if he or she contributed to the Plan for one of the following periods:

- two of the last three years in his or her B contributory period;
- five of the last ten years in his or her B contributory period; or
- at least half of the years in his or her B contributory period, but not less than two years.

A person between the ages of 60 and 65 may be entitled to a disability pension if he or she contributed to the Plan for at least three of the last six years in his or her B contributory period.

A retirement pension beneficiary between the ages of 60 and 65 with a total disability after the first six months of his or her retirement pension payments can receive the additional amount for disability under the base plan, provided he or she contributed to the Plan for at least three of the last six years. Starting on 1 January 2024, a person may receive the fixed portion of the disability pension and the retirement pension at the same time. As of that date, there will be no new additional amounts for disability granted.

A disability pension is not paid to anyone receiving an unreduced income replacement indemnity paid pursuant to the *Act respecting industrial accidents and occupational diseases*.

6.2 Calculation of disability benefits

The initial monthly disability pension comprises the following elements:

Base plan		**Additional plan**	
Fixed portion	Variable portion: 75% of the accrued retirement pension	**Component 1** 75% of the accrued retirement pension	**Component 2** 75% of the accrued retirement pension

As of 1 January 2024, the retirement pension will replace the variable portion for beneficiaries age 60 years and over. In 2022, the fixed portion of the disability pension is $524.61 a month, with the additional amount for disability, applicable under the base plan only, set at $524.61 a month.

[3] This criterion also applies before 1 January 2024 to persons between the ages of 60 and 65 who have a total disability.

6.3 Cessation of payment

Payment of the fixed portion of the disability pension stops on the date on which a person ceases to be disabled or on his or her 65th birthday. If a variable portion is payable, payment of the variable portion of the disability pension stops on the date on which a person ceases to be disabled or on his or her 60th birthday.[4] In this situation, the variable portion of the disability pension is replaced by a retirement pension.

6.4 Pension for a disabled contributor's child

A fixed monthly benefit is paid for each child of a disabled contributor, provided the latter is receiving a disability pension under the Plan and the child is under 18. The benefit is $83.99 a month in 2022.

7. Survivors' benefits

7.1 Eligibility requirements

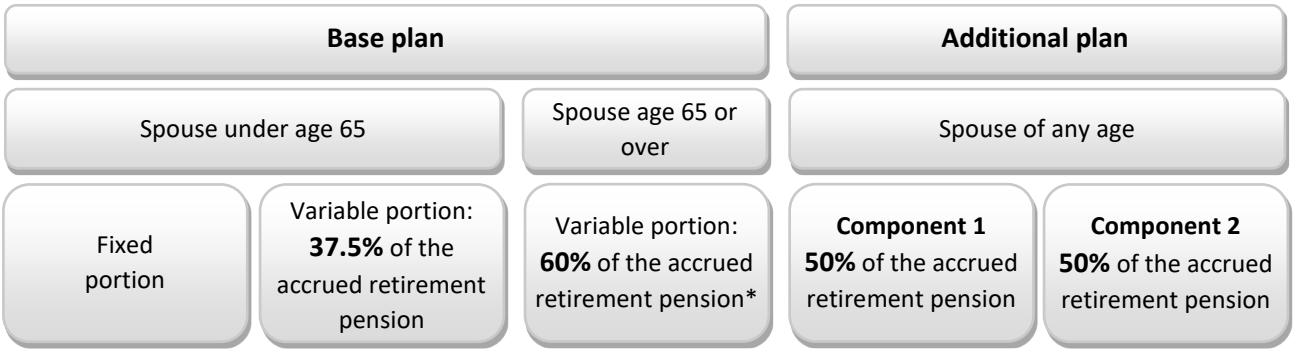
A deceased contributor must have paid contributions during one third of his or her B contributory period, and for at least three years. The number of years of contribution required is never more than 10, regardless of the number of years in his or her B contributory period.

Contributions the deceased made after payment of his or her retirement pension began are also taken into account when determining eligibility for those benefits.

A surviving spouse's pension is paid to a person recognized as the spouse of the deceased contributor. To be deemed spouses, the two persons must have been married or in a de facto relationship at the time of death, regardless of their sex.

7.2 Calculation of the surviving spouse's pension

The following diagram shows the components of the calculation of the surviving spouse's pension. The accrued retirement pension shown in the diagram is that of the deceased. The amount of the surviving spouse's pension is recalculated when the beneficiary turns 45 or 65, or when they become entitled to a retirement or disability pension.



* If a surviving spouse's pension is paid at the same time as a retirement or disability pension, the surviving spouse's pension may be reduced.

[4] Before 1 January 2024, the variable portion ceases on the person's 65th birthday. On 1 January 2024, the variable portion of the disability pension of beneficiaries between the ages of 60 and 64 will be replaced by a retirement pension.

The fixed portion of a monthly pension (base plan) varies based on age:

- For a surviving spouse under age 45, the amount is $134.37 in 2022; if they care for a child of the deceased, it is $487.12 a month.
- For a surviving spouse between the ages of 45 and 64, the amount is $524.61 a month in 2022.

7.3 Death benefit

The death benefit is payable under the base plan to the family of the deceased, provided the deceased contributed sufficiently to the Plan. It is $2500.

Where the deceased does not meet the eligibility requirements mentioned above, the deceased could give entitlement to a death benefit, provided he or she made at least $500 in contributions to the base plan of the Québec Pension Plan or the Canada Pension Plan (CPP). In addition, he or she must not have received a disability pension or retirement pension under either plan. The amount of the death benefit is limited to the amount of the contributions made to the base plan of the QPP or the CPP, up to a maximum of $2500.

7.4 Orphan's pension

The orphan's pension is a fixed monthly benefit under the base plan. It is $264.53 a month in 2022, and can be paid for each child of the deceased contributor until the child reaches age 18, provided the contributor made sufficient contributions to the Plan.

8. Details on Plan benefits

8.1 Pension indexation

All pensions in payment are increased on 1 January of each year according to the increase in the Consumer Price Index for Canada.

8.2 Partition of benefits

The pensionable earnings of two former spouses are divided equally for each of the months in which they lived together during their marriage or civil union. Partition is generally automatic. Partition can also be carried out for de facto spouses, but they must file a joint application. In such a case, partition concerns the period of cohabitation..

8.3 Retirement pension sharing

It is possible for spouses who have reached 60 years of age to transfer a portion of their retirement pensions between themselves, based on the number of years of conjugal relationship. This can be done, for example, to reduce the income tax payable. Sharing is possible even if only one of the spouses has contributed to the Plan.

Pension sharing ends with the death of either of the spouses or the breakdown of their conjugal relationship.

9. Automatic adjustment mechanism

9.1 Base plan

The steady-state contribution rate allows for the application of the automatic adjustment mechanism required under section 44.1 of the Act. This mechanism restabilizes Plan funding if required. Where the steady-state contribution rate exceeds the statutory contribution rate by at least 0.1%, the latter rate is increased by 0.1% annually until the gap between the rates is less than 0.1%. The government can decide to stay the automatic adjustment mechanism by making an order.

9.2 Additional plan

The Act provides for an automatic adjustment mechanism that would make it possible to restabilize the funding of the additional plan if need be. The terms of the mechanism will be defined at a later date.

Appendix II

Methodology used for the actuarial valuation

1. Introduction

The purpose of this actuarial valuation is above all to project cash inflows and outflows for each plan. Once the projections have been carried out, it is then possible to estimate the future reserves for both plans and evaluate the steady-state and reference contribution rates. This appendix provides clarification on the methodology used for the actuarial valuation.

2. Separate accounts

The projections were carried out separately for each plan. The Act provides that contributions and benefits for each plan are subject to separate accounting and that they are credited or debited respectively from the account from which they are allotted.

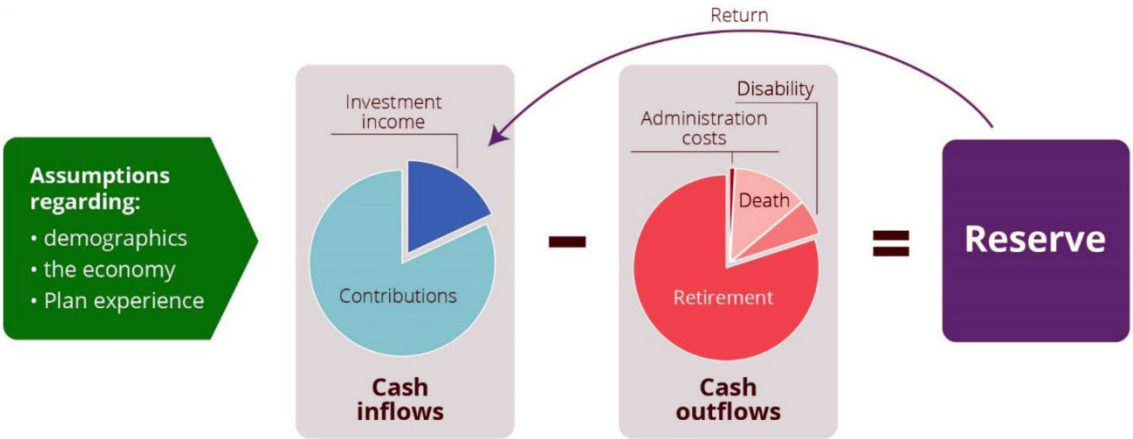
The base plan and the additional plan each have a separate reserve. The base plan's reserve is the accumulated difference between cash inflows and outflows since the plan's inception in 1966. The additional plan's reserve was implemented in 2019.

3. Projecting cash inflows and outflows

For the purposes of the valuation, a demographic and economic projection model is used to estimate cash inflows and outflows under the base plan and the additional plan. The model requires a range of data—particularly data on the Plan's contributors and beneficiaries—and that numerous assumptions be set, some of which apply to both plans, others to one or the other plan separately. The actuarial valuation was carried out in accordance with the provisions of the Plan described in Appendix I.

The method used projects the **population of Québec** based on assumptions for fertility, migration and mortality. The projected population (broken down by age and sex) serves to determine both the population that contributes to the Plan and the population that receives benefits. The projection is the same for both the base plan and the additional plan. The projected number of contributors is identical for both plans, since it is not possible to contribute to one plan and not the other.

The following illustration shows the projection methodology and interaction between the components.



3.1 Cash inflows

Contributions and investment income make up the cash inflows for both plans.

For each year in the projection period and for each plan, **total contributions** are determined from the total contributory payroll and the contribution rate prescribed in the Act. The total payroll is estimated on the basis of the projected number of contributors and the increase in earnings assumption.

Investment income is the return obtained on the invested reserve, taking into account cash inflows and outflows during the year. The rates of return used for calculation purposes are net of management fees.[5] They are calculated separately for the base plan and the additional plan. Investment income includes:

- the current income that the Caisse de dépôt et placement du Québec (CDPQ) pays to Retraite Québec;
- the variation in the fair value of the reserve's investments.

3.2 Cash outflows

Cash outflows are made up of the benefits paid out and administration costs.

Benefits are projected using assumptions based largely on the experience of the base plan. The calculations are carried out by sex and by age and are divided into three steps:

1. Determine the number of beneficiaries receiving a pension at the date of the valuation and their average pension amount.
2. Determine the number of new pensions, i.e. the number of pensions the payment of which will begin after the valuation date, as well as the average amount of those pensions.
3. Project the number of beneficiaries and the average amount of the pensions calculated in the two previous steps for each year of payment.

Administration costs are projected on the basis of Retraite Québec's budgets and the agreement with Revenu Québec on the collection of contributions.

[5] The rate of return assumption is described in Section 3.4.4 of Appendix III.

4. Projection period

The projection period used for this actuarial valuation covers 50 years, ending in 2071. This is the minimum projection period prescribed in the Act. To properly evaluate the Plan's future financial situation, the projection period must be long enough to fully understand the extent of the demographic transition that will occur in Québec in the future.

Although the projection period covers 50 years, certain results related to the size of the additional plan's reserve is analyzed at the end of the 20th year of the projection.

5. Development of assumptions

The assumptions **do not include any margins for adverse deviation**. As a result, they provide a best estimate of Plan risks. This minimizes the risk of funding the Plan based on contribution rates that are either too high or too low, thus favoring intergenerational fairness. Because the various Plan risks are often interdependent, the assumptions are determined so as to be reasonable on an individual basis and coherent on an overall basis.

The assumptions take a **long-term view**. Cash inflows and outflows under the Plan are projected until 2071. It is therefore important to consider any structural changes within Québec society and its economy. Recent events resulting from a specific or temporary set of circumstances must be taken into consideration, without assigning them undue importance.

6. Accounting basis

As is the case for financial statements, the actuarial valuation uses the **accrual basis of accounting**, where benefits are disbursed when they are encumbered, and contributions and investment income are entered in the year in which they become due, regardless of whether the amounts are actually paid during that year.

Therefore, in addition to the data obtained from Plan statistics, the estimated number of benefits payable at 31 December 2021 but whose payment had not yet begun (mainly as a result of application processing times or late applications) must also be added. Financial statements were reconciled to ensure that the contributions for fiscal year 2021 used in this actuarial valuation are consistent with those in the financial statements.

7. Participation in the Québec Pension Plan and the Canada Pension Plan

The benefit amounts shown in the report take into account the administrative agreement between the Québec Pension Plan and the Canada Pension Plan (CPP) for beneficiaries who contributed to both plans. The two plans compensate each other based on a beneficiary's participation in each plan, given that only one plan will pay a benefit. The plan that pays is determined on the basis of the beneficiary's place of residence when an application for benefits is filed.

8. Method of stochastic analysis

The stochastic analysis takes into account, in an integrated manner, returns, the growth in employment earnings, inflation and unemployment. Interest rates and rates of return were used to determine investment income. Unemployment rates, inflation rates and the increase in average employment earnings rates mainly affect contributions and benefits.

An economic scenario generator was used to simulate multiple scenarios at the same time for several variables. The economic scenario generator is based on stochastic processes to model the evolution of variables, and replicates economic cycles and economic upheavals. It helps enhance understanding of the interdependency of components, as well as their role in the various phases of the economic cycles. The starting conditions take into account the initial economic conditions.

The components are modelled according to the following categories:

- the interest rates and rates of return for bonds and other fixed-income financial products;
- the equity returns for various asset subcategories[6];
- the returns for infrastructure investments, private equities and real estate investments.

Specific information about the methodology

- **The inflation rate and the risk-free interest rate curves** were modelled using a multifactorial process based on the work of Vasicek (1977). The goal was to reproduce realistic behaviours and curves using historical data, the projections of experts, and the term structure of interest rates theory. The generator replicated cyclical behaviours, as well as more temporary variations in the inflation rate.
- **Equity returns and the return of the infrastructures portfolio** were modelled using a multidimensional (asset subcategories) regime-switching model drawing on the work of Hamilton (1989) and Hardy (2001). The model recreates a multivariate distribution of rates of return.
- **The unemployment rate and the rate of increase in average employment earnings** are also linked to this regime-switching model. The simulation for the two rates included no form of seasonality and simulated economic cycles of varying degrees, as well as the various interdependencies with some asset classes such as shares.
- **The returns of the private equities portfolio, the bonds and other fixed-income securities portfolio and the real estate portfolio** were simulated using interrelated econometric models linked to other variables of the model, such as interest rates and equity returns. The modelling of the variables also takes into account credit and liquidity risks.

[6] There are four asset subcategories: Canada, United States, emerging countries and other industrialized countries.

9. Data sources

The actuarial valuation used the data sources below. The dates on which the data were consulted are also shown.

Plan administration data (December 2021) – Benefits paid – Contributions collected – Total earnings and contributory earnings of contributors – Mortality of beneficiaries – Eligibility and Plan participation rates	**Statistics Canada** (December 2021) – Labour force (active population, employed population and unemployment rate)[7] – Interprovincial and international migration – Average weekly earnings – Consumer Price Index (May 2022)
Institut de la statistique du Québec (November 2021) – Population of Québec – Interprovincial and international migration – Mortality – Fertility	**Ministère de l'Immigration, de la Francisation et de l'Intégration** (October 2021) – Québec Immigration Plan 2022
Thomson Reuters Datastream (March 2022) – Historical returns on financial assets	**Bank of Canada** (February 2022) – Monetary policy
Caisse de dépôt et placement du Québec (March 2022) – Historical returns on financial assets – Management fees	**Plan's financial statements** (March 2022) – Initial fund – Adjustments to contributions and benefits
Plan investment policy (March 2022) – Asset distribution	

Other sources factored into the development of assumptions, such as:

Comparative analysis on an international scale

The *Comparative Analysis of the Data and Demographic, Economic and Financial Projections in the Actuarial Valuations of 17 Social Security Plans,* prepared by Plan actuaries in collaboration with the Canadian Pension Plan's Office of the Chief Actuary, shows the results of a survey on social security plans of member organizations of the International Social Security Association (ISSA) and compares the main assumptions used by various countries.

Seminars

Plan actuaries also organized the "Perspectives économiques et démographiques relatives à la retraite-volet destiné aux experts" seminar, at which eight specialists shared their expertise and points of view. Participants included representatives from the private sector and from various provincial and federal departments and agencies. The results of a survey conducted as part of the seminar also fuelled discussion. Plan actuaries took part in a similar seminar on the Canada Pension Plan (CPP) organized by the Office of the Chief Actuary.

[7] The historical data were taken from the Labour Force Survey. The population in this survey corresponds to the civilian population and excludes certain categories of persons (institutionalized persons in particular). The demographic projections have been readjusted to account for these exclusions.

Appendix III

Demographic and economic assumptions

1. Introduction

To project cash inflows and outflows under the Plan, demographic and economic assumptions must be determined and Plan data must be analyzed in detail. The assumptions **do not include any margins for adverse deviation** and take a **long-term view**.

This appendix describes the demographic and economic assumptions used for the actuarial valuation. Section 2 shows the demographic assumptions, and Section 3, the economic assumptions. Appendix IV addresses plan-specific assumptions, that is, contributions, benefits and administration costs.

2. Demographic assumptions and population projection

The projection of Québec's population serves as the basis for determining the number of Plan contributors and beneficiaries. The projection is made using the initial population and assumptions for fertility, migration and mortality.

The **initial population** is based on the population as at 1 July 2021, i.e. 8 604 500. This number is 68 000 more than the number projected in the last actuarial valuation, mainly because of the higher number of non-permanent residents.

The number of persons of a given age in a given year depends on the number of persons in the preceding year adjusted to take into account population movements during the year. A projection was made for each year of age from 0 to 119. The number of persons age 0 represents the number of births in the year.

Table 16 summarizes the main demographic assumptions in this valuation.

Table 16
Summary of the main demographic assumptions

Assumption	Actuarial valuation as at 31 December 2021	Section of the appendix
Total fertility rate	1.57 children/woman in 2022, decreasing to 1.55 in 2051	2.1 *page 67*
Net migration (as a percentage of the population)	0.61% in 2022, 0.45% in 2023, increasing to 0.48% in 2071	2.2.1 *page 70*
Non-permanent residents (as a percentage of the population)	2.99% as of 2022	2.2.4 *page 72*
Life expectancy at birth[a]	*2022 to 2071:* Men: 81.1 to 85.7 years Women: 84.6 to 88.5 years	2.3.1 *page 73*
Life expectancy at age 65[a]	*2022 to 2071:* Men: 19.8 to 23.4 years Women: 22.2 to 25.5 years	0 *page 73*

a) The life expectancies shown in this table do not take into account any reductions in mortality after the year shown.

2.1 Fertility

The **total fertility rate** is used to estimate the number of children that will be born to each woman in a generation during her child-bearing years in accordance with the fertility rates observed in a given year. It is calculated by totalling the age-specific fertility rates in a given year.

The total fertility rate in Québec has been decreasing for several years, accompanied by an increase in the proportion of women who are childless at age 35.

Certain situations may temporarily affect the total fertility rate without influencing the number of children women will bear in their lives. For example, the uncertainty caused by the COVID-19 pandemic could have a greater impact on the timing of births than on overall numbers. Several socioeconomic and cultural factors impact fertility rates, including education, urbanization, the participation of women in the labour market and access to contraception. The anticipated evolution of these determining factors is not conducive to a higher fertility rate.

In recent decades, the **average maternal age** increased from 27.7 years in 1990 to 30.9 years in 2020. Although women born in the 1980s had their children at a later age on average, their fertility rates were similar to those of preceding generations at the age of 35, which is not the case for the latest generations to reach this age. A growing proportion of persons are choosing not to have children for a variety of reasons, while others who want children are unable to conceive.

The total fertility rate projected in the valuation decreases from 1.57 in 2022 to 1.55 in 2051. It then remains constant until the end of the projection period. Chart 6 shows the fertility rate in the past as well as the projected rate used in the actuarial valuation. The assumption used is lower than the one in the previous actuarial valuation, where the total fertility rate increased to 1.65 in 2048.

Chart 5
Total fertility rate – 1966 to 2071

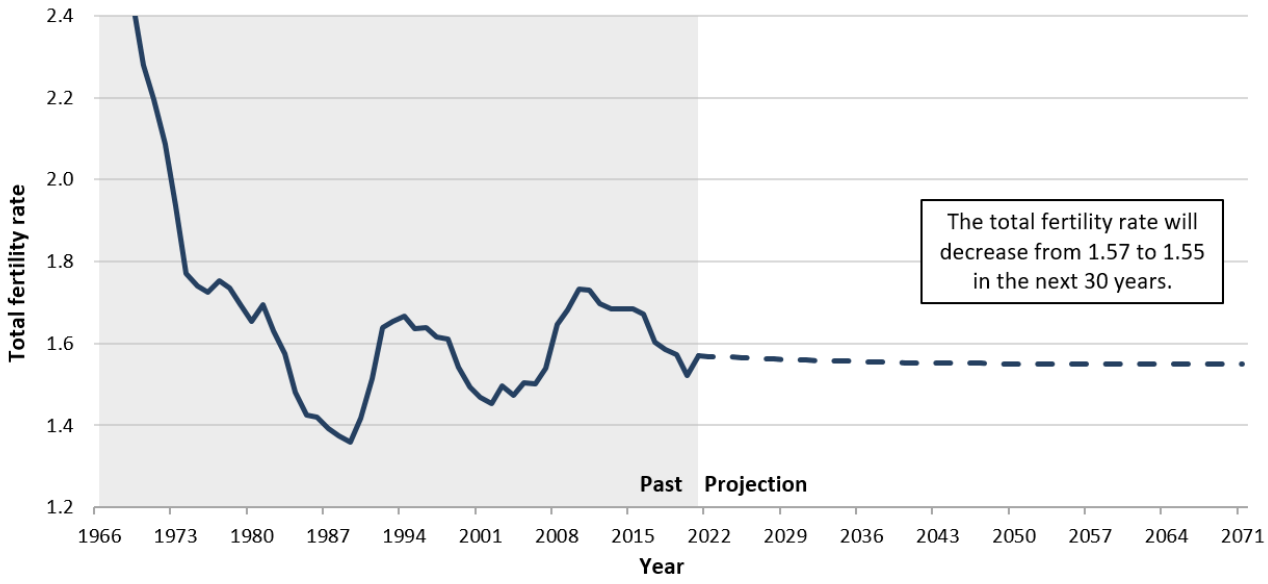
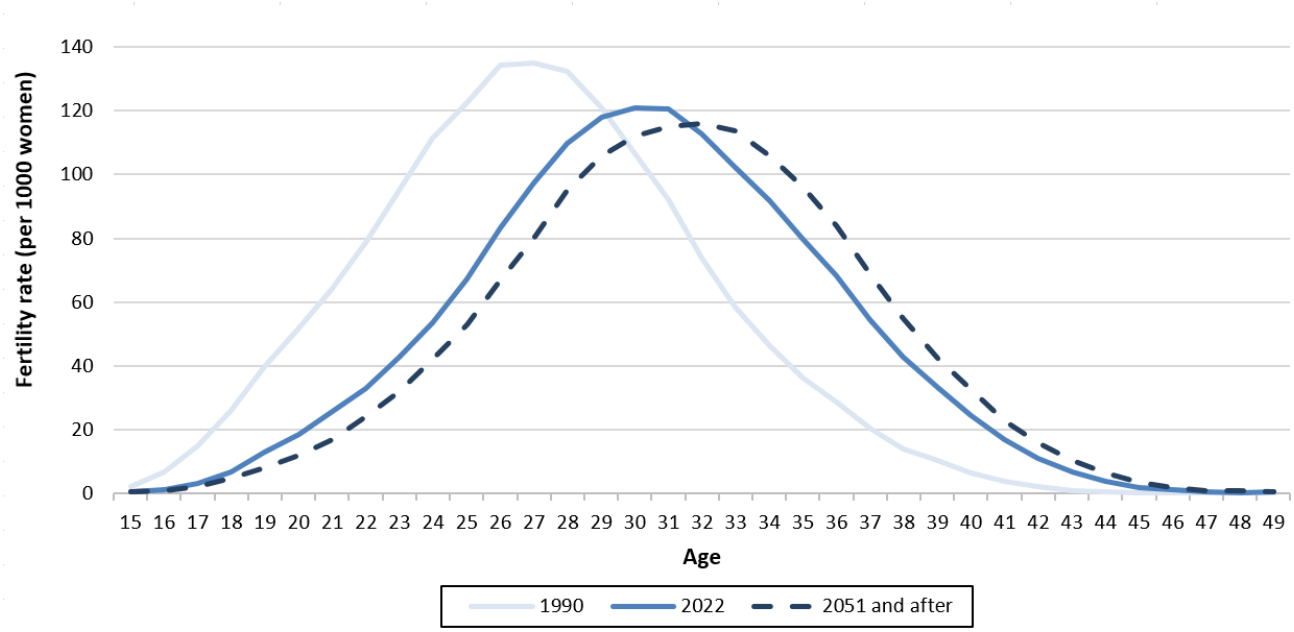


Chart 7 shows that women will continue to bear children at a later age, but at a slower rate than that observed since 1990. The projected average maternal age reaches 32.0 years in 2051 and remains constant thereafter. The same average age was used in the previous actuarial valuation.

Chart 6
Fertility rates by age – 1990, 2022 and 2051 and after



For the purposes of this valuation, the **sex ratio at birth** corresponds to the average ratio observed between 2011 and 2020 (51.3%). This means that 513 boys and 487 girls are born for each 1000 births.

2.2 Migration

Net migration is the difference between immigration and emigration over the course of a year. Separate assumptions are made for **immigration** (Section 2.2.2) and **emigration** (Section 2.2.3) and are determined for both the international and interprovincial levels. **Total net migration** is the result of all those factors. Although the **variation in non-permanent residents** (Section 2.2.4) is not a factor in net migration, it is necessary to establish an assumption for it in order to project Québec's total population.

The diagram below summarizes the migration assumptions for 2022 to 2071. They are in proportion to the population.

Total net migration
2022: 0.61%
2023 and after: 0.45% to 0.48%

Variation in the number of non-permanent residents
0.02%
to 0.01%

Net international migration
2022: 0.71%
2023 and after: 0.55%

Net interprovincial migration
-0.10% to -0.08%

Immigration rate
2022: 0.80%
2023 and after: 0.64%

Emigration rate
0.09%

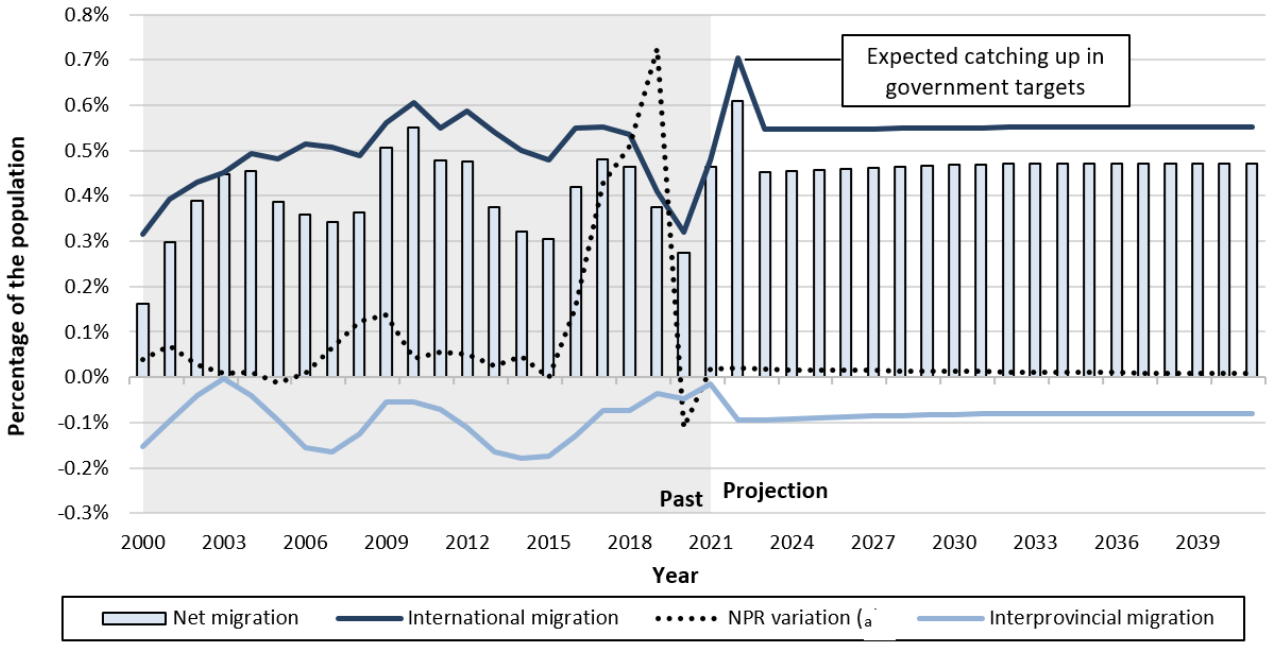
Immigration rate
0.24%

Emigration rate
0.34% to 0.32%

2.2.1 Net migration

The net migration rate projected as of 2023 is the same as the average for the past 10 years. The projected rates (0.45% to 0.48% of the population) correspond to approximately 40 000 persons in the short term, increasing to 48 000 persons in the next 50 years. The variations in total net migration during the first years of the projection are the result of international immigration, which is higher in 2022, but will return to a level similar to that seen in previous years as of 2023. The increase in total net migration between 2024 and 2071 is mainly the result of a decline in emigration stemming from the aging of the population. The net migration rates, as well as the variation in the number of non-permanent residents, are shown below.

Chart 7
Net migration in Québec – 2000 to 2041
(as a percentage of the population)



a) *NPR variation means the annual variation in the number of non-permanent residents.*

Table 17
Net migration in Québec
(in number of persons)

Year	International			Interprovincial			Total	NPR variation[a]
	Immigrants	Emigrants	Net migration	Immigrants	Emigrants	Net migration	Net migration	
2022	69 000	8000	61 000	21 100	29 400	-8300	52 800	1700
2023	55 600	8000	47 600	21 200	29 400	-8200	39 400	1500
2024	55 900	8000	47 900	21 400	29 400	-8000	39 900	1400
2025	56 200	8000	48 200	21 500	29 400	-7900	40 300	1400
2026	56 500	8000	48 500	21 600	29 400	-7800	40 700	1400
2031	57 900	7900	50 000	22 100	29 500	-7400	42 600	1100
2036	59 000	7900	51 100	22 500	30 000	-7400	43 600	900
2041	59 900	8100	51 800	22 900	30 400	-7500	44 300	800
2051	61 500	8400	53 100	23 500	31 100	-7600	45 500	600
2061	62 800	8500	54 300	24 000	31 500	-7500	46 800	700
2071	64 300	8600	55 700	24 600	32 200	-7600	48 000	700

a) *NPR variation means the annual variation in the number of non-permanent residents.*

2.2.2 Immigration

International immigration was lower in the past three years than it has been in the past. The Ministère de l'Immigration, de la Francisation et de l'Intégration (MIFI)'s international immigration target for 2019 represents a sharp decline compared with the number of international immigrants in previous years. Furthermore, the border closures in 2020 and 2021 made it impossible to achieve this target. The assumption used for international immigration as of 2023 is the average rate over the past 10 years, excluding the years 2019 to 2021. In 2022, the assumption corresponds to MIFI's immigration target, which includes a catch-up and the welcoming of 69 000 international immigrants.

Interprovincial immigration will remain at its average over the past 10 years for the entire projection period.

The average age of arriving immigrants has been increasing for several years. A slower increase in the average age is projected for the first 10 years of the projection period. Therefore, the average age of arriving immigrants will reach 31.1 in 2031 and remain at that level thereafter.

Immigration assumptions are made as a percentage of the population of Québec for the entire projection period. This assumes that Québec's absorptive capacity remains proportional to the size of its population.

2.2.3 Emigration

Both international and interprovincial emigration rates for a given age and sex remain constant throughout the entire projection period. Using rates by age makes it possible to take into account the differences observed in emigration among various age groups as well as the aging population. Since the majority of emigration occurs among young adults, as the population ages, global emigration as a percentage of the population decreases over the entire projection period. However, the number of emigrants increases as the population continues to grow over the projection period.

Furthermore, as observed in the past, the average age of persons leaving Québec will keep pace with the rest of the population. It increases from 33.3 in 2022 to 34.7 in 2071. The emigration assumptions were based on data from the past 10 years.

2.2.4 Variation in the number of non-permanent residents

Non-permanent residents are a separate segment of the population. The increase in their number has been particularly significant since 2016.

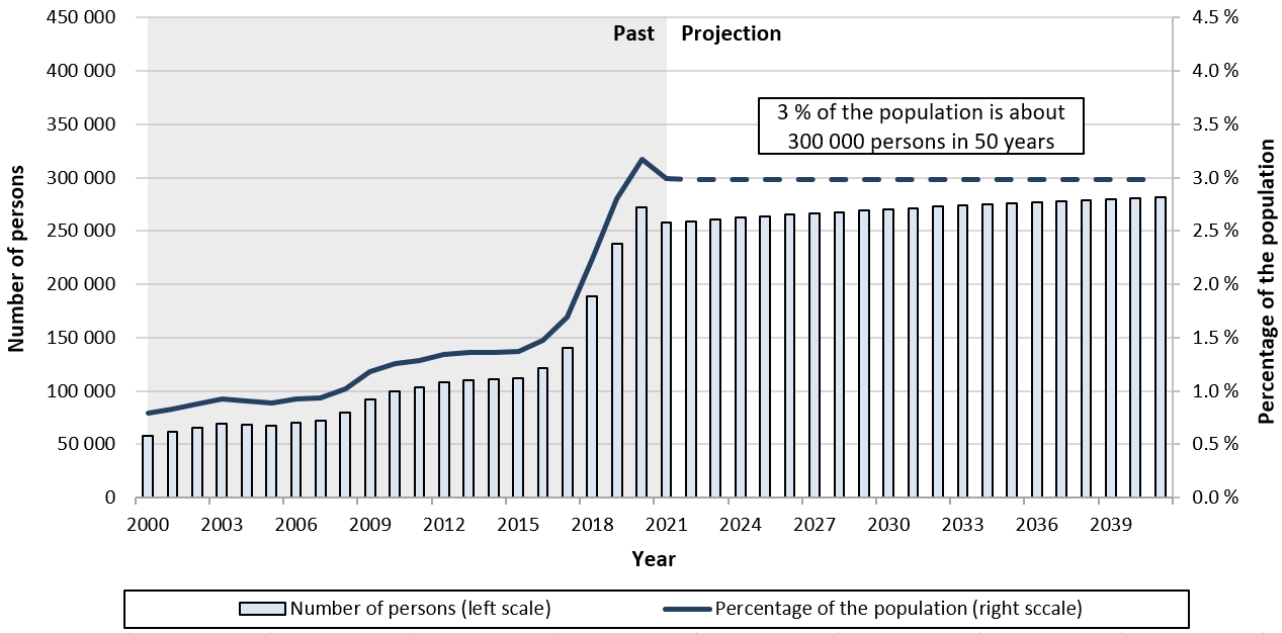
The variation in the number of non-permanent residents largely stems from changes made to student and foreign worker programs, immigration policies in Québec, Canada and the United States, and labour market attractiveness in Québec. Although the current labour shortage is conducive to an increase in the number of non-permanent residents in the short term, considerable uncertainty remains as to what will happen in the long term. Furthermore, historical levels are significantly lower than those observed in recent years.

To reconcile all of these considerations, the assumption used consists in projecting a number of non-permanent residents as a stable percentage of the population equal to the average rate for the past three years, i.e. 2.99%. The latter percentage, applied to a growing population, will create a 0.01% to 0.02% variation in the number of non-permanent residents each year. The number of non-permanent residents was projected at 2.4% of the population in the last actuarial valuation. This projection was exceeded in 2019.

In addition, no provisions for aging were made for non-permanent residents since the constant renewal of its population has meant that the average age varies little (the average age has been around 29 for the past 10 years). However, this population segment is used for the calculation of fertility and mortality rates.

Chart 9 shows the number of non-permanent residents, expressed as a number of persons (left) and as a percentage of the population (right)

Chart 8
Number of non-permanent residents – 2000 to 2041
(in number of persons and as a percentage of the population)



2.3 Mortality

2.3.1 Life expectancy

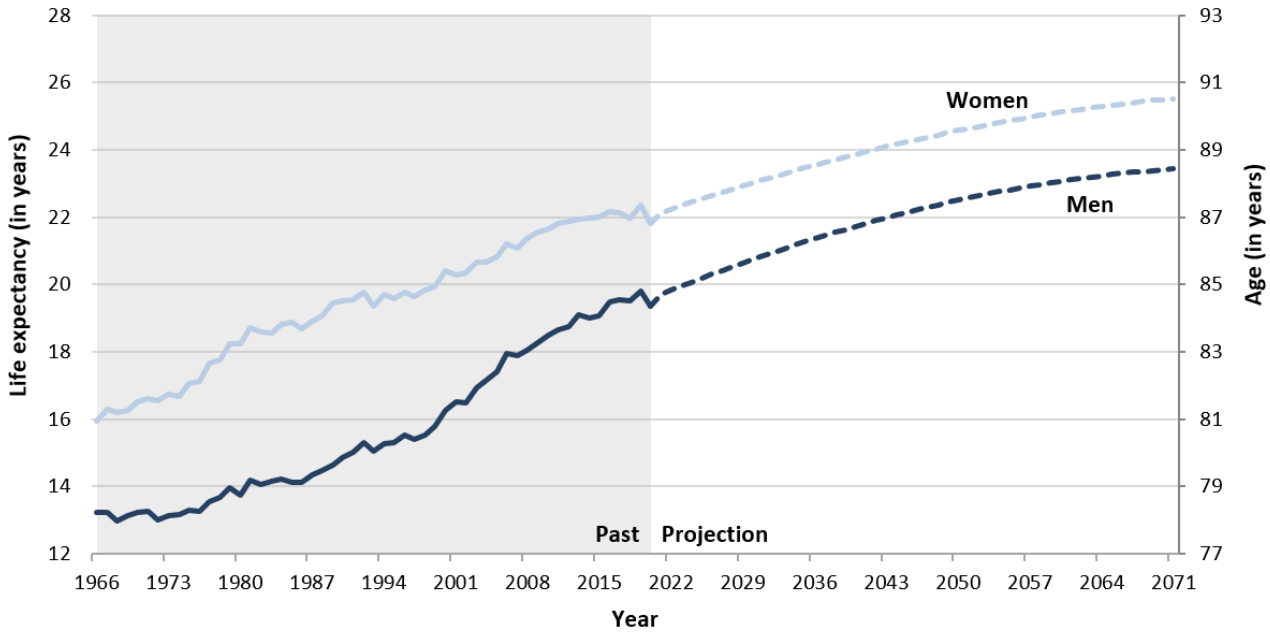
The following are the measurements related to mortality:

- **Life expectancy <u>without</u> improvements after the year shown** is calculated using a **static mortality table**, which does not take into account expected improvements in life expectancy for subsequent years. A static mortality table shows overall mortality for the population in a given year and can be compared with life expectancy data generally compiled.
- **Life expectancy <u>with</u> improvements after the year shown** is calculated using a **dynamic mortality table**, which takes into account the expected improvements in life expectancy for subsequent years. A dynamic mortality table can be used to calculate the life expectancy of a particular person.

Chart 10 shows that **life expectancy at age 65** without improvements after the year shown has increased by approximately six years since the Plan's inception in 1966. It is projected that life expectancy at age 65 without improvements after the year shown will increase by approximately 3.6 years in the next 50 years. The rate of increase is higher in the first years of the projection and slows gradually thereafter.

As observed in the past 30 years, the increase is higher among men. Therefore, **the gap between the life expectancy of men and women at age 65 is narrowing,** from a high of 4.8 years in 1989 to 2.4 years in 2020. According to the projection, it will decrease to 2.1 years in 2071.

Chart 9
Life expectancy without improvements after the year shown at age 65, by sex – 1966 to 2071



It can be reasonably anticipated that the improvement in life expectancy observed in the past will continue. This projection is based on past improvements, as well as on the anticipated overall effect of various factors affecting mortality rates, including:

- the aging population and its impact on access to quality health care;
- the increased use of medically assisted death;
- the evolution of lifestyle habits, in particular the proportion of obese persons;
- medical advances.

The effect of each of these elements on mortality rates is variable, as is the underlying uncertainty. Projected life expectancy, with and without improvements after the year shown, for the general population by age is shown in Tables 18 and 19. Although life expectancy at the beginning of the projection period is slightly lower than life expectancy projected in the previous valuation because of the COVID-19 pandemic, long-term life expectancy is comparable to the previous estimate.

Impact of the COVID-19 pandemic

The COVID-19 pandemic resulted in episodes of excess and lower than expected mortality rates in Québec. Life expectancy decreased in 2020 and increased in 2021. The starting point of the projection is the average for the years 2018 to 2020, and takes into account only part of the effect of the pandemic on life expectancy. New variants could cause further variations in the mortality rate. Several unknowns persist, in particular the long-term effects of COVID-19, offloading and pandemic-related medical advances, such as RNA messenger vaccines.

Table 18
Life expectancy without improvements after the year shown, by age and sex – 2022, 2046 and 2071
(in years)

Age	Men			Women		
	2022	2046	2071	2022	2046	2071
0 years	81.1	84.2	85.7	84.6	87.1	88.5
10 years	71.6	74.7	76.2	75.0	77.5	78.9
20 years	61.7	64.8	66.3	65.1	67.6	69.0
30 years	52.0	55.0	56.5	55.2	57.7	59.1
40 years	42.4	45.3	46.7	45.4	47.9	49.2
50 years	32.9	35.7	37.1	35.8	38.1	39.5
60 years	24.0	26.6	27.9	26.6	28.8	30.1
65 years	19.8	22.2	23.4	22.2	24.3	25.5
70 years	15.9	18.1	19.2	18.1	20.0	21.2
80 years	9.2	10.9	11.8	10.7	12.4	13.4
90 years	4.5	5.6	6.3	5.4	6.7	7.5
100 years	2.2	2.9	3.3	2.6	3.3	3.8

Table 19
Life expectancy with improvements after the year shown, by age and sex – 2022, 2046 and 2071
(in years)

Age	Men			Women		
	2022	2046	2071	2022	2046	2071
0 years	86.0	86.3	86.6	88.9	89.1	89.4
10 years	76.2	76.6	76.9	79.1	79.4	79.7
20 years	66.1	66.6	66.9	69.0	69.4	69.6
30 years	56.1	56.7	57.0	58.9	59.4	59.7
40 years	45.9	46.8	47.1	48.7	49.4	49.7
50 years	35.8	37.0	37.4	38.5	39.5	39.9
60 years	26.0	27.6	28.1	28.6	29.9	30.4
65 years	21.4	23.1	23.6	23.9	25.3	25.8
70 years	17.2	18.8	19.4	19.4	20.8	21.4
80 years	9.7	11.3	11.9	11.4	12.9	13.6
90 years	4.7	5.8	6.3	5.6	6.9	7.5
100 years	2.3	2.9	3.3	2.6	3.4	3.9

Note: Projected life expectancies for Plan beneficiaries are not the same as those for the general population. They are presented in Appendix IV. Life expectancies for beneficiaries are used to estimate the number of years of retirement pension payments.

2.3.2 Mortality rates

A gradual shift in mortality improvement to the oldest age groups is projected. Mortality for the youngest age groups has declined significantly in the past decades, leading to a very low mortality rate. It is unlikely that that rate will continue to decline at the same pace as in the past. In other words, the most easily accessible life expectancy gains in this age group have already been achieved. The projection model used (an extension of the model created by Ronald D. Lee and Lawrence R. Carter in 1992) allows for a gradual shift in mortality improvement from the youngest age groups to the oldest age groups.

Annual reductions in mortality rates by sex and age group are shown in Table 20. Mortality improvement among retired individuals has the greatest impact on Plan funding.

Table 20
Annual reductions in mortality rates, by age group and sex

Age group	Men				
	2022-2031	2032-2041	2042-2051	2052-2061	2062-2071
0 to 9 years	1.2%	0.9%	0.6%	0.3%	0.2%
10 to 19 years	1.1%	0.9%	0.8%	0.6%	0.5%
20 to 29 years	1.3%	1.1%	0.9%	0.6%	0.4%
30 to 39 years	1.7%	1.3%	1.0%	0.7%	0.3%
40 to 49 years	1.6%	1.3%	1.0%	0.7%	0.4%
50 to 59 years	1.4%	1.1%	0.9%	0.6%	0.3%
60 to 69 years	1.7%	1.4%	1.1%	0.9%	0.6%
70 to 79 years	1.4%	1.2%	0.9%	0.6%	0.4%
80 to 94 years	1.5%	1.2%	0.9%	0.6%	0.3%
95 to 109 years	1.1%	0.9%	0.8%	0.6%	0.4%

Age group	Women				
	2022-2031	2032-2041	2042-2051	2052-2061	2062-2071
0 to 9 years	0.4%	0.3%	0.2%	0.1%	0.1%
10 to 19 years	1.3%	1.0%	0.7%	0.4%	0.2%
20 to 29 years	1.2%	0.9%	0.7%	0.5%	0.3%
30 to 39 years	1.5%	1.2%	0.9%	0.6%	0.3%
40 to 49 years	1.6%	1.3%	1.0%	0.6%	0.3%
50 to 59 years	1.3%	1.0%	0.7%	0.5%	0.2%
60 to 69 years	1.4%	1.2%	1.0%	0.8%	0.5%
70 to 79 years	1.1%	0.9%	0.7%	0.5%	0.3%
80 to 94 years	1.3%	1.1%	0.9%	0.7%	0.4%
95 to 109 years	1.2%	1.0%	0.8%	0.6%	0.4%

2.4 Projected population

The population of Québec is estimated at 8 604 500 as at 1 July 2021 and is expected to reach nearly 10.1 million in 2071. **The population of Québec is gradually getting older.**

- Although only 6% at the Plan's inception in 1966, the proportion of the population age 65 and over increases from 21% to 27% over the next 25 years.
- The increase is greater up to 2030 as a result of the generation of baby boomers transitioning to retirement. This means that there are fewer contributors for each beneficiary.
- Contributors in the 20 to 64 age group make up the vast majority of Plan contributions. Whereas that group is estimated to grow by 353 000 persons by 2071, the proportion of the total population it represents will decrease by 5% during that period.

The results of the projection by age are presented below.

Chart 10
Québec's population by age group

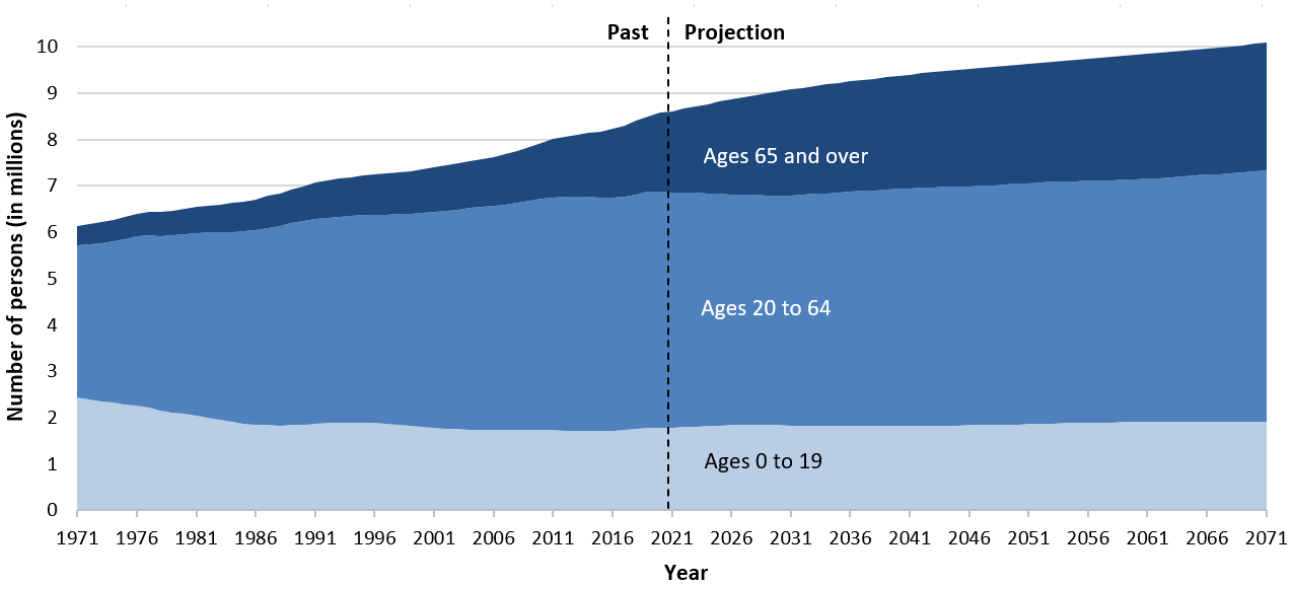
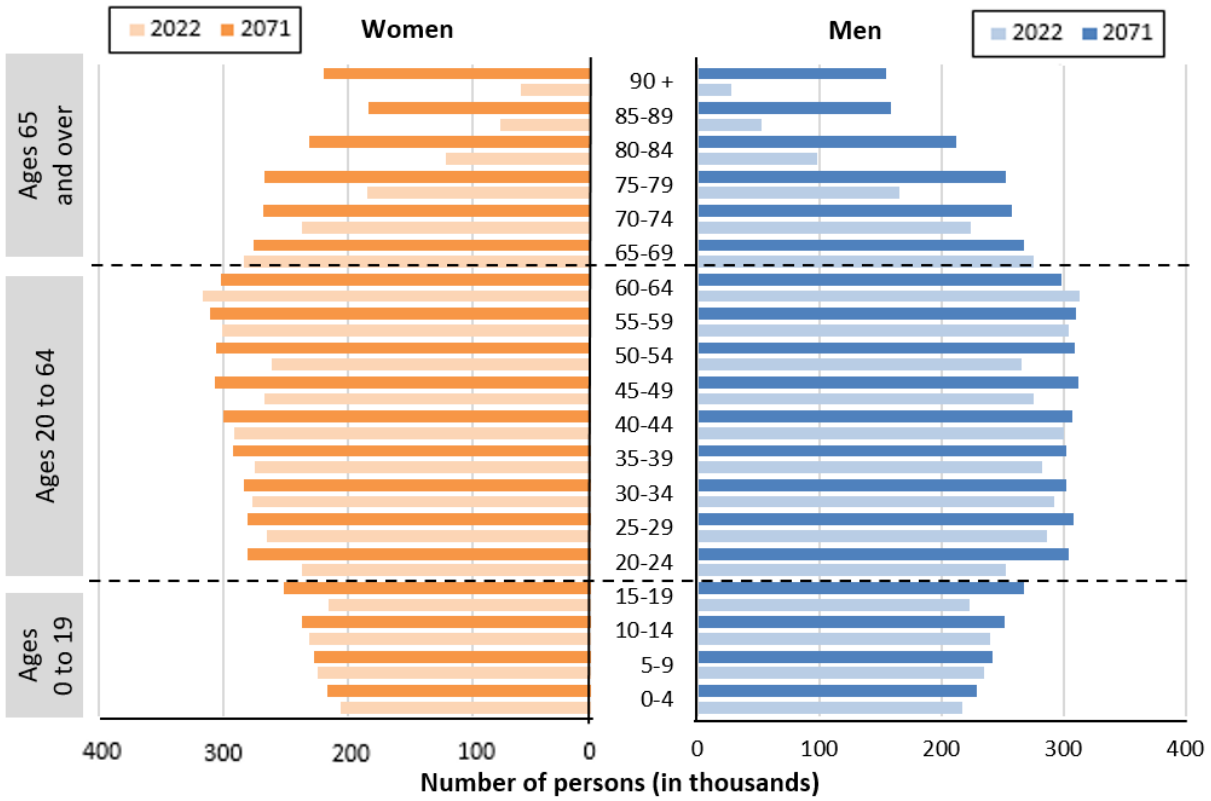


Table 21
Projection of the population of Québec by age group – 2022, 2046 and 2071
(in thousands)

Year	0 to 19 years	20 to 64 years	65 years and over	Total	Ratio of 65 years and over to the total population
2022	1791	5063	1809	8663	21%
2046	1834	5163	2532	9529	27%
2071	1921	5416	2747	10 084	27%

Chart 11
Age-sex pyramid – 2022, 2071

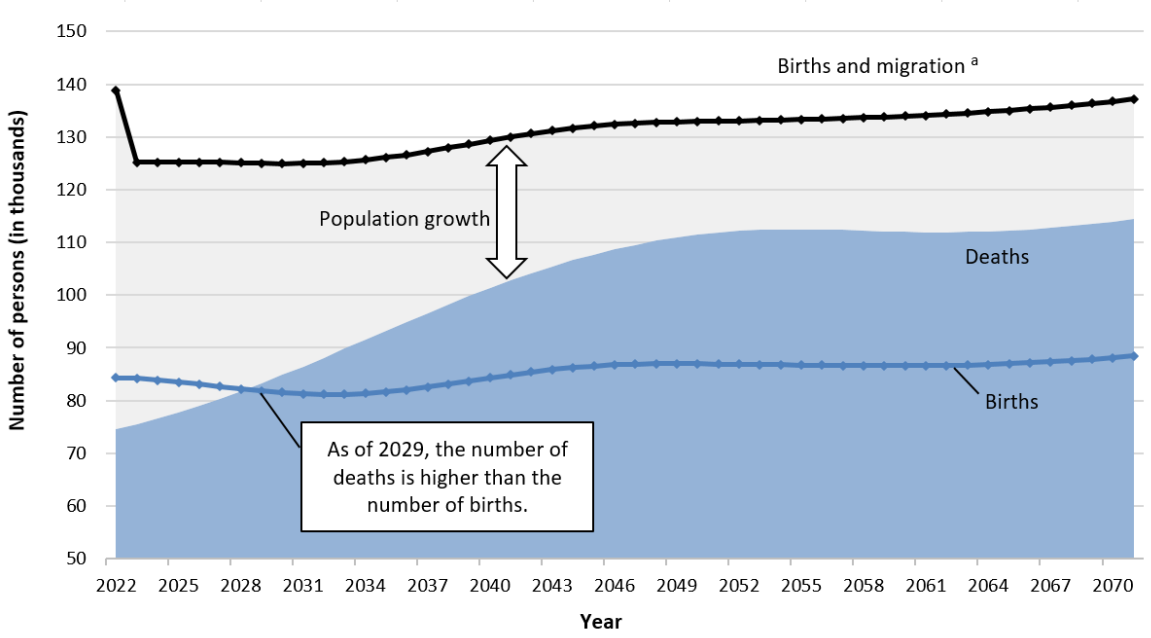


2.4.1 Components of Québec's demographic variation

Chart 13 shows the changes in births, migration and deaths in Québec for 2022 to 2071. Table 22 gives the annual population variation, that is, total births and migration minus deaths.

As of 2029, the number of deaths is greater than the number of births. However, since the sum of births and migration remains higher than the number of deaths, the Québec population continues to grow until the end of the projection period. The increase in migration is therefore the main factor accounting for demographic growth.

Chart 12
Components of Québec's demographic variation



a) Including the variation in the number of non-permanent residents.

Table 22
Components of Québec's demographic variation
(in thousands)

Year	Total population at 1 July	Births	Migration[a]	Deaths	Annual population variation
2022	8663	84	54	75	64
2023	8720	84	41	76	50
2024	8769	84	41	77	49
2025	8818	84	42	78	47
2026	8865	83	42	79	46
2027	8910	83	42	80	45
2028	8955	82	43	82	43
2029	8997	82	43	83	42
2030	9039	82	43	85	40
2031	9078	81	44	86	39
2036	9254	82	45	95	32
2041	9401	85	45	103	27
2046	9529	87	46	109	24
2051	9642	87	46	112	21
2056	9747	87	47	112	21
2061	9855	87	47	112	22
2066	9969	87	48	112	23
2071	10 084	88	49	114	23

a) Including the variation in the number of non-permanent residents.

3. Economic assumptions

With the baby boom generation transitioning to retirement, large numbers of individuals are leaving the labour market. This is one of the main reasons for the labour shortage. Since there are fewer workers available, they are in high demand. An increase in the participation rate has been observed in recent years in Québec, especially among experienced workers.

The labour shortage is also creating upward pressure on wages. It encourages employers and workers to increase productivity to compensate for the labour shortage. Companies can invest in training and automation. However, salary growth in excess of inflation is limited in the short term because prices are rising faster than salaries. According to the Bank of Canada and other major financial institutions, inflation and salary growth are expected to return to equilibrium in the coming years.

Table 23 summarizes the main economic assumptions in this valuation. They are described in Sections 3.1 to 3.4. Section 3.5 completes the picture with information from the stochastic simulations.

Table 23
Summary of the main demographic economic assumptions

Assumption	Actuarial valuation as at 31 December 2021	Section of the appendix
Participation rate (age 20 to 64)	82.1% in 2022, increasing to 85.8% in 2071	3.1.1 *page 81*
Unemployment rate	5.0% in 2022, increasing to 6.25% in 2051	3.1.2 *page 84*
Inflation rate[a]	4.2% in 2022, 2.3% in 2023, and 2.1% thereafter	3.2 *page 86*
Indexation rate of pensions[b]	5.8% in 2023, 3.4% in 2024, and 2.1% thereafter	3.2 *page 86*
Real increases in average employment earnings and the MPE	-0.6% in 2022, 0% in 2023, increasing to 0.8% in 2027, and remaining constant thereafter	3.3 *page 87*
Real rate of return of the base plan	-4.0% in 2022, 3.6% from 2023 to 2031, and 4.2% thereafter	3.4 *page 88*
Real rate of return of the additional plan	-3.8% in 2022, 3.5% from 2023 to 2031, and 3.7% thereafter	3.4 *page 88*

a) The inflation rates in this table are provided solely for the purpose of calculating the difference between the real and nominal values.

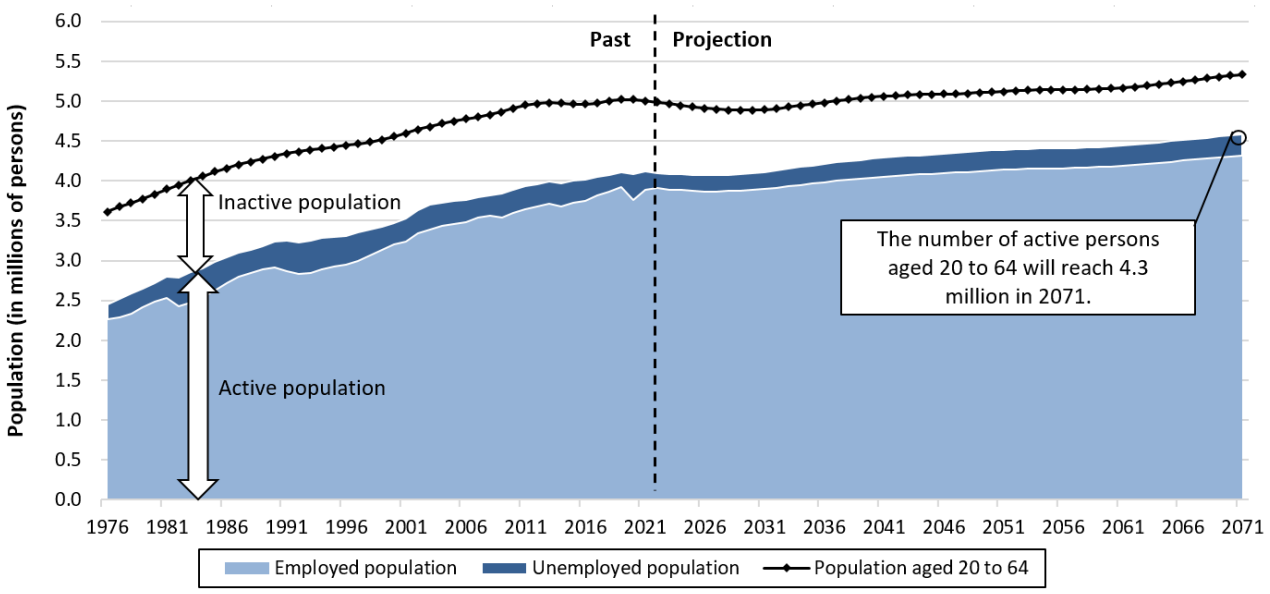
b) Indexation as at 1 January 2023 and 1 January 2024 is increased to take into account the evolution of inflation since the beginning of 2022.

3.1 Labour market

The projection of labour market indicators—mainly the projection of the employed population—is used to determine the number of contributors, which is the same for both the base plan and the additional plan.

The vast majority of Plan contributors are between the ages of 20 and 64. As a result, the greatest impact on changes in the labour force come mainly from the participation rates for this age group. Chart 14 shows the evolution of the 20 to 64 age group's labour force status since 1976. The population age 20 to 64 grows by approximately 350 000 persons over the projection period. The employed population age 20 to 64 increases by 410 000 persons. The difference between the two figures is due to a decrease in the ratio of the inactive population to the total population.

Chart 13
Breakdown of the population aged 20 to 64 by labour force status –1976 to 2071



3.1.1 Active population

The **active population** is composed of persons who are employed or looking for employment (the unemployed). The participation rate is the ratio of the active population to the total population. Participation rates are estimated by age and sex for the entire projection period. The active population is obtained by applying these rates to the total population.

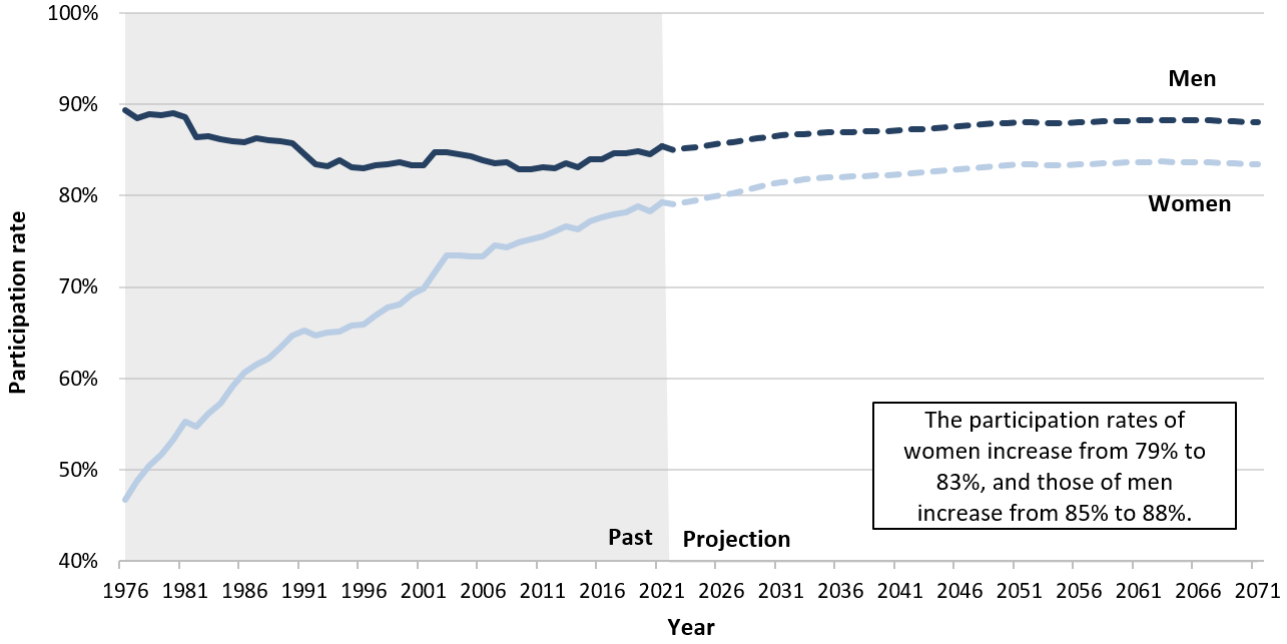
Overall, **participation rates will increase by 2051, particularly among experienced workers.** Most of the increase occurs in the next 15 years and then continues at a slower pace.

The total labour force rises from 4.5 million persons in 2022 to 5.1 million in 2071. During the same period, the labour force aged 20 to 64 rises from 4.1 million to 4.6 million. Chart 15 shows the increase in the participation rate of men and women aged 20 to 64.

Chart 15 also shows the massive entrance of women into the labour market since 1976, which has significantly reduced the **gap between the participation rates for men and women**. Since the integration of women into the labour force has

reached a certain maturity, the gap will remain relatively constant in the future. The predominant role of women as childcare providers is one of the reasons why the gap persists. From an international perspective, the participation rate gap between the sexes in Québec is among the lowest in the member countries of the Organisation for Economic Co-operation and Development (OECD).

Chart 14
Participation rates of persons aged 20 to 64, by sex – 1976 to 2071



The following subsections provide specific information on the projection of participation rates for the broad age groups. The main factors taken into account in the calculation of labour force participation are:

- the labour shortage;
- level of schooling, which results in a gradual increase in participation rates as more educated cohorts age.

15 to 24 age group

The anticipated weak growth in the available workforce means that young persons will increasingly be called on, raising their labour force participation. This increase in participation is not linked to a lower level of school attendance, since youth are increasingly combining work and studies. The projection shows a slight increase in participation from this age group.

25 to 54 age group

The 25 to 54 age group has the highest level of labour market participation. The participation rates for men have been relatively stable for the past 30 years, whereas they are increasing for women. By 2071, the participation rates for men aged 25 to 54 will increase by 1.4%, and the rates for women, by 2.2%.

55 and over age group

There has been a trend toward retiring increasingly later in life. The number of workers who choose to return to work after retiring is also growing. A number of factors are driving the increase in participation rates for older workers, including:

- employers' hiring of older workers to compensate for the labour shortage;
- the increased popularity of phased retirement;
- a reduction in the number of defined benefit plans that encourage early retirement;
- government continued employment initiatives;
- continuing increases in life expectancy, better worker health and less physically demanding work.

For these reasons, the participation rates of persons aged 55 and over are increasing faster than the participation rates of other age groups. By 2071, the participation rates for persons aged 55 to 69 increase by 7.0% for men and 9.3% for women.

Participation rate assumptions

Overall, the projected participation rates are slightly lower than those projected in the last actuarial valuation. Table 24 shows the participation rate assumptions for men and women, by five-year age group, in 2022, 2046 and 2071. Chart 16 shows the projection of the participation rates for both sexes combined.

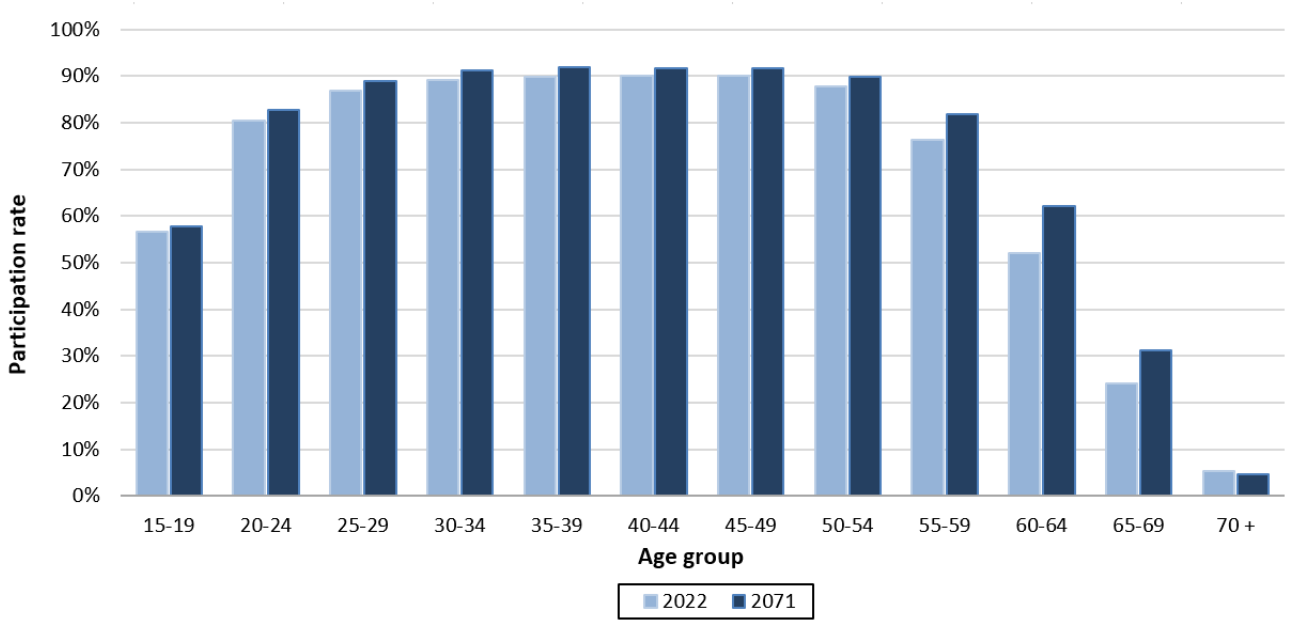
Table 24
Labour force participation rate by age group and sex – 2022, 2046 and 2071

Age group	Men			Women		
	2022	2046	2071	2022	2046	2071
15 to 19 years	55.0%	56.4%	56.5%	58.4%	59.2%	59.2%
20 to 24 years	80.2%	82.3%	82.6%	80.9%	82.4%	82.7%
25 to 29 years	87.5%	89.1%	89.4%	86.1%	88.0%	88.3%
30 to 34 years	92.4%	93.5%	93.7%	86.0%	88.4%	88.9%
35 to 39 years	92.7%	94.1%	94.3%	87.2%	89.1%	89.4%
40 to 44 years	92.7%	93.5%	93.6%	87.5%	89.6%	89.9%
45 to 49 years	91.9%	93.0%	93.2%	88.1%	89.8%	90.1%
50 to 54 years	90.0%	91.5%	91.8%	85.6%	87.6%	88.0%
55 to 59 years	81.0%	85.2%	85.7%	71.6%	77.4%	78.2%
60 to 64 years	59.3%	66.5%	67.9%	44.9%	54.7%	56.5%
65 to 69 years	29.8%	35.4%	36.2%	18.5%	25.5%	26.6%
70 years and over	8.3%	6.2%	6.0%	2.9%	3.4%	3.5%
20 to 64 years	**85.0%**	**87.6%**	**88.1%**	**79.0%**	**82.9%**	**83.4%**
15 years and over	67.2%	64.0%	63.6%	59.5%	58.0%	57.7%

Note: The participation rate of the population aged 15 and over is shown in Table 24 for information purposes only. This rate is heavily influenced by the population's age distribution. The aging of the population will place downward pressure on the participation rate of the population aged 15 and over, even though the participation rates per age group increase.

Chart 15

Labour force participation rate by age group – 2022 and 2071



3.1.2 Employment and the unemployment rate

Unemployment rate

The unemployment rate rose sharply as a result of the COVID-19 pandemic and the measures put in place to address it. Since then, however, the increase has subsided. In 2022, the unemployment rate was 5.0%. It is projected to be 6.25% as of 2051.

The average unemployment rate for the 50-year projection period is higher than in the last actuarial valuation (6.0% compared with 5.8%). This is because the likelihood of destabilizing events was revised slightly upward. Section 3.5.1 shows the stochastic distribution of the projected unemployment rate.

Chart 17 shows the 2022 and 2071 employment rates for women (on the left) and men (on the right). More women than men begin working in the youngest age group, whereas men continue working longer at the end of their careers.

Employed population

The employed population is the portion of the population employed full or part time. The unemployment rate corresponds to the portion of the active population that is not employed. Table 25 shows the projected active population, employed population and unemployment rate for certain years between 2022 and 2071. On the whole, the employed population increases from 4.3 million in 2022 to 4.8 million in 2071.

Employment growth depends on changes in unemployment rates and the active population. As such, the employed population keeps pace with the active population as of 2051 because the unemployment rate reaches its maximum level at that time.

Chart 16

Projected employment rate by age group and sex – 2022 and 2071

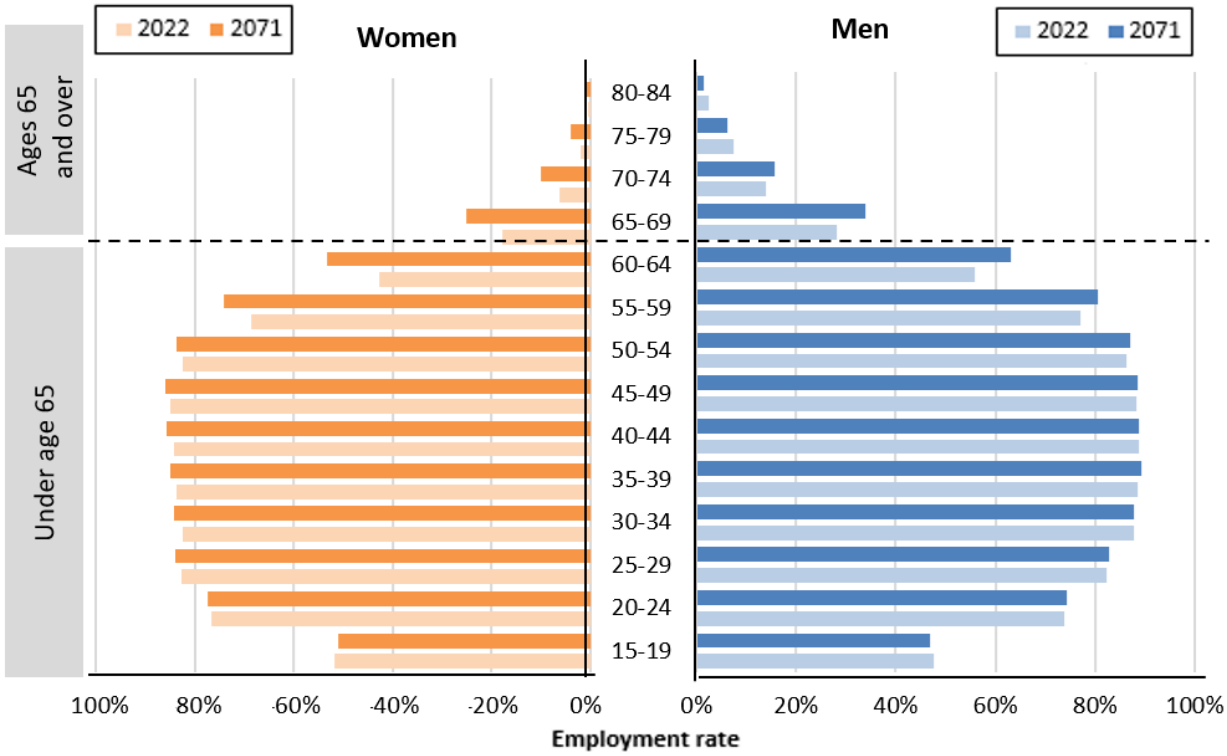


Table 25

Projection of the active population, employed population and unemployment rate

Year	Active population (in thousands)			Employed population (in thousands)			Unemployment rate
	Men	Women	Total	Men	Women	Total	
2022	2393	2141	4534	2263	2045	4308	5.0%
2023	2398	2147	4545	2261	2046	4307	5.2%
2024	2400	2152	4553	2261	2049	4310	5.3%
2025	2403	2158	4561	2262	2053	4315	5.4%
2026	2407	2164	4571	2263	2057	4321	5.5%
2027	2411	2171	4582	2266	2063	4329	5.5%
2028	2416	2178	4594	2269	2069	4338	5.6%
2029	2421	2187	4608	2273	2076	4349	5.6%
2030	2427	2196	4623	2277	2084	4362	5.7%
2031	2434	2205	4639	2282	2092	4375	5.7%
2036	2470	2251	4721	2311	2133	4444	5.9%
2041	2509	2295	4804	2343	2172	4515	6.0%
2046	2543	2332	4875	2372	2204	4576	6.1%
2051	2573	2364	4937	2397	2232	4628	6.3%
2056	2590	2378	4968	2413	2245	4658	6.3%
2061	2615	2399	5014	2435	2265	4700	6.3%
2066	2648	2427	5076	2467	2292	4759	6.3%
2071	2684	2455	5138	2500	2317	4817	6.3%

3.2 Inflation rate and pension indexation

Inflation is measured by the rate of increase in the consumer price index (CPI) for Canada. Plan pensions are indexed on 1 January of each year based on the increase in the CPI. The indexation assumption is directly linked to the inflation assumption, taking into account the two-month difference between the reference periods for the two measurements.[8]

Consideration of high inflation rates

Like many other countries, Canada is seeing high inflation rates in 2022. The economic scenario developed at the beginning of the year reflects this situation. However, the inflation rates observed after the valuation date remained high rather than gradually decreasing to meet the Bank of Canada's target. As a result, the projected rate of indexation for pensions for 1 January 2023 and 1 January 2024 has been revised upward to take into account the impact of this exceptional situation on Plan funding.

Monetary policy

The inflation targeting monetary policy was introduced in 1991 in Canada. The core of this policy has been to keep the inflation rate within a target range of 1% to 3%, with a midpoint of 2%. After rising sharply in the preceding decades, the inflation rate has remained at a low, stable level for almost 30 years. The federal monetary policy was renewed in December 2021 with no major changes. Its secondary objective is now to support achievement of the maximum level of sustainable employment.

High inflation in the short term

The short-term inflation assumption is greater than the Bank of Canada's targeted midpoint. The recent economic situation (pandemic-related supply chain disruptions, labour shortage, Russian invasion of Ukraine, higher oil prices, etc.) has resulted in inflation rates higher than have been seen in decades. These disruptions create an imbalance between supply and demand. Central banks around the world are increasing interest rates to limit inflationary pressures.

Return to the inflation target in the medium term

The current inflation targeting component of the monetary policy has served the Canadian economy well in the past decades. However, as we can see with the current disruptions, the Bank of Canada cannot control all factors that affect inflation. Furthermore, during the 50-year projection period, there is a slight possibility that the monetary policy will be renewed with another inflation target or significantly modified. Section 3.5.1 shows the stochastic distribution of the projected inflation rate. The distribution is asymmetrical, since, in the event of an economic crisis affecting inflation, deflationary pressures are more worrying than an inflation rate exceeding the upper limit of the current target. The Bank of Canada would thus act faster to prevent deflation. Consequently, the long-term inflation assumption is slightly higher than 2%.

Inflation assumption

The projected long-term inflation rate is 2.1%. This rate is the same as was projected in the last actuarial valuation. The inflation rates for 2022 (4.2%) and 2023 (2.3%) are those projected by the Bank of Canada in its updated monetary policy framework published in January 2022. These rates are used exclusively to calculate average employment earnings, maximum pensionable earnings (MPE) and investment return assumptions.

[8] The reference period for indexation ends on 31 October, whereas the reference period for inflation ends on 31 December.

Pension indexation assumption

The inflation rates in the months following the determination of the inflation assumption were significantly higher than anticipated. To take full account of the impact of this exceptional situation on Plan funding, indexation rates were revised upward. The projected short-term rates and the return trajectory to the inflation target are based on the known monthly indices and the average projections of the major financial institutions available in May 2022. The pension indexation rate assumption is 5.8% on 1 January 2023 and 3.4% on 1 January 2024. As of 2025, the pension indexation rate is 2.1%.

3.3 Real rate of increase in average employment earnings, MPE and YAMPE

3.3.1 Real rate of increase in average employment earnings

Impact of the COVID-19 pandemic

Average employment earnings have fluctuated wildly since the beginning of the pandemic. Job losses were concentrated in the lowest-paid sectors of activity such as the retail and restaurant sectors. These changes in the composition of the labour market accentuated income disparities and had an unusual effect on average weekly earnings (AWE) in 2020: while the number of jobs fell, AWE increased by approximately 7%. In 2021, the employment rate returned to near normal levels, but wage growth was below inflation.

In the short term

Although wage growth assumptions are expressed in real terms, **the current high inflation levels were taken into account and significantly influence the assumption in the first years of the projection**. Wages do not change as quickly as inflation, in particular because:

- collective agreements are renewed periodically;
- there is a delay between price increases and the transfer of a portion of the profits to employment earnings.

Because of the high interest rates and all of the economic disruptions caused by the pandemic, the real rate of increase in average employment earnings is negative in 2022, followed by a gradual increase as the disruptions abate.

In the long term

Recent salary growth is less than one might have expected given current labour shortages. Delays in capital investments have an adverse effect on productivity gains, while the labour shortage slows down production in some companies. In the longer term, the labour shortage should encourage capital investment and investment in training in order to increase productivity. Investment in workforce training has already begun: requalification programs have been implemented, and many persons took advantage of the pandemic to further their training or refocus their career. Automation is also well under way and should continue into the future.

The labour shortage should lead to a stronger demand for certain categories of workers that are currently less well represented in the labour market. Historically, these workers' annual salaries are lower than average for a variety of reasons: more part-time work, type of job, less recognition for certain types of diplomas and degrees, etc. Because of the composition effect, the presence of more persons in the labour market could limit the growth of average employment earnings, even if the contributory payroll increases.

Lastly, more emphasis is now being placed on total compensation. Workers are not only requesting salary hikes, but also competitive social benefits, flexible working conditions, a convivial work place, etc. As a result, productivity gains are not fully reflected in the increase in average employment earnings.

Difference between men and women

The projected increase in average employment earnings is not distributed equally between men and women. The projection shows that the average earnings of women will therefore catch up to those of men, particularly because women are obtaining a higher level of education than men are. The rate and extent of this phenomenon varies by age.

Summary of the assumption

The real rate of increase in average employment earnings is -0.6% in 2022 and 0% in 2023. The rate rises to 0.8% in the following four years, then remains constant as of 2027. The nominal rate of increase in average employment earnings is then 2.9% (inflation being at 2.1%).

Section 3.5.1 shows the stochastic distribution of the projection. The long-term assumption is 0.1% lower than the assumption used in the last actuarial valuation.

Table 26 summarizes the assumptions for inflation and the increase in average employment earnings.

Table 26
Inflation rate and the increase in average employment earnings

Year	Inflation[a]	Increase in average employment earnings	
		Real	Nominal
2022	4.2%	-0.6%	3.6%
2023	2.3%	0.0%	2.3%
2024	2.1%	0.2%	2.3%
2025	2.1%	0.4%	2.5%
2026	2.1%	0.6%	2.7%
2027 and after	2.1%	0.8%	2.9%

a) The inflation rates in this table are provided solely for the purpose of calculating the difference between the real and nominal values. The pension indexation rates are shown in Section 3.2.

3.3.2 Real rate of increase in the MPE and YAMPE

The increase in the MPE is calculated according to the increase in the average weekly earnings (AWE) in Canada. For the purposes of this actuarial valuation, the assumed increase in maximum pensionable earnings is the same as the assumed increase in average employment earnings in Québec. The additional maximum pensionable earnings (YAMPE) are 114% of the MPE,[9] rounded down to the nearest hundred.

The MPE is known to be $64 900 in 2022. This amount is higher than the amount projected for that date in the last actuarial valuation. It has grown more rapidly in recent years because of greater than anticipated increases in the AWE. Table 8 of the main report shows the projected MPE and YAMPE. The YAMPE will apply only as of 2024.

3.4 Rates of return of the reserves

Rates of return are determined for each year in the projection period and for each asset class. These assumptions make it possible to project investment income generated by the base plan and additional plan reserves.

Pursuant to the Act, **the base plan and the additional plan are funded separately.** Therefore, the assets of each reserve are deposited separately in the Caisse de dépôt et placement du Québec (CDPQ). The assets are then invested in accordance with their respective and separate investment policy.

[9] 107% of the MPE in 2024.

3.4.1 Allocation of assets

Review of the funds' investment policies

Retraite Québec's Board of Directors determines the investment policy of each plan. The policies set out the investment objectives and the reference portfolio's allocation of assets for each fund. The committee responsible for the investment policy meets at least four times a year to review the policies. The policies must be wholly revised at least every three years.

Since the last actuarial valuation, the base plan's investment policy has been modified to gradually introduce a leverage ratio[10] of 5%. The revised investment plan meets the Plan's investment risk targets. Furthermore, the current investment policy stipulates that Retraite Québec believes it is important that the CDPQ take into account environmental, social and governance (ESG) issues in its risk management of Plan investments.

Asset allocation assumption

For each fund, the assumption for the allocation of assets over the 10 next years is equal to the asset allocation of the reference portfolio of the investment policies in effect in 2022. During that period, the weighting of fixed income is the same for both plans.

a) Additional plan

The projected weighting of fixed income increases as of 2032. As a result, the additional plan will see a transition of its allocation of assets toward a portfolio generating less volatile returns, while the portion of investment income in its cash inflows will increase. For example, in the long term, investment income represents around 70% of the additional plan's cash inflows, whereas it is only 38% in the case of the base plan.

Since the additional plan relies more on investment income as a source of funding, its sensitivity to fund returns is greater than that of the base plan, which relies more on contributions. Appendix VI shows that the additional plan's results are five times more sensitive to variations in returns than those of the base plan. These characteristics are important for the development of an investment policy.

b) Base plan

Since it is partially funded and most of its funding will come from future contributions, the base plan is less vulnerable to investment return fluctuations than a fully funded pension plan. Thus, portfolio assets can be allocated toward long-term growth. The allocation of assets assumption is maintained throughout the entire projection period.

The allocation of assets is shown by category in Table 27. The "Short-term," "Rate" and "Credit" categories contain fixed-income securities. The other categories contain variable-income securities. The "Rate" category is a specialized portfolio from the CDPQ made up mainly of Canadian federal and provincial bonds. The "Credit" category is another specialized portfolio containing mainly securities, whose credit risk is comparable to those of corporate bonds.

[10] A leveraged approach makes it possible to borrow to invest. On average, the return on investment is higher than the cost of borrowing. The use of a leveraged approach increases the expected rate of return and the risk level of the portfolio.

Table 27
Distribution of fund assets – Base plan and additional plan

Asset class	Base plan	Additional plan	
		2022 to 2031	2032 and after
Short-term	1.0%	1.0%	1.0%
Rate	8.5%	4.0%	8.5%
Credit	11.5%	15.0%	25.5%
Infrastructures	12.0%	12.5%	12.5%
Real estate	13.5%	12.0%	12.0%
Equities	36.5%	35.5%	25.5%
Private equities	22.0%	20.0%	15.0%
Leverage ratio	-5.0%	0.0%	0.0%
Total	**100.0%**	**100.0%**	**100.0%**

3.4.2 Rate of return by asset class

Returns on fixed income securities are composed mainly of coupon income and the variation in asset fair values based on interest rate variations.

Returns on other securities are composed of current income—notably dividends and rents—and the variation in the market value of securities. No distinction is made between earned and unearned income resulting from any fair value variations.

In developing the rate of return assumption for each asset class, historical returns over long periods were analyzed. Changes in economic conditions were considered, and the differences in rates of return between the various asset classes were identified. While respecting the Plan's investment policies, other factors were also taken into account, such as return projections by various institutions (including the CDPQ), financial research documents, the stochastic analysis presented in Section 3.5.2 and the survey on the social security plans of International Social Security Association (ISSA) member countries.

For the first 10 years

The economic disruptions at the beginning of 2022 (Russian invasion of Ukraine, high inflation levels, etc.) led to negative returns for the first months of the year, and there is still some uncertainty. The nominal rate of return for the entire year is expected to be near zero.[11]

For the next nine years, from 2023 to 2031, the real rate of return for each asset class will be on average 0.6% lower than the rate of return for subsequent years (according to the base plan's asset allocation). On the one hand, increasing interest rates limit the rate of return for fixed-income asset classes. On the other hand, variable-income asset classes face several headwinds: the climate change transition; the central banks' efforts to fight inflation, which could cause an economic slowdown (higher borrowing costs); the uncertainty surrounding changes in the labour market, the slow re-establishment of supply chains, etc.

[11] The nominal rate of return for the additional plan is slightly higher than 0% because of its different asset allocation.

2032 and after

Interest rates are key to the return on fixed-income securities. On the valuation date, interest rates were below their historical average. The projected return for fixed-income securities during the first years is based on a bond portfolio's anticipated return on the valuation date. The return then gradually increases to its maximum level. The leverage cost exceeds the return on the "Short-term" asset class by 0.7%.

The projected real return on **equities** uses a risk premium corresponding to the additional return that investors expect to offset the greater volatility associated with investment in equities. The real return for **infrastructures** is identical to the return for equities. The real return for **real estate** is 0.5% lower than that for equities in order to reflect the ending real estate market cycle and interest rates that will rise gradually in the long term. Since **private equities** are more volatile, the return for that asset class exceeds the return for publicly traded equities by 1.0%.

Table 28 shows the real rates of return for each asset class.

Table 28
Real rate of return by asset class

Asset class	2022	2023 to 2031	2032 and after
Short term	-4.1%	-0.2%	0.0%
Rate	-4.1%	0.2%	0.7%
Credit	-4.1%	1.7%	2.4%
Infrastructures	-4.1%	3.6%	4.2%
Real estate	-4.1%	3.1%	3.7%
Equities	-4.1%	3.6%	4.2%
Private equities	-4.1%	4.6%	5.2%
Leverage ratio	0.0%	0.5%	0.7%

3.4.3 Additional elements considered

a) Diversification effect

Plan assets are well diversified and are rebalanced periodically to prevent any overly large deviations from the investment policy's targets. The average medium- to long-term return of a diversified and regularly rebalanced portfolio is systematically greater than the weighted average of the average long-term returns of the various asset classes. This difference is called the *diversification effect*. It is included in the overall rate of return assumption.

Based on the financial literature and the stochastic analysis carried out, the diversification effect is 0.5% for each year in the projection period for the base plan and additional plan.

b) Added value of active management

Over a long period of time, active management aims to add value to overall return by:

- expanding the choice of securities and sectors;
- providing flexibility with regard to investment policy allocation targets.

For the purposes of this actuarial valuation, no added value is included in the overall rate of return assumption.

c) Investment management fees

Investment management fees are deducted from the realized return. They are expressed as a percentage of managed assets. A reduction of 0.3% in the gross return was assumed for the entire projection period. This value takes into account the management fees for each asset class and for the allocation of portfolio assets.

Table 29 shows the average real rates of return over the projection period.

Table 29
Average real rate of return by period

Source	Base plan	Additional plan	
	2022 to 2071	2022 to 2031	2032 to 2071
Weighted return for each asset class	3.7%	2.5%	3.5%
Diversification effect	+0.5%	+0.5%	+0.5%
Added value	+0,0%	+0,0%	+0,0%
Management fees	-0.3%	-0.3%	-0.3%
Average real rate of return	**3.9%**	**2.7%**	**3.7%**

3.4.4 Overall return assumption

The overall return assumption is the result of weighting the different rates of return for each asset class according to the projected allocation of assets and including the diversification effect.

Since the rates of return for each asset class, the diversification effect and management fees are similar for both plans, the difference between the additional plan's projected overall return and the base plan's projected overall return comes from the differences between the asset allocation assumptions.

Table 30 shows the assumption for the overall return on assets for both plans, net of management fees, for the projection period. The projected return is stable for each year bracket shown in the table. The assumed inflation rate and rate of return by asset class are the same for both plans' valuations, whereas the investment policies are different. Consequently, each plan's rate of return is different.

Table 30
Rates of return, net of management fees – Base plan and additional plan

Year	Net real rate		Inflation rate[a]	Net nominal rate	
	Base plan	Additional plan		Base plan	Additional plan
2022	-4.0%	-3.8%	4.2%	0.0%	0.2%
2023 to 2031	3.6%	3.5%	2.1%	5.8%	5.7%
2032 and after	4.2%	3.7%	2.1%	6.4%	5.9%
50-year average (2022 to 2071)	**3.9%**	**3.5%**	**2.1%**	**6.1%**	**5.8%**

a) The inflation rates in this table are provided solely for the purpose of calculating the difference between the real and nominal values. The pension indexation rates are shown in Section 3.2.

3.5 Stochastic projection of the economic factors

The charts in this section illustrate the distribution of the averages of the economic factors simulated over 50 years in the stochastic analysis. The assumption used in the actuarial valuation is shown for the purpose of comparison, as are the percentiles and the standard deviation. Appendix VI provides additional information about the risks related Plan funding and the uncertainty of results. It also shows the distribution of funding measures resulting from the joint factor simulation.

Since the averages obtained from the stochastic simulation are very close to the assumptions in the actuarial valuation, they are not shown in the charts. The statistics presented show that the most volatile assumptions are the rates of return for the reserve of each plan.

3.5.1 Inflation rate, unemployment rate and rate of increase in average employment earnings

a) Inflation rate

The economic scenario generator replicated cyclical behaviours, as well as more temporary variations in the inflation rate. The long-term average is slightly above the Bank of Canada's 2% target. Its volatility is moderate, and is within the target range of 1% to 3% in most scenarios. However, the inflation rates in some scenarios are outside of that target range.

b) Unemployment rate

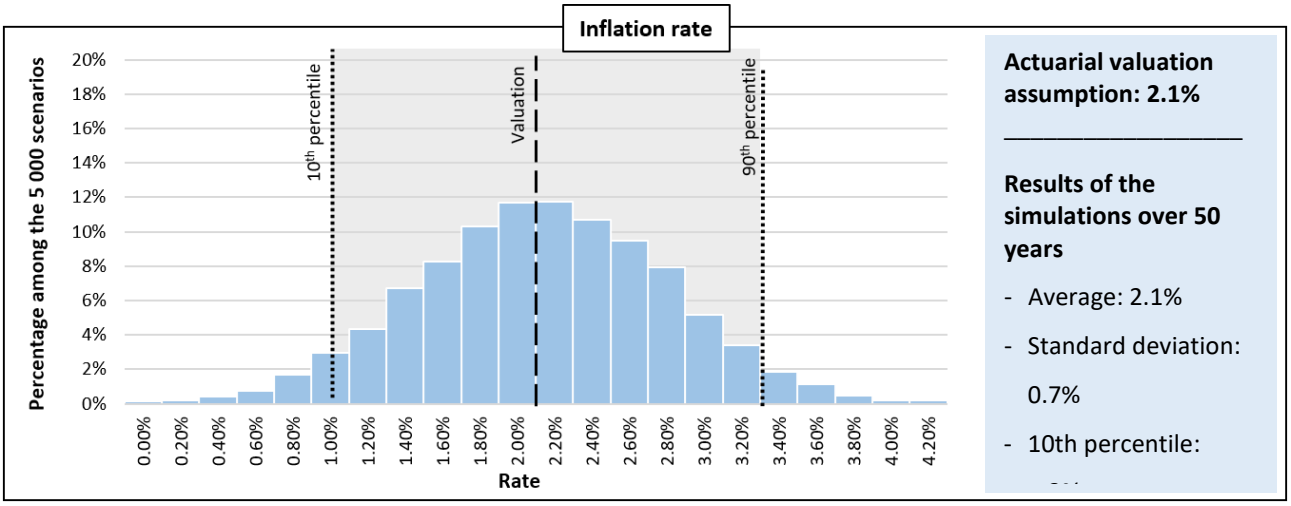
The simulation for the unemployment rate included no form of seasonality and replicated economic cycles of varying ranges, as well as the strong interdependencies with some asset classes such as equities. The projected scenarios show cycles where unemployment rates are sometimes high following an economic shock.

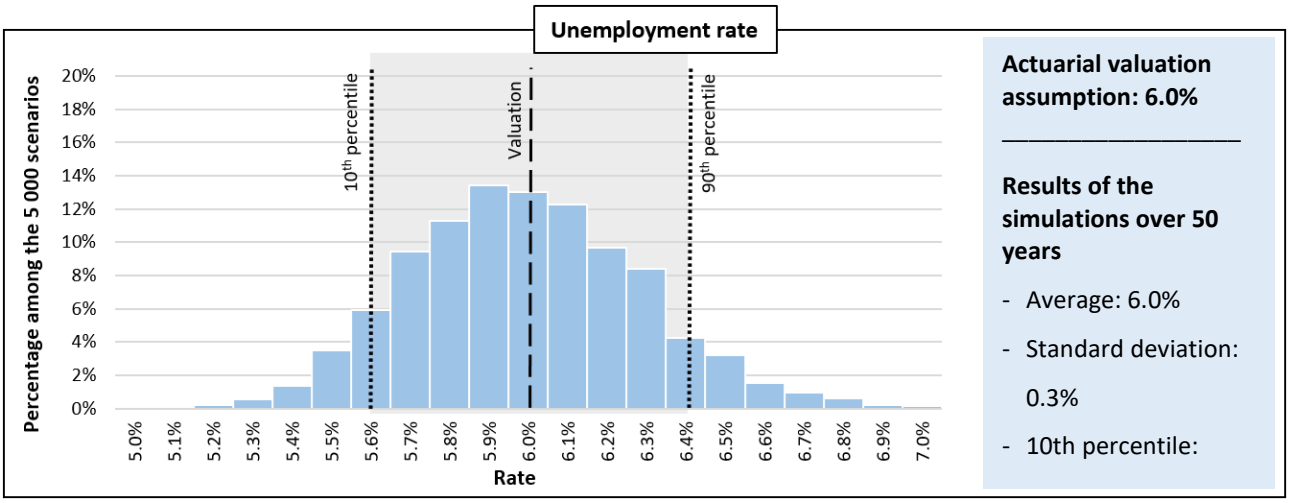
c) Nominal rate of increase in average employment earnings

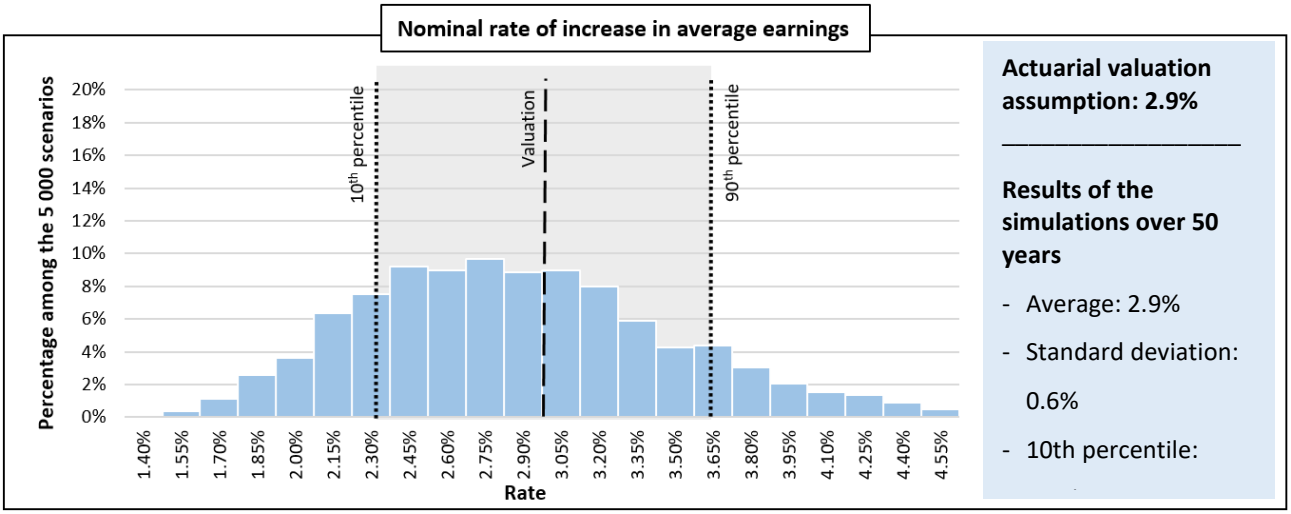
The nominal rate of increase in average employment earnings is characterized by a certain rigidity that generally takes the form of wage freezes during economic slowdowns. In addition, salary variations are often the result of collective agreements that are negotiated and renewed periodically, thus limiting rapid and sudden increases. On average, over 50 years, the nominal rates of increase in average employment earnings are rarely under the average inflation rate.

Chart 17

Stochastic projection: distribution of the average simulated inflation rates, unemployment rates and nominal rates of increase in average employment earnings over 50 years







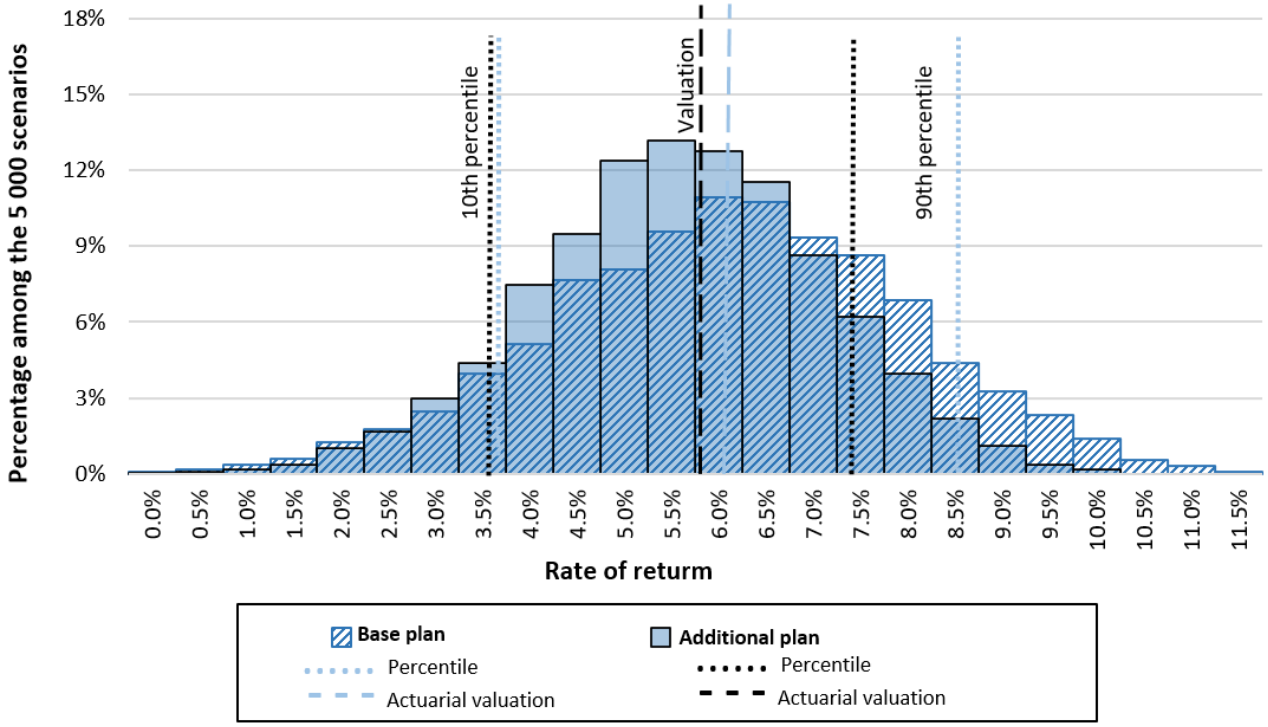
3.5.2 Reserve returns

The rates of return for the various asset classes simulated are identical for the base plan and the additional plan. The rates are weighted based on the investment policy of each plan in order to obtain the annual rate of return. Since the investment policy is different for each plan, the rates of return that were simulated are also different.

On average, investments in fixed-income securities have less volatile returns than investments in variable-income securities. The additional plan's investment policy will eventually include a greater portion of fixed income securities than the base plan. As a result, and as illustrated in Chart 19, the distribution of the simulated average rates of return for the additional plan is more concentrated around the average than the distribution in the base plan.

Very low or very high returns can occasionally occur. However, the average rates of return vary less when considered over a long period of time, since lower returns are often offset by higher returns a few years later.

Chart 18
Stochastic projection: distribution of 5 000 simulated average nominal rates of return over 50 years – Base plan and additional plan



Base plan:	**Additional plan:**
Actuarial valuation assumption: 6.1%	Actuarial valuation assumption: 5.8%
10th percentile: 3.7%	10th percentile: 3.7%
90th percentile: 8.5%	90th percentile: 7.6%
Standard deviation: 1.9%	Standard deviation: 1.5%

Appendix IV

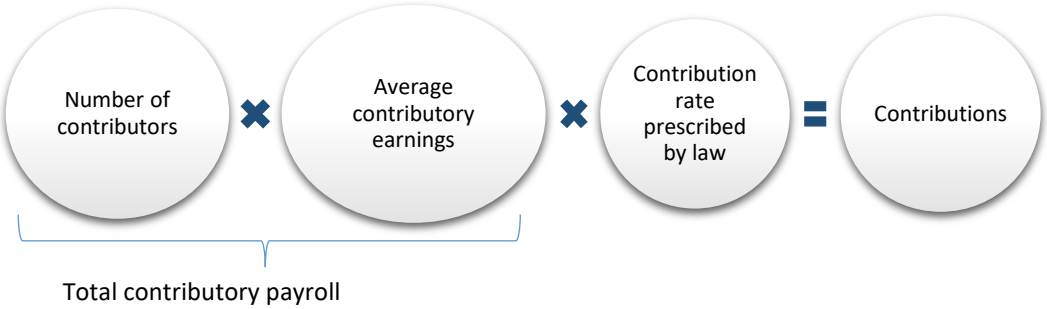
Plan-specific assumptions

1. Introduction

This appendix describes the Plan-specific assumptions needed to project contributions (Section 2), benefits (Section 3) and administration costs (Section 4). Section 5 provides information about the calculation of the initial reserves.

2. Plan contributions

Contributions are determined from the total contributory payroll and the contribution rate prescribed in the Act. The number of contributors (Section 2.1) and the average contributory earnings (Section 2.2) are used to calculate the total contributory payroll.



Tables 3 and 8 in the main report show the projected contributions for each plan until 2071. They also show the contribution rates, applicable upper limits, number of contributors and total contributory payroll.

2.1 Number of contributors

The projected population[12] and Plan participation rates are used to calculate the number of contributors.

The Plan participation rates are shown in Table 31. They are determined using participation rates, unemployment rates and the distribution of employment earnings.[13] Since the basic exemption is $3500 a year, the annual increase in workers' earnings results in an increase in Plan participation.

Chart 20 breaks down the projected number of contributors by age group and sex. The number of contributors grows at a rate similar to the growth rate of the population old enough to contribute. The proportion of contributors aged 20 to 64 decreases from 92% in 2022 to 90% in 2071. The chart also shows that the number of contributors aged 65 and over increases over the projection period as more older persons remain in the workforce.

The difference between the Plan participation rates of men and women remain relatively stable over time. As a result, the percentage of women among all contributors remains around 48% for the entire projection period. However, the percentage of women among contributors in the 65 and over age group is 39% in 2022 and 45% in 2071.

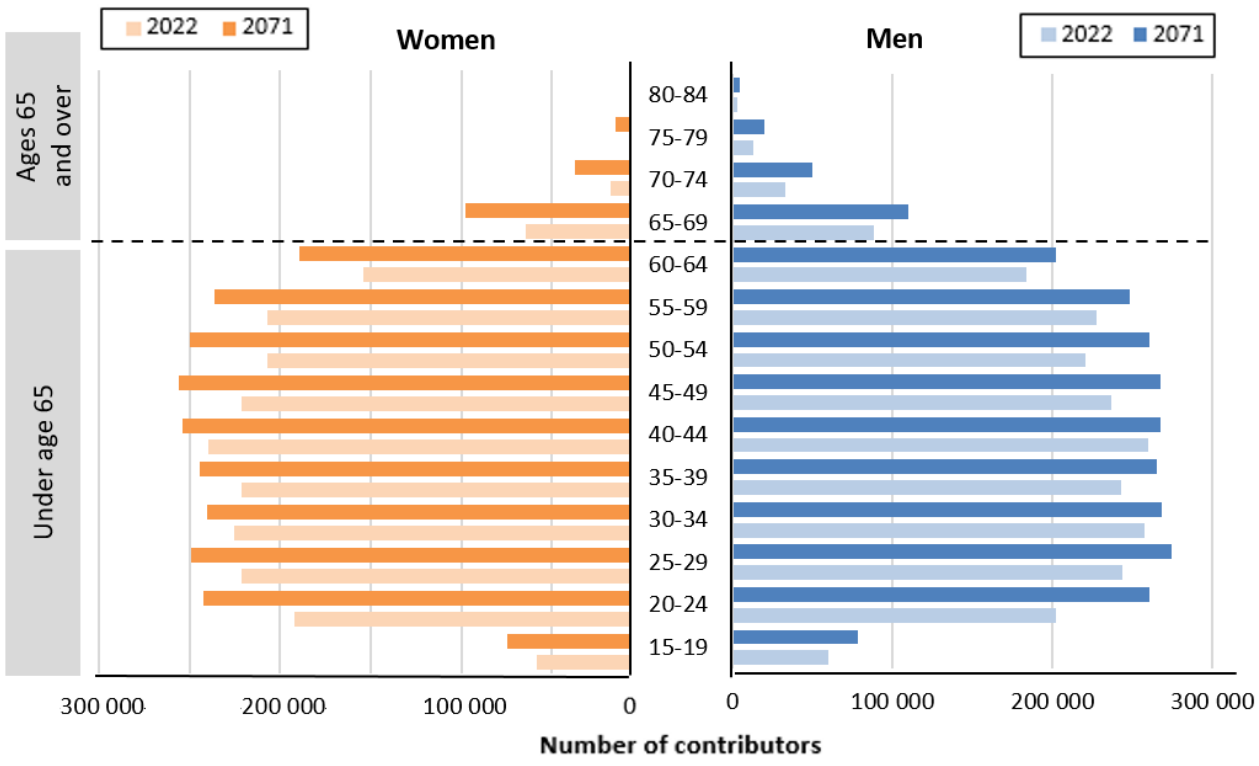
[12] The demographic projection assumptions are described in Appendix III.

[13] The distribution of employment earnings is established based on information in the Plan's Record of Contributors for 2018 through 2020. The Record of Contributors contains information on Plan participation since the Plan's inception.

Table 31
Plan participation rate by age group and sex – 2022, 2046 and 2071

Age group	Men			Women		
	2022	2046	2071	2022	2046	2071
20 to 24 years	81%	84%	86%	82%	85%	87%
25 to 29 years	86%	88%	89%	84%	87%	89%
30 to 34 years	87%	88%	89%	81%	83%	85%
35 to 39 years	87%	87%	88%	81%	83%	84%
40 to 44 years	87%	87%	87%	82%	84%	85%
45 to 49 years	85%	85%	86%	82%	83%	84%
50 to 54 years	83%	84%	84%	80%	81%	82%
55 to 59 years	76%	79%	80%	70%	75%	76%
60 to 64 years	58%	65%	67%	49%	59%	62%
65 to 69 years	31%	38%	41%	22%	32%	35%
18 to 64 years	80%	82%	84%	76%	80%	81%

Chart 19
Projected number of contributors by age group and sex – 2022 and 2071



2.2. Contributory earnings

Contributory earnings and pensionable earnings are determined based on a person's employment earnings and the Plan parameters.[14] Average employment earnings are projected based on the most recent known average employment earnings and the nominal rate of increase in average earnings (see Appendix III).

Table 32 shows the projected average employment earnings by age group and sex. The highest average employment earnings fall under the 45 to 49 age group for both men and women.

Table 33 shows changes in average employment earnings and average pensionable earnings by sex, as well as the applicable maximums. The difference between the average employment earnings and the average pensionable earnings is due to the application of Plan parameters. For example, limiting earnings (to the MPE or YAMPE) lowers average earnings. In addition, excluding from the average pensionable earnings the earnings of workers who earned less than the basic exemption increases the calculated average. The ratio of the average employment earnings of women to those of men was 53% in 1966. It increases from 78% in 2022 to 84% in 2071.

Table 32
Projected average employment earnings by age group and sex – 2022, 2046 and 2071

Age group	Men			Women		
	2022	2046	2071	2022	2046	2071
20 to 24 years	24 000	45 700	93 500	20 200	38 100	77 900
25 to 29 years	43 100	83 400	170 700	35 700	70 100	143 300
30 to 34 years	57 000	110 600	226 200	44 400	88 400	180 900
35 to 39 years	65 400	126 400	258 800	52 200	106 000	217 100
40 to 44 years	72 500	141 300	289 300	59 100	124 500	255 000
45 to 49 years	77 400	149 300	305 500	62 000	131 900	270 100
50 to 54 years	77 000	148 000	303 000	60 200	125 800	257 600
55 to 59 years	72 000	141 400	289 000	52 700	114 100	233 100
60 to 64 years	58 400	111 200	228 100	40 100	87 000	178 200
65 to 69 years	41 100	73 500	150 400	28 000	58 100	118 900
18 years and over	58 000	110 400	226 800	45 500	93 000	190 600

[14] Appendix I provides additional information about the Plan parameters.

Table 33
Projected MPE, YAMPE, average employment earnings and average pensionable earnings, by sex

Year	MPE	YAMPE	Average employment earnings		Average pensionable earnings			
					1st bracket[a]		2nd bracket[b]	
			Men	Women	Men	Women	Men	Women
2022	64 900	0	58 000	45 500	43 100	38 800	0	0
2023	66 900	0	59 200	46 800	44 200	39 800	0	0
2024	68 800	73 600	60 400	48 000	45 200	40 800	1500	1100
2025	70 300	80 100	61 800	49 400	46 100	41 800	2900	2100
2026	72 000	82 000	63 300	51 000	47 200	42 900	3000	2200
2027	73 800	84 100	65 000	52 600	48 300	44 000	3100	2300
2028	75 900	86 500	66 700	54 400	49 500	45 300	3200	2400
2029	78 100	89 000	68 500	56 200	50 800	46 600	3300	2400
2030	80 400	91 600	70 300	58 000	52 200	48 000	3300	2500
2031	82 700	94 200	72 200	59 800	53 600	49 400	3400	2600
2036	95 400	108 700	82 900	69 700	61 400	56 900	3900	3000
2041	110 100	125 500	95 600	80 600	70 600	65 500	4500	3500
2046	127 000	144 700	110 400	93 000	81 200	75 200	5100	4000
2051	146 500	167 000	127 600	107 300	93 400	86 500	5900	4600
2056	169 000	192 600	147 200	124 000	107 500	99 500	6800	5300
2061	195 000	222 300	170 000	143 200	123 600	114 400	7900	6200
2066	225 000	256 500	196 300	165 200	142 400	131 700	9100	7100
2071	259 600	295 900	226 800	190 600	164 100	151 500	10 500	8100

a) The first earnings bracket applies to the base plan and the additional plan. It refers to employment earnings between the basic exemption and the MPE.
b) The second bracket applies to the second component of the additional plan, and corresponds to employment earnings between the MPE and the YAMPE.

2.3 Additional adjustment to the calculation of contributions

The total amount of contributions was increased to take into account the fact that some contributions are not refunded to employers. Such a situation occurs when a worker changes jobs or holds more than one job at the same time, or where their total annual earnings are less than the basic exemption. The assumption is based on data provided by Revenu Québec. The amount of the adjustment is $271 million in 2021 (1.5% of collected contributions). This percentage is reduced thereafter, particularly to account for the freeze of the basic exemption.

3. Plan benefits

Section 3 shows the number of pensions in payment at the valuation date (Section 3.1), the assumptions and calculations regarding pensions that will be in payment after the valuation date (Section 3.2), the assumptions regarding the cessation of pension benefits (Section 3.3), and the totals by type of benefit (Section 3.4).

3.1 Pensions in payment at the valuation date

Table 34 shows the number of pensions payable as at 31 December 2021 for each type of benefit. Table 35 shows the average monthly benefit. These data include the data adjustments made to reflect delayed payment, as explained in the "Accounting basis" section in Appendix II.

Table 34
Number of beneficiaries of pensions payable as at 31 December 2021, by sex

Type of benefit	Base plan			Additional plan		
	Men	Women	Total	Men	Women	Total
Retirement pension[a]	953 440	1 041 172	1 994 612	85 194	77 977	163 171
Surviving spouse's pension:						
– Under age 65	14 957	41 450	56 407	1442	3435	4877
– 65 years and over	62 407	263 104	325 511	809	1591	2400
Disability pension[b]	28 453	31 219	59 672	3970	4193	8163
Additional amount for disability	801	752	1553	N/A	N/A	N/A
Orphan's pension	N/A	N/A	12 533	N/A	N/A	N/A
Pension for a disabled contributor's child	N/A	N/A	8031	N/A	N/A	N/A

a) In the case of the additional plan, this number excludes beneficiaries who receive the retirement pension supplement only. This situation applies to beneficiaries under the base plan who worked after the creation of the additional plan.
b) The number of beneficiaries of the disability pension is determined for both total disability and flexible disability.

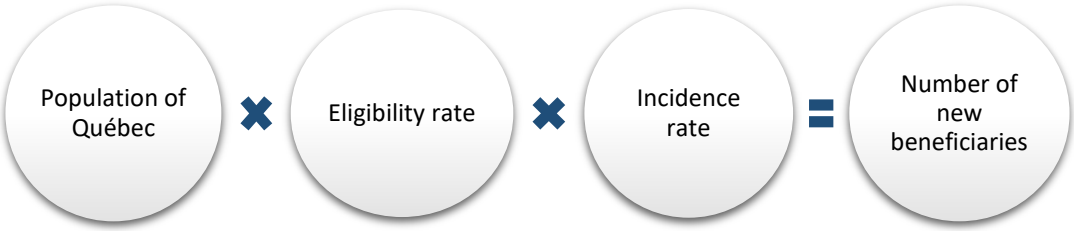
Table 35
Average monthly amount of pensions payable as at 31 December 2021, by sex

Type of benefit	Base plan			Additional plan		
	Men	Women	Total	Men	Women	Total
Retirement pension	652	451	547	1	1	2
Surviving spouse's pension[a]						
– Under age 65	704	764	748	1	1	2
– 65 years and over	120	369	321	0	0	1
Disability pension	973	934	952	1	1	2
Additional amount for disability	511	511	511	N/A	N/A	N/A
Orphan's pension	258	258	258	N/A	N/A	N/A
Pension for a disabled contributor's child	82	82	82	N/A	N/A	N/A

a) The average amount of this pension takes into account the combination with a retirement pension.

3.2 Pensions in payment after the valuation date

The number of new beneficiaries for each type of benefit is calculated as follows:



The number of beneficiaries is projected using the demographic projections in Appendix III. The eligibility rate (Section 3.2.1) is used to calculate the number of persons eligible, while the incidence rate is used to establish the start date of payment of benefits (Section 3.2.2). Lastly, Section 3.2.3 gives the number of new beneficiaries for each type of benefit.

The population, the eligibility rate and the starting date of payment of benefits are the same for both plans.

3.2.1 Benefit eligibility rates

Using the earnings recorded each year, eligibility for benefits is determined for each person in the Record of Contributors by applying the eligibility requirements for various benefits. Eligibility is related to earnings during the base plan contributory period.

The number of persons eligible is then divided by the population of Québec to obtain the eligibility rates by age and sex. Since some persons who contributed to the QPP now live outside Québec, eligibility rates can exceed 100%.

Statistical regressions are carried out to determine the relationship between Plan participation rates and the eligibility rates observed. Migratory movements are taken into consideration in the regression, since they also influence eligibility rates. The results of these regressions are then applied to the projected participation rates and migratory movements in order to estimate future changes in eligibility.

The following charts show the eligibility rates for certain benefits,[15] by projection year and sex.[16]

Not all persons eligible for a retirement pension apply for one. This is the case for persons who temporarily worked in Québec over the course of their career. For the last five cohorts that reached the age of 70, 92% of men and 95% of women eligible for a retirement pension applied for one. These percentages are assumed to be constant throughout the projection period. When these percentages are applied to the proportions in Chart 21, the percentage of the population that will apply for a retirement pension in 2022 is 96% for men and 95% for women.

[15] The eligibility rates for orphan's pensions are the same as those for the death benefit, whereas the eligibility rates for pensions for a disabled contributor's child are the same as those for disability pensions. It is not necessary to calculate the eligibility rate for the retirement pension supplement because all retirement pension beneficiaries are eligible for it.

[16] Age 60 is used in the charts because it is the age at which payment of a retirement pension can begin. Chart 22 also shows the eligibility rates for disability benefits at age 50, since the eligibility criteria are different for these benefits depending on whether the person is under or over age 60.

Chart 20

Proportion of the population eligible for a retirement pension at age 60, by sex

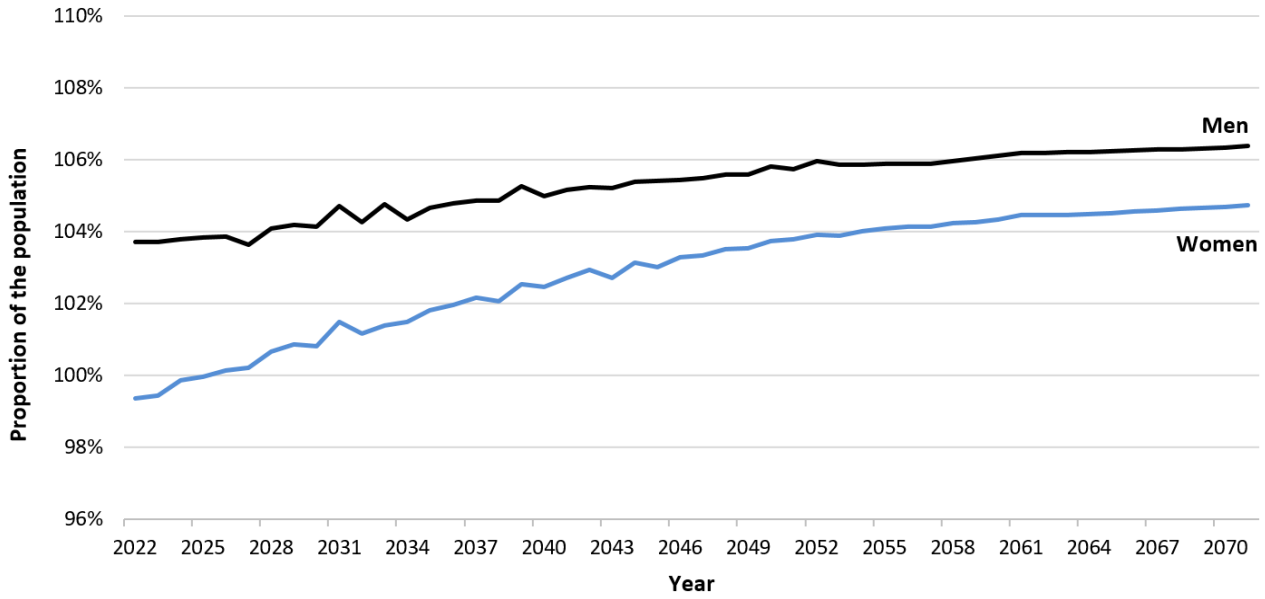


Chart 21

Proportion of the population eligible for disability benefits at age 50 and 60, by sex

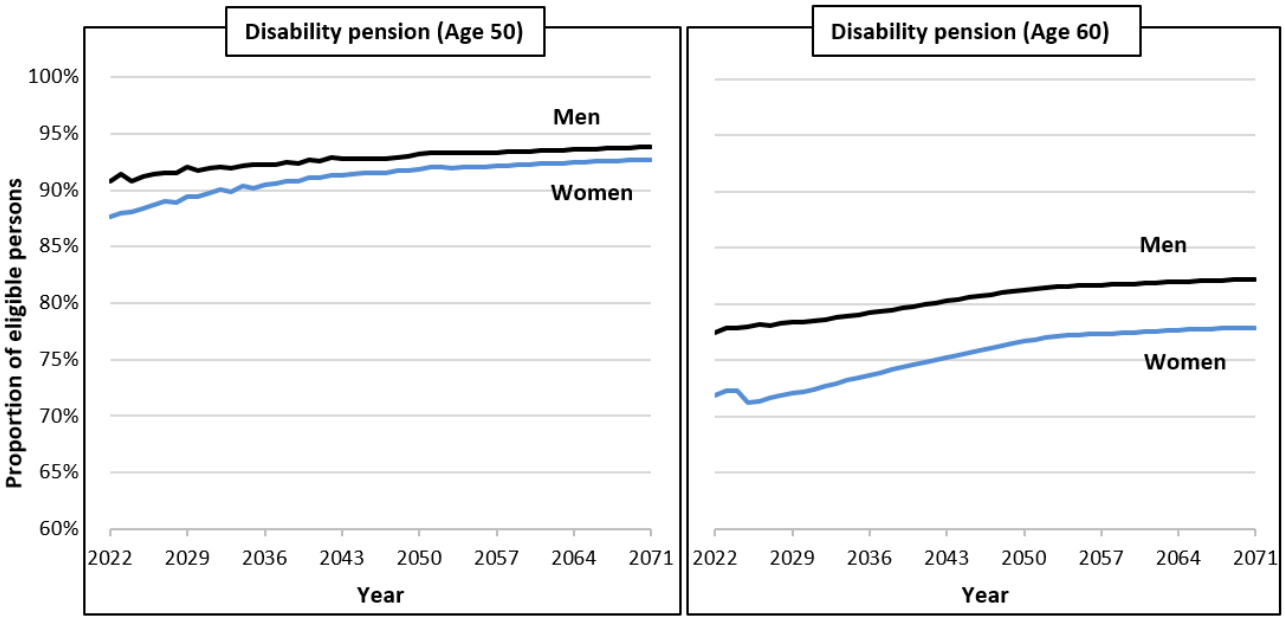
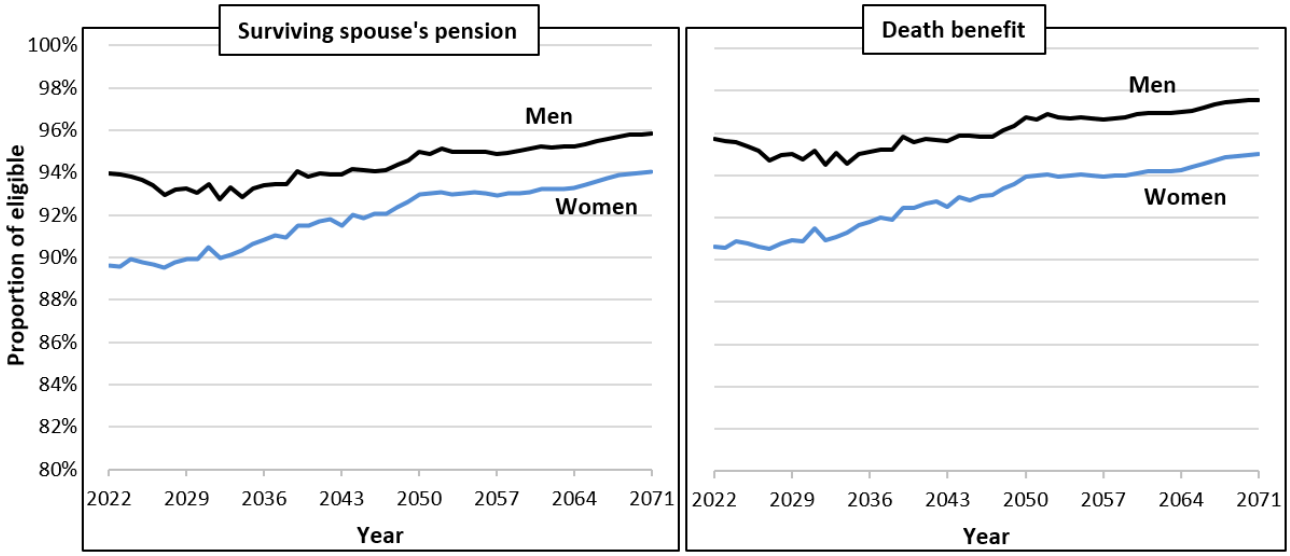


Chart 22

Proportion of the population at age 60 eligible for a surviving spouse's pension and death benefit, by sex



Difference between men and women

The charts show that more men are eligible for benefits then women. This difference can be explained by the gap between their respective Plan participation rates. Furthermore, the past and projected increases in women's participation in the Plan result in a greater increase in their eligibility rate than that of men. Since eligibility requirements differ based on the benefit type, the eligibility rate of women will continue to catch up with that of men for certain benefits, whereas it has stopped for others.

3.2.2 Pension starting date

a) Retirement pension

Reduction in the retirement rate at age 60

The retirement rate is the ratio of the number of persons who will become beneficiaries at a given age to the total number of eligible persons in the cohort. Chart 24 shows the retirement rate at age 60. For a long time, most persons in Québec applied for their retirement pension at age 60. Since 2014, persons do not have to have stopped working to receive their retirement pension.

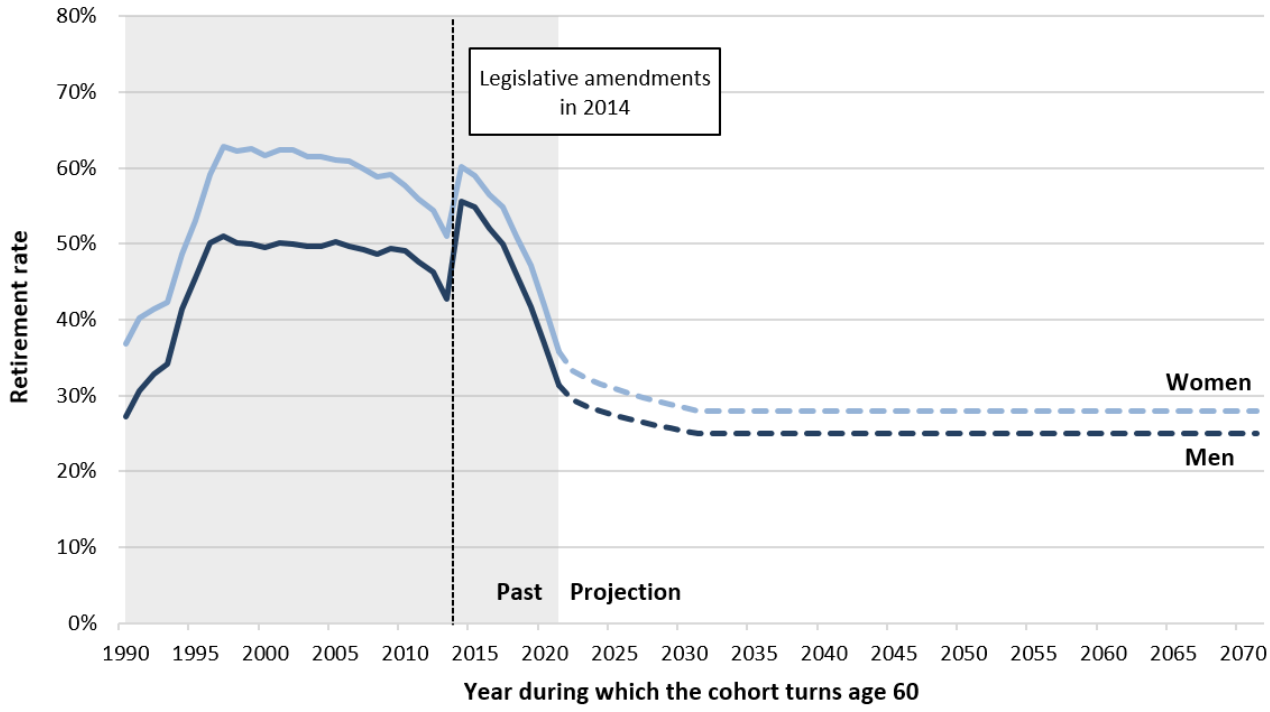
The retirement rate at age 60 has declined significantly. From 2014 to 2021, it dropped from 60% to 36% among women and from 56% to 31% among men. Thus, the proportion of persons who apply for their retirement pension after age 60 has increased by around 25%.

The delay in applying for a retirement pension can be explained by the higher participation rates of older workers. The more recent cohorts are more highly educated, in better health and more attached to the labour market. Furthermore, financial planning and retirement advice is changing, and the benefits of waiting longer before applying for a retirement pension are better known. As a result, a change in behaviour has been observed.

The reduction in the retirement rate at age 60 is significant. This trend should continue and perhaps even gain slight momentum. As a result, the reduction continues in the projection, but at a far slower pace, since most changes in behaviour have probably already occurred. In 2031, the retirement rate at age 60 stabilizes to levels comparable to those observed in the rest of Canada.

Chart 23

Retirement rate at age 60, by sex and year in which the cohort reaches age 60 – 1990 to 2071



Impact of the age at which retirement pension payments begin on retirement pension levels

Retirement rates also influence retirement pension levels because of the adjustment factors for early or delayed retirement. By delaying payment of the retirement pension from age 60 to age 65, a person will receive a retirement pension without an adjustment for early retirement. Overall, delaying payment of the retirement pension represents higher costs for the Plan.[17]

Delaying the retirement pension from age 60 to age 65

After age 60, age 65 is when most persons apply for their retirement pension. Very few applications are made at other ages. The last known retirement rate at age 65 for the cohort that reached age 60 in 2016 is approximately 20%. It increases to around 40% for the cohort that reached age 60 in 2021, and around 47% 10 years later. So most of those who delay the starting date of payment of their retirement pension will apply for it at age 65.

Chart 25 shows the average age at which persons **start receiving their retirement pension**, by year in which they turn 60. The **average age** has increased significantly in recent years. The chart also shows that, on average, women tend to retire earlier than men. This can be explained in part by the fact that women tend to have an older spouse and, for several couples, the decision to retire is made jointly. This gap is therefore maintained throughout the projection period.

Table 36 shows the retirement rates for cohorts reaching age 60 in 2031 and after.

[17] Appendix VI shows the sensitivity of funding to variations in the retirement rate assumption. Appendix VII shows the effect of changes in the retirement rate since the last actuarial valuation on Plan funding.

Chart 24
Average age at which persons start receiving their retirement pension, by sex and year in which the cohort reaches age 60 – 1990 to 2071

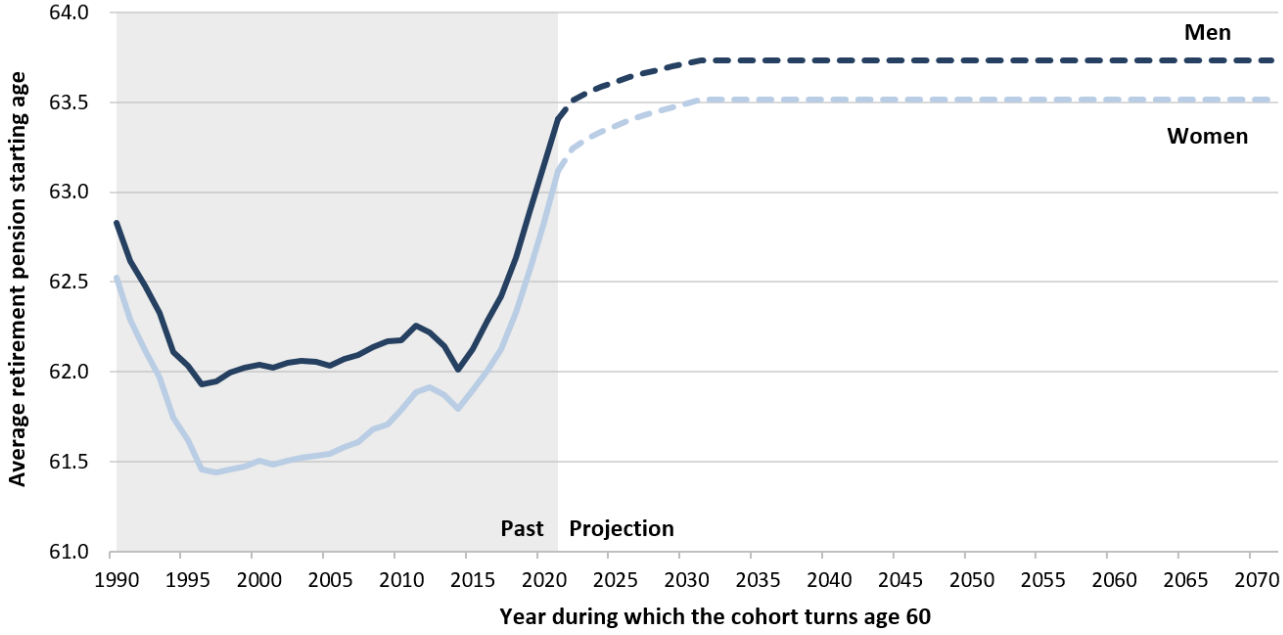


Table 36
Retirement rate for cohorts reaching age 60 in 2031 and after, by sex

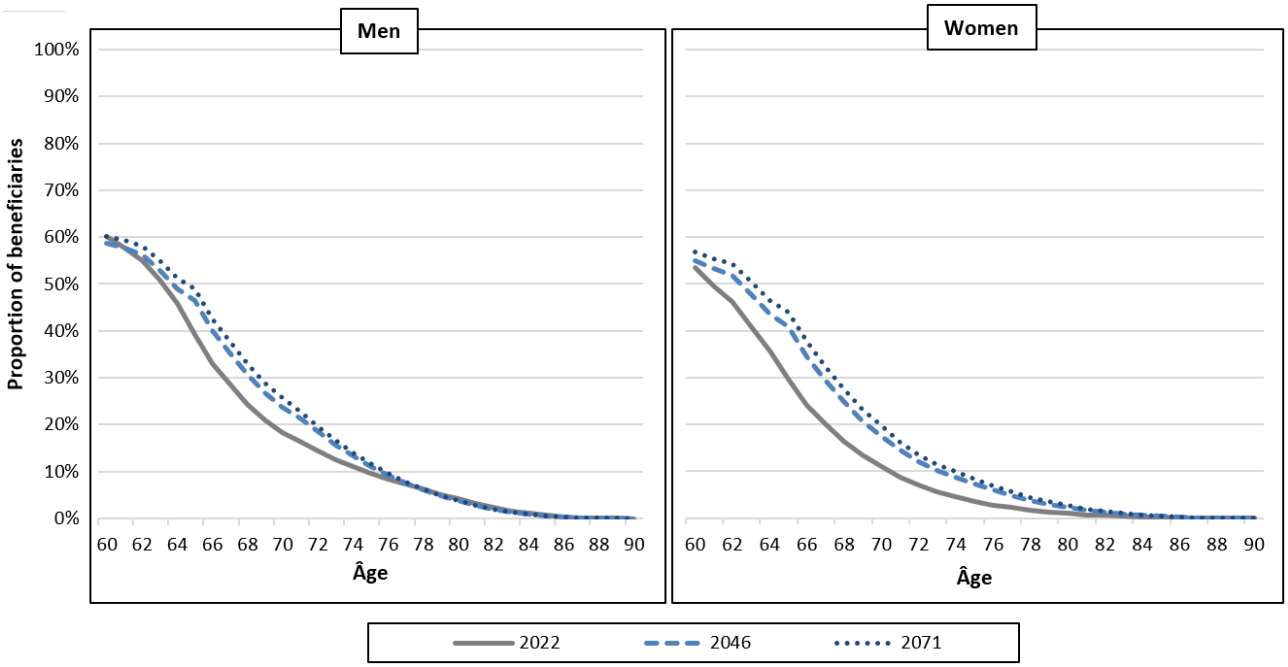
Situation	Age	Retirement rate	
		Men	Women
Early retirement	**60**	**25.0%**	**28.0%**
	61	5.5%	5.5%
	62	3.5%	3.6%
	63	3.0%	3.0%
	64	3.4%	3.4%
Unreduced retirement pension	**65**	**47.5%**	**46.5%**
Delayed retirement	66	2.5%	2.1%
	67	1.8%	1.4%
	68	1.6%	1.2%
	69	1.6%	1.2%
	70 and over	4.6%	4.1%
	Total	**100.0%**	**100.0%**

b) Retirement pension supplement

The age at which retirement pension payments begin is increasingly out of sync with the age at which persons definitively withdraw from the labour market. Since contributors can receive their retirement pension while continuing to work, the retirement rates under the Plan do not directly reflect the increase in participation rates for older workers. However, that increase is reflected in the proportion of retirement pension beneficiaries who contribute to the Plan. As a result, more beneficiaries will receive the supplement in the future. The proportion is shown in Chart 26.

Chart 25

Projected proportion of retirement pension beneficiaries contributing to the Plan, by age and sex – 2022, 2046 and 2071



c) Disability pension

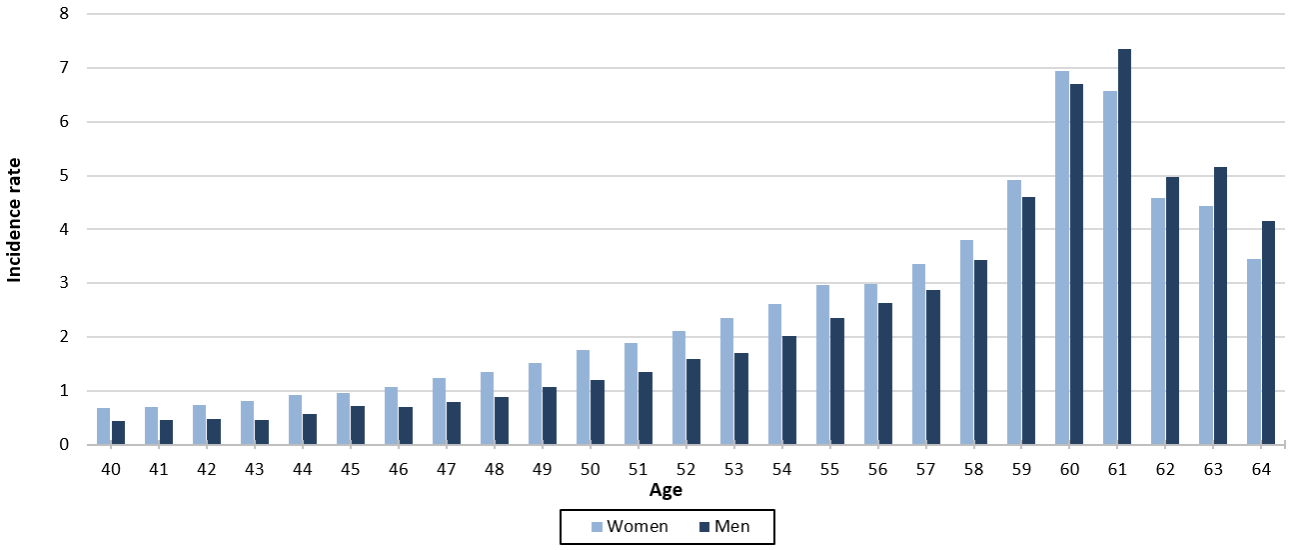
The disability incidence rate has been dropping for several years. Between 2009 and 2019, it dropped by more than 35% for persons aged 20 to 59 and by more than 50% for persons aged 60 to 64.

The downward trend observed between 2014 and 2019[18] will, to a certain extent, continue until 2031. The incidence rate will remain stable thereafter and correspond to a minimal prevalence of disability.

Chart 27 shows the disability incidence rates at certain ages starting in 2031.

[18] Between 2019 and 2021, an additional 20% to 30% drop in the incidence rate was observed. This significant decrease is likely related to the special conditions resulting from the COVID-19 pandemic. It is therefore not taken into account in the projection, since the effect should be temporary.

Chart 26
Disability incidence rate, by sex – 2031 and after
(per thousand persons)



d) Surviving spouse's pension

The incidence rate for the surviving spouse's pension is obtained by combining:

- the probability of death among the general population; and
- the proportion of persons eligible for the death benefit who were in a couple at the time of their death.

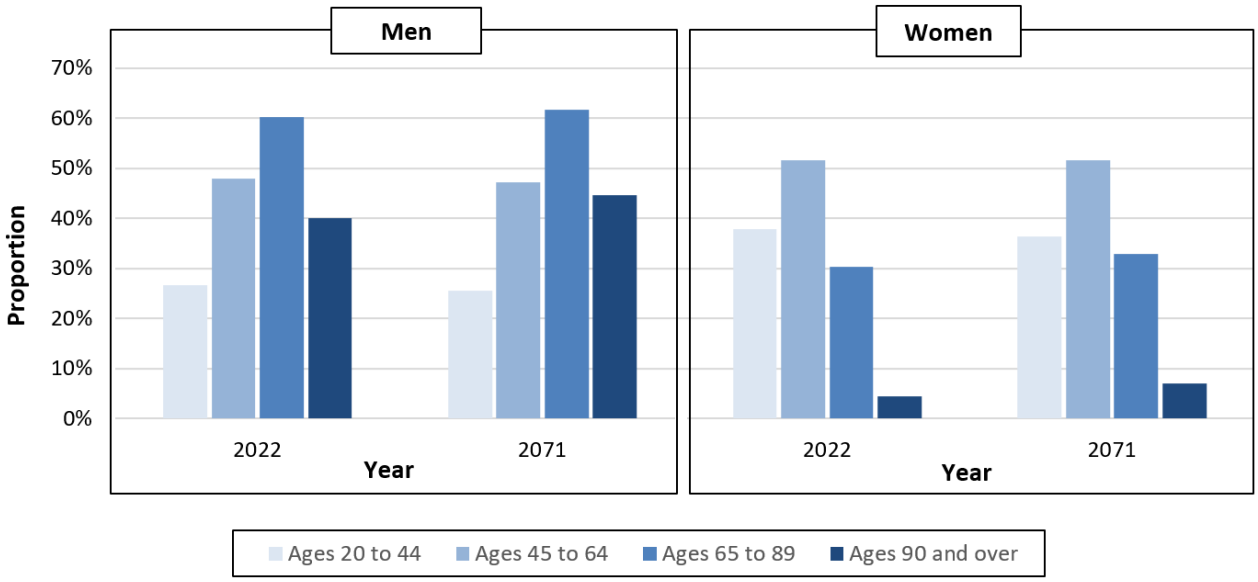
A decline in the proportion of persons in couples[19] has been observed in Québec in recent years. Data on the proportion of contributors in a couple at the time of death were taken from Plan statistics. The period from 2011 to 2020[20] was retained for the purposes of the projection. Furthermore, because of increased life expectancy, this proportion increases slightly over time for persons aged 60 and over.

Chart 28 shows the average proportions by age group for the first and fiftieth years in the projection period. The proportions for the intervening years were determined by interpolation.

[19] In this section, the expression *a person in a couple* means that the person has a recognized spouse as defined under the Plan. That includes both married persons and persons in a de facto relationship (including same-sex couples).

[20] The pandemic and the health measures put in place to address it had a negative effect on the relationship of many couples. Since this effect should be temporary, the year 2021 was not taken into consideration.

Chart 27
Average proportion of contributors in a couple at the time of death, by age group and sex of the deceased – 2022 and 2071



e) Orphan's pension and pension for a disabled contributor's child

The incidence rates for the **orphan's pension** are based on those for the death benefit, to which is added the probability that the deceased had one or more children under age 18. Likewise, the incidence rates for the **pension for a disabledcontributor's child** are based on those for disability, to which is added the probability that the disabled person has one or more children under age 18. Table 37 shows the average number of children under age 18 of the deceased or disabled person, by age and sex.

Table 37
Average number of children under age 18, for every 1000 deceased or disabled persons, by age group and sex – 2022, 2046 and 2071

Age group of the deceased or disabled person	Deceased person[a]						Disabled person[b]					
	Men			Women			Men			Women		
	2022	2046	2071	2022	2046	2071	2022	2046	2071	2022	2046	2071
20 to 24 years	50	30	30	40	30	30	40	30	30	180	130	120
25 to 29 years	190	140	130	320	240	230	150	110	110	480	370	350
30 to 34 years	480	390	380	570	460	440	550	440	430	1000	800	780
35 to 39 years	680	580	560	840	720	700	810	700	670	1200	1030	990
40 to 44 years	750	670	640	730	650	620	910	800	770	960	850	810
45 to 49 years	590	530	500	420	380	360	580	530	500	450	410	390
50 to 54 years	270	250	240	150	150	140	250	240	220	140	140	130
55 to 59 years	90	90	80	30	30	20	80	90	80	30	30	20
60 to 64 years	30	30	30	0	0	0	30	40	30	10	10	10
65 to 69 years	10	10	10	0	0	0	10	10	10	10	20	10

a) Deceased persons taken into consideration are those whose death gives entitlement to a death benefit. The age is the age of the deceased person at the time of death.

b) The age is the age of the disabled person at the start of the disability.

3.2.3 Number of new beneficiaries

a) Retirement pension

Table 38 projects the number of new retirement pension beneficiaries. In the case of the additional plan, the number of new beneficiaries increases as the plan matures. It reaches the level associated with the base plan at the end of the projection period.

Table 38
Projected number of new retirement pension beneficiaries, by sex – Base plan and additional plan

Year	Base plan			Additional plan[a]		
	Men	Women	Total	Men	Women	Total
2022	45 000	45 300	90 300	17 400	18 000	35 400
2023	47 400	47 400	94 800	18 800	19 300	38 100
2024	62 600	63 200	125 800	24 300	24 500	48 900
2025	53 200	52 600	105 900	36 300	34 300	70 600
2026	54 500	53 600	108 100	38 100	36 700	74 700
2027	54 100	53 600	107 700	39 100	37 800	76 900
2028	53 800	53 300	107 100	39 900	38 700	78 600
2029	53 500	53 000	106 500	40 700	39 500	80 200
2030	52 500	51 900	104 400	42 200	40 900	83 200
2031	50 800	50 400	101 200	41 300	40 400	81 800
2036	50 900	50 900	101 800	43 900	43 900	87 800
2041	54 700	55 200	109 900	49 300	49 600	98 900
2046	55 900	56 500	112 400	52 000	52 400	104 400
2051	56 500	57 700	114 200	54 000	54 900	108 900
2056	58 000	59 200	117 200	56 700	57 600	114 200
2061	55 200	56 800	112 000	54 800	56 200	111 000
2066	54 300	56 300	110 500	54 200	56 200	110 400
2071	57 200	59 300	116 500	57 200	59 300	116 500

a) This number excludes beneficiaries who receive the retirement pension supplement only. This situation applies to beneficiaries under the base plan who worked after the creation of the additional plan.

b) Retirement pension supplement

Table 39 shows, for the base plan and the additional plan, the projected number of retirement pension beneficiaries who will receive a new supplement amount. The number increases from 330 600 in 2022 to 421 300 in 2071 for the base plan. This increase reflects the anticipated demographic changes in Québec in the coming decades, as well as the increase in the proportion of retirement pension beneficiaries contributing to the Plan.

Table 39
Projected number of beneficiaries receiving a new retirement pension supplement amount, by sex, 2022, 2046 and 2071 – Base plan and additional plan

Year	Base plan			Additional plan		
	Men	Women	Total	Men	Women	Total
2022	194 500	136 100	330 600	255 600	179 000	434 500
2046	202 500	172 900	375 400	202 500	172 900	375 400
2071	221 400	199 800	421 300	221 400	199 800	421 200

c) Disability pension

Table 40 shows the number of new disability pension beneficiaries. The number of new beneficiaries is relatively stable, but rises slightly because of the increase in the population. In the case of the additional plan, the number of new beneficiaries also increases as the plan matures. It reaches the level associated with the base plan at the end of the projection period.

Table 40
Projected number of new beneficiaries of disability benefits, by sex, 2022, 2046 and 2071 – Base plan and additional plan

Age	Year	Base plan			Additional plan		
		Men	Women	Total	Men	Women	Total
Under 60 years	2022	1900	2200	4000	1500	1800	3300
	2046	1800	2200	4100	1800	2200	4000
	2071	2000	2400	4300	2000	2400	4300
60 to 64 years	2022	1400	1100	2600	600	500	1100
	2046	1300	1100	2400	1200	1000	2300
	2071	1400	1200	2600	1400	1200	2600

d) Death benefit

Table 41 shows the projected number of death benefit beneficiaries, by sex of the deceased. The sharp increase in the number of beneficiaries is due mainly to the aging population.

Table 41
Projected number of death benefit beneficiaries, by sex of the deceased, 2022, 2046 and 2071 – Base plan

Year	Men	Women	Total
2022	35 700	23 600	59 300
2046	52 800	44 300	97 200
2071	56 200	49 000	105 200

e) Surviving spouse's pension

Table 42 shows the projected number of new surviving spouse's pensions. The sharp increase in the number of new beneficiaries under the base plan in the first years of the projection is due to the aging population.

The number of new beneficiaries under the additional plan will not reach the numbers under the base plan as quickly as for other types of benefits because the majority of deaths that give entitlement to a surviving spouse's pension occur among the elderly who have never contributed to the additional plan.

Table 42
Projected number of new beneficiaries of the surviving spouse's pension, by age group and sex, 2022, 2046 and 2071 – Base plan and additional plan

Age	Year	Base plan			Additional plan		
		Men	Women	Total	Men	Women	Total
Under age 65	2022	1300	3700	5000	800	1500	2300
	2046	1000	2800	3900	1000	2500	3500
	2071	1000	2600	3500	1000	2600	3500
65 years and over	2022	4900	15 200	20 100	300	200	500
	2046	7600	24 400	31 900	4600	11 100	15 600
	2071	8500	26 500	35 000	8100	24 700	32 800

f) Orphan's pension and pension for a disabled contributor's child

Table 43 shows the number of new beneficiaries of the orphan's pension and the pension for a disabled contributor's child. These benefits are paid under the base plan only.

Table 43
Projected number of new beneficiaries of the orphan's pension and the pension for a disabled contributor's child, 2022, 2046 and 2071 – Base plan

Year	Orphan's pension	Pension for a disabled contributor's child
2022	1400	1200
2046	1000	1100
2071	900	1100

3.2.4 Average amount of new pensions

New pensions can be made up of a variable amount (retirement pension), a fixed amount (additional amount for disability, orphan's pension, pension for a disabled contributor's child), or the sum of both amounts (disability pension and surviving spouse's pension). As explained in Appendix I, the variable amount is a proportion of the retirement pension amount accrued.

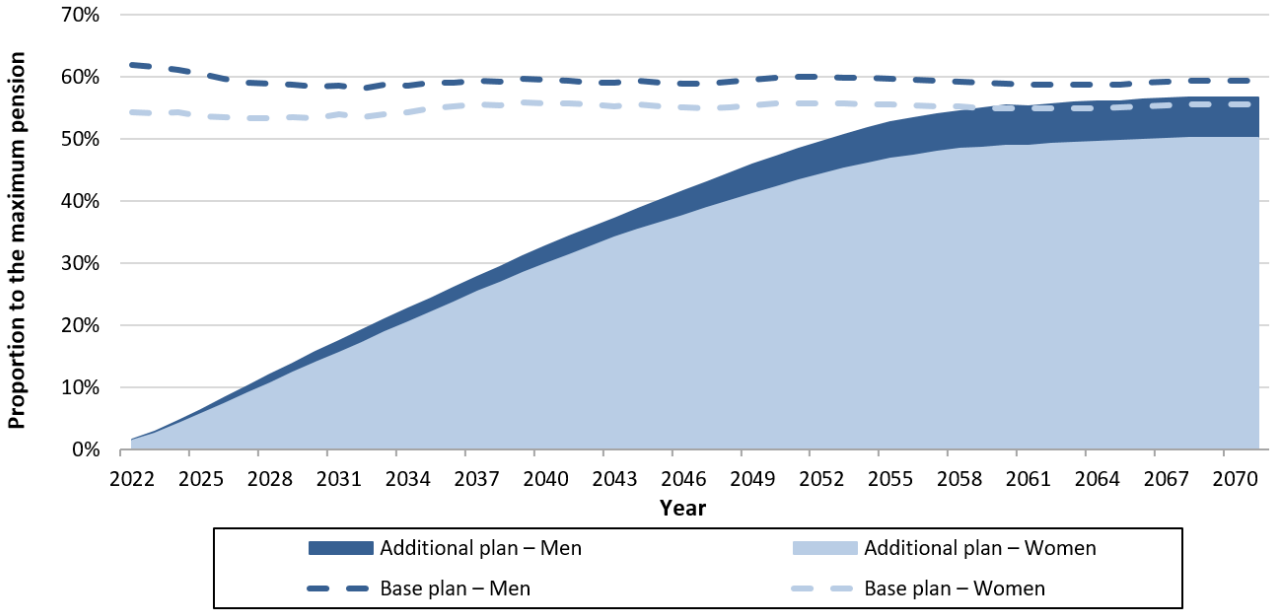
In order to calculate the average variable amount of the pensions in question, the projection model uses the concept of **potential benefit as a percentage of the maximum** to designate the ratio of the average retirement pension of eligible persons to the maximum pension. The model initially calculates a gross potential pension taking into account Plan participation rates, average pensionable earnings, the MPE and the YAMPE. Then, factors are applied to the potential gross pension to take into account the legislative provisions pertaining to the calculation of benefits.

Chart 29 shows the potential retirement pension in proportion to the maximum pension for new beneficiaries age 60.

- Under the base plan, the potential retirement pension in proportion to the maximum pension in 2071 is 59% for men and 56% for women.
- Average pensions paid under the additional plan increase gradually as the plan is implemented.
- The long-term gap between the potential retirement pensions under the additional and base plans is because certain deductions and exclusions apply under the base plan only. The gap is larger among women.

Chart 28

Potential retirement pension in proportion to the maximum pension at age 60, by sex – Base plan and additional plan



a) Retirement pension

Table 44 shows the projected average monthly amount of new retirement pensions. The change in these amounts clearly shows the gradual accumulation of benefits in the additional plan. Given that few years of contributions are possible during the first years following the implementation of the additional plan, the monthly amount of pensions is relatively low. Thereafter, new beneficiaries will contribute for a greater number of years, thus engendering an increase in the monthly pension amount. In the long term, the differences between the average monthly amounts under the base plan and the additional plan can be explained mainly by the different percentages of income replacement between the two plans.

The Plan data show that retirees who receive a larger pension have a greater life expectancy. Thus, within the same cohort, the average pension of beneficiaries has been adjusted upward to account for the fact that the survival probability for beneficiaries receiving a larger pension is higher than for beneficiaries receiving a smaller pension.

Table 44
Projected average monthly amount of new retirement pensions, by sex – Base plan and additional plan

Year	Base plan			Additional plan		
	Men	Women	Total	Men	Women	Total
2022	680	550	620	10	10	10
2023	720	580	650	10	10	10
2024	730	600	670	20	10	20
2025	790	650	720	30	20	20
2026	820	680	750	30	30	30
2027	850	700	770	40	30	40
2028	870	720	800	50	40	50
2029	890	750	820	60	50	60
2030	910	760	840	70	60	70
2031	930	780	860	90	70	80
2036	1050	910	980	160	140	150
2041	1220	1080	1150	260	220	240
2046	1440	1280	1360	390	320	360
2051	1660	1470	1570	530	440	480
2056	1950	1720	1840	700	580	640
2061	2250	1990	2120	870	710	790
2066	2550	2260	2400	1020	840	930
2071	2930	2610	2770	1190	970	1080

b) Benefits other than the retirement pension

Table 45 shows the average monthly amounts for new **retirement pension supplements**, new **disability pensions** and new **surviving spouse's pensions** under each plan. In the long term, the differences between the base plan and the additional plan can be explained mainly by the different percentages of income replacement between the two plans and the fact that fixed-amount benefits are paid under the base plan only.

Table 45
Projected average monthly amount of new retirement pension supplements, new disability pensions and new surviving spouse's pensions, by sex, 2022, 2046 and 2071 – Base plan and additional plan

Benefit	Beneficiary's age	Year	Base plan			Additional plan		
			Men	Women	Total	Men	Women	Total
Retirement pension supplement	All ages	2022	10	8	9	2	2	2
		2046	18	16	17	7	6	7
		2071	37	32	35	14	12	13
Disability pension[a]	All ages	2022	1070	1000	1030	10	10	10
		2046	2010	1890	1950	260	210	240
		2071	3810	3560	3680	680	540	610
Surviving spouse's pension[b]	Under 65 years	2022	740	810	790	10	10	10
		2046	1380	1470	1450	160	190	180
		2071	2500	2670	2630	400	570	520
	65 years and over	2022	140	410	340	10	10	10
		2046	490	690	650	90	110	100
		2071	1140	1290	1250	420	510	490

a) The amounts include both total and flexible disability.

b) The amounts shown take into account the adjustment of the amount of the fixed portion and the fact that pension amounts are recalculated when a beneficiary reaches age 65 or retires.

3.3 Cessation of payment

3.3.1 Mortality rate for retirement pension and surviving spouse's pension beneficiaries

The survival probabilities for **retirement pension beneficiaries** are determined based on the probabilities for the overall population. They are adjusted according to Plan data. Table 46 shows the mortality rates for retirement pension beneficiaries, by age and sex, for 2022, 2046 and 2071.

Payment of the **retirement pension supplement** and the retirement pension stop at the same time. The survival probabilities for retirement pension supplement beneficiaries are the same as those for retirement pension beneficiaries.

The data on the survival of Plan beneficiaries show that the mortality rate for **surviving spouse's pension beneficiaries** is higher than the rate for the overall population. Table 47 shows the mortality rates for surviving spouse's pension beneficiaries, by age and sex, for 2022, 2046 and 2071. Chart 30 shows the life expectancies of retirement pension beneficiaries and surviving spouse's pension beneficiaries. The life expectancy of surviving spouse's pension beneficiaries is lower than that of retirement pension beneficiaries at the beginning of the projection period. After that, the mortality rates for the two types of beneficiaries change at the same pace as the rate for the overall population.

Table 46

Mortality rates for retirement pension beneficiaries, by age and sex, – 2022, 2046 and 2071

(per thousand persons)

Age	Men			Women		
	2022	2046	2071	2022	2046	2071
60 years	6.5	4.6	3.8	3.9	2.8	2.4
65 years	10.6	7.4	5.9	6.8	5.0	4.1
70 years	16.8	12.6	10.9	11.2	8.8	7.8
75 years	27.6	20.6	17.8	18.3	14.8	13.2
80 years	47.5	34.8	29.6	32.4	25.7	22.4
90 years	152.3	113.3	99.9	111.4	84.0	72.6
100 years	352.4	267.7	227.1	317.4	236.6	199.5

Table 47

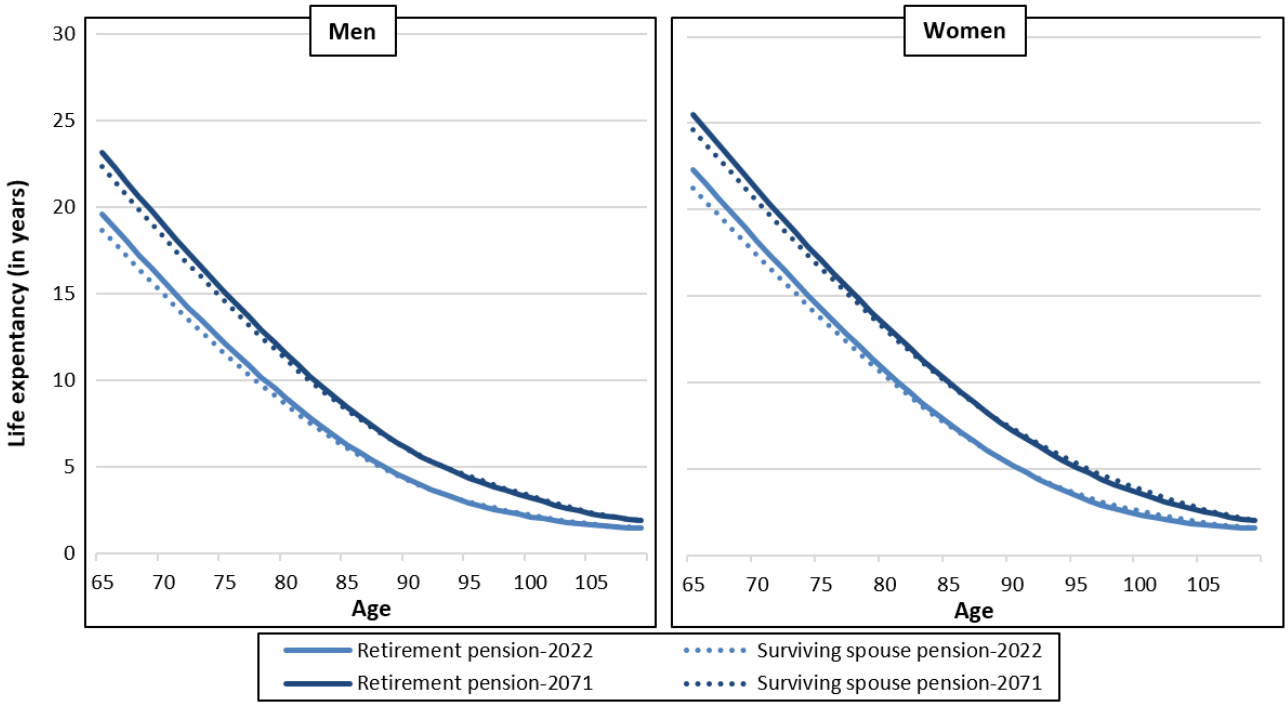
Mortality rates for surviving spouse's pension beneficiaries, by age and sex, – 2022, 2046 and 2071

(per thousand persons)

Age	Men			Women		
	2022	2046	2071	2022	2046	2071
60 years	7.8	5.5	4.6	6.3	4.6	3.9
65 years	12.5	8.7	7.0	9.6	7.0	5.8
70 years	20.0	15.0	13.0	14.8	11.7	10.3
75 years	32.2	24.0	20.7	22.7	18.4	16.4
80 years	54.3	39.8	33.9	37.3	29.6	25.8
90 years	158.0	117.5	103.6	116.2	87.6	75.7
100 years	336.3	255.5	216.7	287.4	214.2	180.7

Chart 29

Life expectancy of surviving spouse's pension beneficiaries, without taking into account the mortality reductions that are projected for the years following the year shown, by age and sex – 2022 and 2071



3.3.2 Cessation rates for disability pensions, orphan's pensions and pensions for a disabled contributor's child

a) Disability pension

The cessation rate for disability pensions depends on the contributor's probability of recovery and probability of death. It is based on Plan statistics for 2000 to 2019 and varies according to the beneficiary's age and sex, as well as the duration of the disability. The eligibility criteria change when the person reaches the age of 60. This is taken into account in the establishment of cessation rates.

Table 48 shows the cessation rate for disability pensions for selected ages.

Table 48

Cessation rate for disability pensions, by age and sex

(per thousand persons)

Sex		Men						Women					
Year		1	2	3	4	5	6 and +	1	2	3	4	5	6 and +
Age when pension begins	30 years	68	66	56	46	36	17	60	72	49	36	39	14
	40 years	99	80	56	34	29	17	82	78	47	32	27	12
	50 years	126	98	58	43	36	24	104	88	52	38	28	16
	60 years	33	30	23	23	21	–	23	20	15	12	9	–

b) Orphan's pension and pension for a disabled contributor's child

The cessation rates for **orphan's pensions** are very low because they correspond to the probabilities of death among beneficiaries, who are under age 18. Therefore, these rates are not shown.

In addition to the probabilities of the beneficiary's death, the cessation rates for **pensions for a disabled contributor's child** take into consideration the probabilities that the contributor no longer receives a disability pension, either because his or her disability has ended, he or she has begun receiving a retirement pension or has died. Given that few deaths occur before age 18, the cessation rates for pensions for a disabled contributor's child are very similar to the cessation rates for disability pensions.

3.4 Projected amounts paid and number of beneficiaries

3.4.1 Amounts paid

Tables 5 and 10 in the main report show the amounts paid under each of the plans for both sexes combined. Table 49 breaks down the amounts paid, **by sex** and plan for the main benefits, i.e. retirement pensions, disability pensions and surviving spouse's pensions. These benefits represent 97% of disbursements under the base plan in 2022.

Table 49
Main benefits projected, by sex – Base plan and additional plan
(in millions of dollars)

Year	Retirement pension				Disability pension				Surviving spouse's pension			
	Men		Women		Men		Women		Men		Women	
	B[a]	A[a]	B	A	B	A	B	A	B	A	B	A
2022	8038	12	6073	7	329	0	348	0	219	0	1578	0
2023	8640	23	6618	15	334	0	357	0	233	0	1662	0
2024	9104	38	7062	25	304	1	330	1	244	0	1713	1
2025	9570	58	7528	39	259	1	290	1	252	1	1745	1
2026	9990	83	7947	56	258	1	291	2	261	1	1780	2
2027	10 426	112	8387	77	256	2	291	2	271	1	1817	3
2028	10 870	146	8837	102	254	3	292	3	282	2	1857	4
2029	11 316	185	9296	132	253	3	293	4	294	3	1900	6
2030	11 760	232	9758	168	254	4	296	4	307	3	1946	8
2031	12 192	286	10 214	210	256	5	300	5	322	4	1998	10
2036	14 327	681	12 566	527	284	10	341	12	412	12	2312	30
2041	16 790	1381	15 309	1118	322	17	392	19	525	27	2710	72
2046	19 874	2519	18 640	2106	358	24	443	29	654	52	3171	149
2051	23 481	4150	22 448	3547	405	33	505	39	797	91	3670	280
2056	27 919	6386	26 983	5534	453	41	567	47	948	148	4172	484
2061	33 178	9196	32 248	8045	505	49	638	57	1113	225	4674	780
2066	38 849	12 355	38 022	10 923	588	59	741	69	1307	326	5258	1186
2071	45 352	15 914	44 761	14 220	687	70	859	81	1537	449	6028	1720

a) In this table, "B" refers to the base plan, and "A" refers to the additional plan.

3.4.2 Number of beneficiaries

Tables 4 and 9 in the main report show the projected number of beneficiaries, by type of benefit, for both sexes combined. Table 50 breaks down the amounts paid, **by sex** and plan for the main benefits, i.e. retirement pensions, disability pensions and surviving spouse's pensions. [21]

Table 50
Projected number of beneficiaries receiving main benefits as at 31 December of a given year, by sex – Base plan and additional plan
(in thousands)

Year	Retirement pension[a, b]				Disability pension[c]				Surviving spouse's pension[a]			
	Men		Women		Men		Women		Men		Women	
	B[d]	A[d, e]	B	A[e]	B	A	B	A	B	A	B	A
2022	966	102	1059	95	27	6	30	6	79	3	306	7
2023	980	120	1078	114	26	7	29	8	81	4	308	8
2024	1009	142	1111	138	26	9	29	10	83	6	310	10
2025	1027	177	1133	171	25	10	28	11	85	7	312	12
2026	1046	213	1155	207	24	11	28	12	87	8	315	15
2027	1063	249	1177	243	24	12	27	13	89	10	318	17
2028	1079	286	1196	279	23	12	26	14	91	11	321	20
2029	1095	323	1215	317	22	13	26	15	93	13	324	23
2030	1108	361	1232	355	22	13	25	15	94	14	328	27
2031	1119	397	1246	392	21	14	25	16	96	16	332	30
2036	1157	573	1298	578	21	16	25	20	103	28	352	54
2041	1190	747	1341	771	21	18	26	23	108	42	372	89
2046	1222	910	1379	959	21	19	26	24	111	58	388	136
2051	1248	1040	1408	1119	21	20	26	25	111	73	397	192
2056	1279	1143	1441	1251	21	21	26	26	111	85	400	249
2061	1306	1216	1470	1346	21	21	26	26	111	95	398	296
2066	1320	1262	1491	1410	21	21	27	27	113	102	399	331
2071	1338	1302	1519	1 466	22	22	28	28	116	108	404	358

a) A person who is receiving both a retirement pension and a surviving spouse's pension is counted in the two corresponding columns of the table.

b) The number given in this table for retirement pension beneficiaries does not take into account that, as of 1 January 1994, the retirement pension can be shared between spouses.

c) The number of disability pension beneficiaries does not take into account the number of beneficiaries receiving the additional amount for disability.

d) In this table, "B" refers to the base plan, and "A" refers to the additional plan.

e) This number excludes beneficiaries who receive the retirement pension supplement only. This situation applies to beneficiaries under the base plan who worked after the creation of the additional plan.

[21] The total number of orphan's pension beneficiaries and beneficiaries of the pension for a disabled contributor's child is calculated only for both sexes combined. Given that the death benefit is a lump-sum payment, the total number of beneficiaries corresponds to the number of new beneficiaries shown in Table 41.

4. Administration costs

Since the base plan and the additional plan have separate accounting, the respective administration costs are debited from each plan's account. For each plan, the administration costs are broken down by category.

Retraite Québec incurs the **internal administration costs** and the **fees charged** by Revenu Québec for collecting contributions. In 2022, the internal administration costs are estimated to be $65 million for the base plan and $40 million for the additional plan, whereas the fees for collecting contributions are estimated to be $10 million for each plan. Thereafter, costs will change according to wage increases and the inflation rate.

A **start-up cost** is added for the additional plan. This includes all fees related to the implementation of the new plan. The fees include the modification of Retraite Québec's and Revenu Québec's computer systems, the initial training of employees and the hiring of new employees. A portion of the start-up cost is entered as a cost for the year during which it is due, whereas the balance is amortized over a period of 10 years. Start-up costs account for $0.7 million in 2022. They reach $1.5 million in 2025, and drop to zero in 2036.

With regard to the base plan, the administration costs represent 0.4% of its cash outflows in 2022 and decrease gradually to 0.2% in 2071. With regard to the additional plan, there are few cash outflows in the short term, and the proportion is therefore less representative during the period. In 2071, the additional plan's administration costs represents 0.7% of its cash outflows.

5. Initial reserves

In conformity with the accrual basis of accounting described in the "Accounting basis" section in Appendix II, the data in the financial statements have been adjusted to obtain the Plan's initial reserves.

Base plan

The 2021 financial statements show net assets totalling $102.9 billion. An amount of $0.1 billion was subtracted for benefits that were payable before 2022 but will be paid after 2021. The base plan's initial reserve is therefore $102.8 billion.

Additional plan

The 2021 financial statements show net assets totalling $3.3 billion. An amount of $0.1 million was subtracted for benefits that were payable before 2022 but will be paid after 2021. The additional plan's initial reserve is therefore $3.3 billion.

Appendix V

Plan funding

1. Introduction

This appendix highlights first and foremost the main differences between the funding of the base plan and that of the additional plan. It then provides additional information on the funding of the Plan as a whole: funding sources for cash outflows, the pay-as-you-go contribution rate and the portion of investment income for funding.

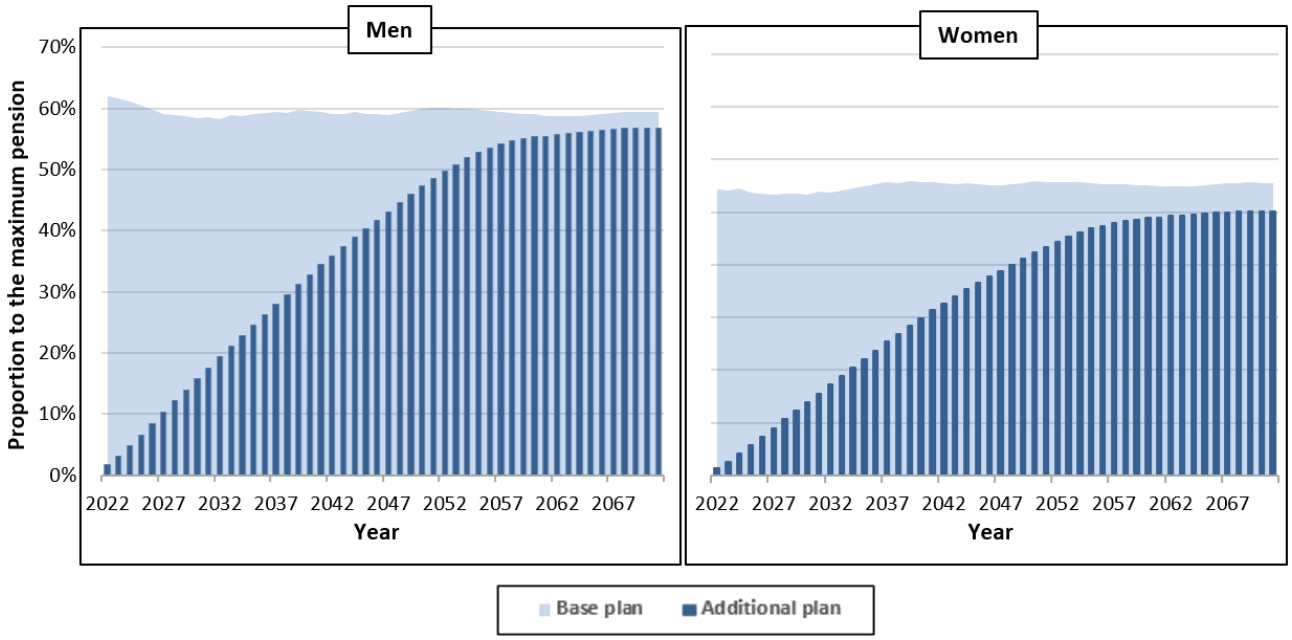
2. Main differences between the funding of the base plan and that of the additional plan

Implementation of the plans and their maturity

The base plan has existed since 1966, whereas the gradual implementation of the additional plan began in 2019. As a result, the base plan is a mature plan compared with the additional plan. Each plan was introduced for different purposes. At the beginning of the 1960s, since the poverty rate among the elderly was very high, the creation of the Plan aimed at remedying the situation quickly. Beneficiaries received full recognition of their rights about 10 years after the implementation of the base plan. The additional plan also aims to improve the income replacement rate in retirement, while ensuring that intergenerational fairness is maintained. This is why the accumulation of benefits will occur gradually over 40 years.

Chart 31 shows the potential retirement pension as a percentage of the maximum for the base plan and the additional plan. The difference between the plans can be explained mainly by the gradual accrual of benefits in the additional plan. The remaining difference at the end of the projection period is due to certain deductions and exclusions that apply under the base plan only. These periods include the years devoted to childcare, which is taken in charge mainly by women. As a result, the difference between the base plan and the additional plan is greater for women than for men.

Chart 30
Potential retirement pension in proportion to the maximum pension, at age 60, by sex – Base plan and additional plan



Funding method

When the base plan was implemented in 1966, the government adopted a partially-funded approach: the plan's funding depended in part on its reserve but also on future contributions. The steady-state contribution rate, which is referred to in Section 4.1.4 of the report, is the rate that ensures that the ratio of the reserve to annual cash outflows remains stable over the long term.

The additional plan's funding depends mainly on its reserve and investment income. The reference contribution rate, which is referred to in Section 4.2.4 of the report, is the rate that makes it possible to accumulate a reserve at least equal to the value of the costs related to contributions paid before the end of the 20th year of projection.

Risk factors

Appendix VI shows that the base plan and the additional plan do not have the same sensitivity to various risk factors. Because of each plan's respective funding method, the base plan is especially sensitive to contributory payroll, whereas the additional plan is especially sensitive to the reserve's rate of return. The diversification of funding sources helps to mitigate Plan risks as a whole, i.e. where the base plan and the additional plan are considered as one.

Automatic funding adjustment mechanism

For each plan, an automatic funding adjustment mechanism is provided for by law. The mechanisms are described in Appendix I.

3. Funding sources for cash outflows

With regard to both the base plan and the additional plan, contributions and investment income are sufficient to fund cash outflows for each of the 50 years in the projection period.

Base plan

Contributions are higher than cash outflows until 2023. During this period, all investment income will be added to the reserve. As of 2024, a portion of the investment income will be used to close the gap between contributions and cash outflows.

Additional plan

Contributions are higher than cash outflows until 2054. During this period, all investment income will be added to the reserve. As of 2055, a portion of the investment income will be used to close the gap between contributions and cash outflows.

Table 51 shows changes in funding sources for cash outflows for each plan. The operating balance is the amount by which contributions exceed cash outflows. A positive operating balance indicates that contributions for a given year are sufficient to pay cash outflows for that same year.

Table 51
Projected funding sources for cash outflows – Base plan and additional plan
(in millions of dollars)

Year	Base plan					Additional plan				
	Cash outflows (1)	Contributions (2)	Operating balance (2) - (1)	Investment income	Portion of investment income used	Cash outflows (1)	Contributions (2)	Operating balance (2) - (1)	Investment income	Portion of investment income used
2022	16 866	17 699	833	0	0%	70	2461	2391	9	0%
2023	18 134	18 176	42	6037	0%	93	3367	3275	408	0%
2024	19 048	18 649	-399	6203	6%	120	3894	3774	614	0%
2025	19 936	19 104	-832	6552	13%	158	4405	4247	876	0%
2026	20 820	19 627	-1193	6907	17%	204	4525	4321	1173	0%
2027	21 747	20 205	-1541	7273	21%	259	4667	4408	1496	0%
2028	22 696	20 847	-1849	7645	24%	323	4817	4494	1848	0%
2029	23 662	21 524	-2138	8026	27%	398	4972	4575	2229	0%
2030	24 635	22 237	-2398	8401	29%	487	5134	4647	2635	0%
2031	25 602	22 984	-2617	8760	30%	590	5304	4714	3061	0%
2036	30 594	27 195	-3399	11 845	29%	1352	6265	4912	5768	0%
2041	36 433	32 159	-4274	14 782	29%	2728	7399	4670	9300	0%
2046	43 556	37 853	-5703	18 369	31%	4989	8695	3706	13 820	0%
2051	51 750	44 439	-7311	22 708	32%	8267	10 207	1940	19 402	0%
2056	61 509	51 850	-9659	27 931	35%	12 787	11 899	-888	26 096	3%
2061	72 847	60 631	-12 216	34 121	36%	18 519	13 913	-4606	33 922	14%
2066	85 286	71 143	-14 143	41 735	34%	25 110	16 312	-8798	43 037	20%
2071	99 783	83 416	-16 367	51 407	32%	32 671	19 107	-13 564	53 709	25%

4. Pay-as-you-go contribution rate

The pay-as-you-go contribution rate is calculated by dividing cash outflows for a given year by the total contributory payroll for that year. It helps illustrate what would be required of contributors to fund cash outflows if there were no reserve and funding were on a pure pay-as-you-go basis. Chart 32 shows, for both the base plan and the additional plan, changes to the pay-as-you-go contribution rate and the contribution rates prescribed by law. For the additional plan, the pay-as-you-go contribution rate is calculated taking into account the fact that the rate for the second component is four times higher than the rate for the first component. For the sake of simplification, for the additional plan, only the rate for the first component is shown.

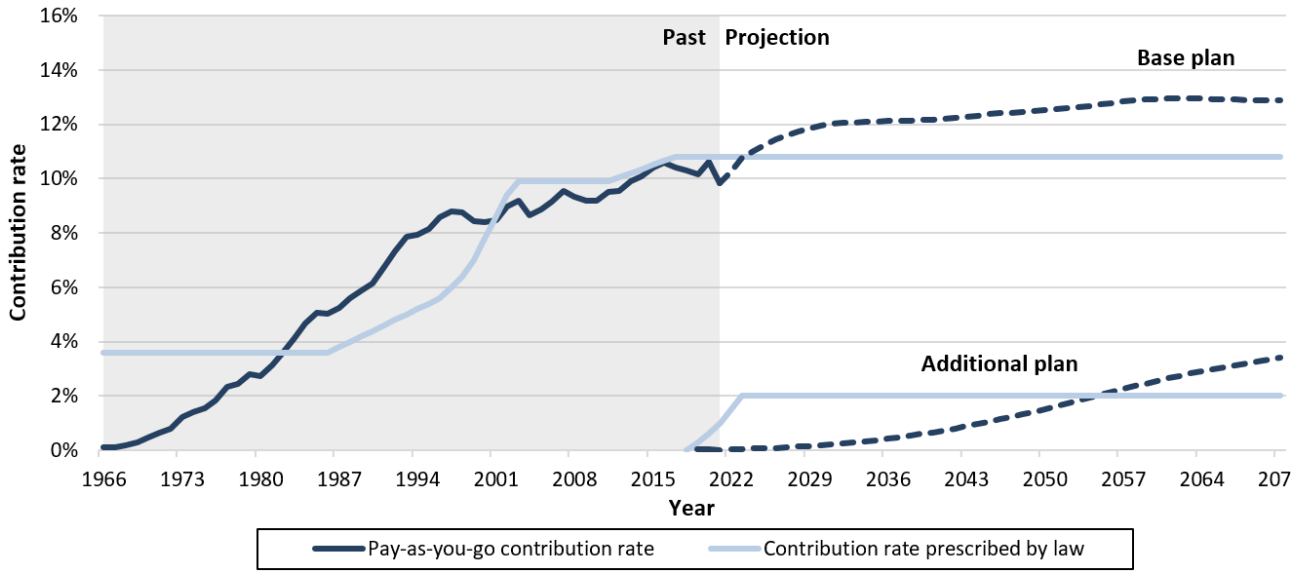
Base plan

The base plan's pay-as-you-go contribution rate increases in the coming decades, from 10.3% in 2022 to 12.9% in 2071. The periods during which the contribution rate prescribed by law is greater than the pay-as-you-go contribution rate, e.g. 2001 to 2023, allow for the accumulation of a reserve with investment income to be used to fund benefits in coming decades. Consequently, the contribution rate necessary to ensure funding of the base plan throughout the projection period is lower than the pay-as-you-go contribution rate thanks to the partial use of investment income generated by the reserve.

Additional plan

Since the additional plan is a new plan, its pay-as-you-go contribution rate is very low in the first years of the plan's existence. The rate increases gradually thereafter and even exceeds the contribution rate prescribed by law. The additional plan's pay-as-you-go contribution rate remains lower than the contribution rate prescribed by law until 2054 because contributions alone suffice to cover all cash outflows. As of 2055, a pay-as-you-go rate higher than the rate prescribed by law means that investment income is used to ensure plan funding.

Chart 31
Pay-as-you-go contribution rate and contribution rate prescribed by law, 1966 to 2071 – Base plan and additional plan



5. Portion of investment income used for funding

Chart 33 shows the projected portion of investment income in the total cash inflows for each plan.

Base plan

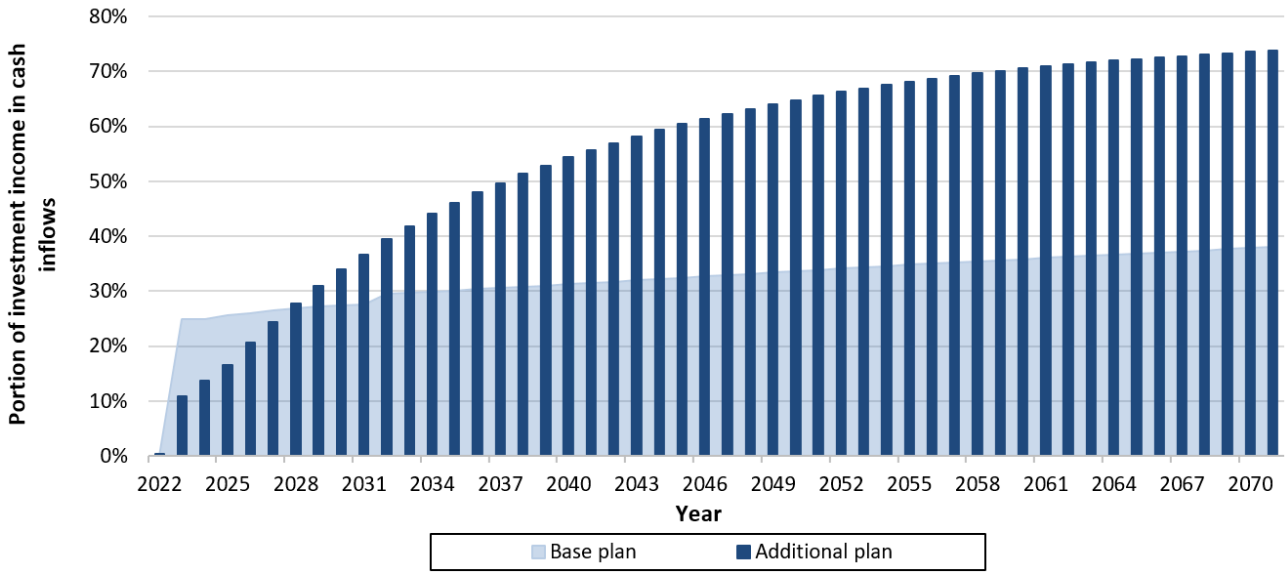
For the base plan, the portion of investment income used for funding increases gradually over the projection period, from 25% in 2023 to 38% in 2071. The increase is nevertheless small compared with the projected increase for the additional plan. The variations in 2023 and 2032 are due to changes in the assumptions for the reserve's rate of return. The higher initial reserve at 31 December 2021 makes it possible to generate more investment income than projected in the last actuarial valuation.

Additional plan

Over the first years of the projection period, the size of the reserve is small, and the portion of investment income is very low compared with the additional plan's contributions. As the reserve grows, the portion of investment income among cash inflows increases until it exceeds 70%. Chart 33 shows that investment income will become the additional plan's main source of cash inflows. The increased use of investment income to fund the additional plan will allow a moderate contribution rate to be maintained.

Chart 32

Projected portion of investment income in cash inflows – Base plan and additional plan



Appendix VI

Risks related to Plan funding and uncertainty of results

1. Introduction

This appendix describes the main risks related to Plan funding and illustrates the inherent uncertainty of the actuarial valuation results. The following two analysis methods were used:

- **Sensitivity analysis** (Section 2), which estimates the impact on results of the changes resulting from an assumption that differs from the one used in the actuarial valuation. The assumptions selected for analysis were modified one at a time in a series of independent tests.
- **Stochastic analysis** (Section 3), which examines the economic assumptions. Random variations were simulated in this analysis, where variables changed jointly. Five thousand scenarios were simulated, providing a more complete picture of the uncertainty of some assumptions.

This appendix also addresses **the difference between the risk sensitivities of the base plan and the additional plan.** Because of their different maturities and methods of funding,[22] the base plan and the additional plan are not exposed to risks in the same way. For example, the base plan's results are more sensitive to fluctuations in the labour market than the additional plan's results.

2. Sensitivity analysis

2.1 Description

For each assumption analyzed, an initial test assessed the impact on results of more favourable[23] variations in the assumption for the Plan than the ones used in the valuation. A second test then measured the effect of less favourable variations. To simplify the presentation, the chart and table on the following page show only the results of the less favourable variations. The results of the favourable tests reach the same levels as those of the corresponding less favourable tests, but have opposite effects.

The changes were selected so as to have a 0.1% effect on the steady-state contribution rate. Thus, the effect on funding is similar for all tests, and the level of the variations in the assumption illustrate the sensitivity of the results to that assumption. The variations used do not necessarily represent the same probabilities of occurrence. Furthermore, since the assumptions were modified one at a time, this is not an integrated scenario. For example, a variation in the average age at which retirement pension payments begin would probably lead to a variation in labour market activity for older workers, which is not reflected here.

2.2 Sensitivity analysis summary

Table 52 shows the sensitivity tests that were carried out, as well as how the variations used affect the funding measures. The differences are shown **in absolute values** with respect to the funding measure. Since the base plan's contribution rate is more than five times greater than the contribution rate for the first component of the additional plan, the absolute value variation entails a different sensitivity for each plan. The results are therefore shown again in Chart 34, but in proportion (**relative value**) to the funding measures.

The following observations have been made from the sensitivity analysis:

- Several assumptions have a significant impact on the base plan's funding.
- The growth in employment earnings has opposite effects on each plan.
- A variation in the real rate of return has a relative effect five times greater on the additional plan's funding measure as on the base plan's funding measure.

[22] Appendix V explains the main differences between the plans' funding methods.
[23] More favourable variations in an assumption result in a decrease in the funding measure.

Table 52

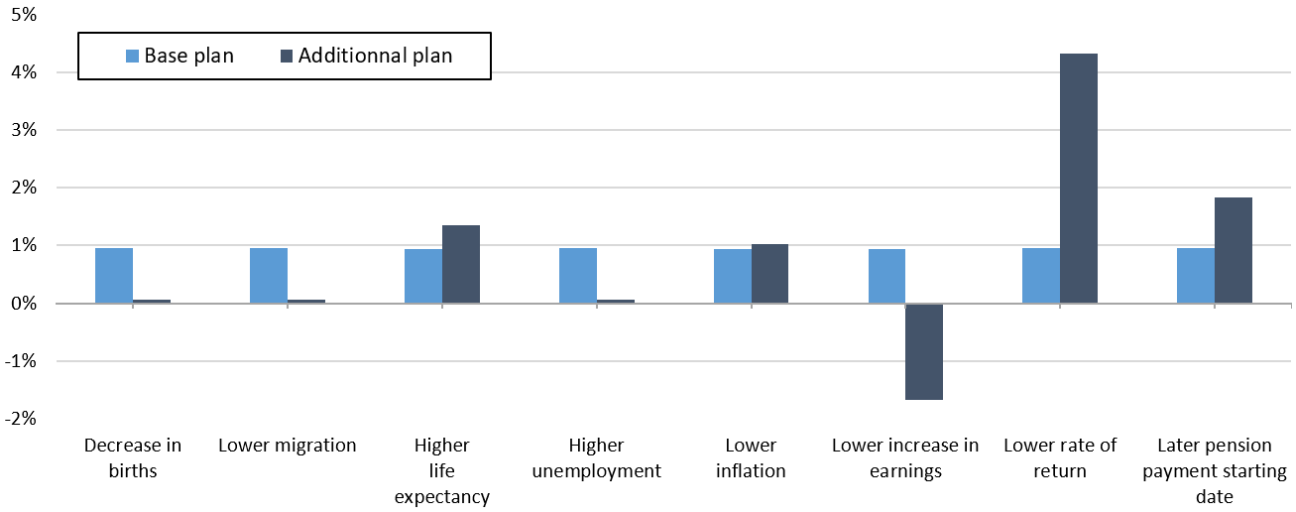
Sensitivity analysis summary

Variation used for the less favourable tests and the effects on the funding measures, in absolute values

Description of the test			Effect on the funding measure		Section of the appendix
	Assumption	Variation	Base plan	Additional plan	
Demographics	1. Total fertility rate	-0.17%	+0.10%	-	2.3.1 *page 136*
	2. Total net migration (as a % of the population)	-0.04%	+0.10%	-	2.3.2 *page 137*
	3. Life expectancy at age 65	+ 6 months	+0.10%	+0.03%	2.3.3 *page 138*
Economy	4. Unemployment rate	+1.8%	+0.10%	-	2.4.1 *page 141*
	5. Inflation rate	-0.3%	+0.10%	+0.02%	2.4.2 *page 142*
	6. Real rate of increase in average employment earnings	-0.1%	+0.10%	-0.03%	2.4.3 *page 143*
	7. Real rate of return	-0.1%	+0.10%	+0.08%	2.4.4 *page 144*
Benefits	8. Average age at which retirement pension payments begin	+ 7 months	+0.10%	+0.03%	2.5.1 *page 146*

Chart 33

Impact of the less favourable sensitivity tests on the funding measures, in relative terms



Notes:

- Under the best estimate scenario, the funding measures are 10.54% in the base plan (steady-state contribution rate) and 1.85% in the additional plan (reference contribution rate).
- For the favourable tests, the results reach the same level, but have opposite effect (not shown).
- Since the assumptions are largely interdependent, the cumulative effect of several changes to the assumptions is not necessarily equal to the sum of each effect on an individual basis.

2.3 Demographic environment

2.3.1 Fertility rate

An increase in the number of births has a favourable effect on the base plan's funding, whereas a decrease in the number of births has an unfavourable effect.

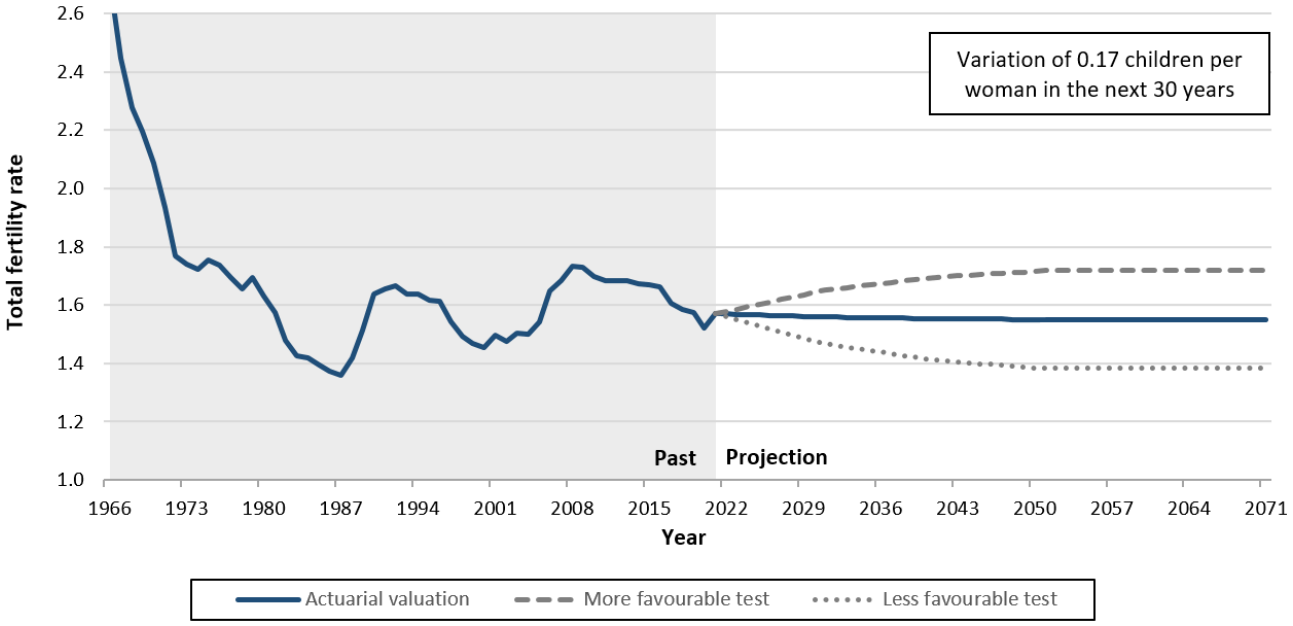
A variation in the total fertility rate and, consequently, in the number of births, would change the number of new Plan contributors around 20 years later. Several decades are required before a variation in fertility has a significant effect on the reserve. Over a very long projection period, the number of offspring produced by a generation will also impact future generations because of the number of women able to bear children.

A variation in the total fertility rate of 0.17 child per woman in the next 30 years would have a 0.10% effect on the steady-state contribution rate. This corresponds to an annual variation of approximately 15 000 births in50 years. The effect of these variations on the additional plan's funding is negligible.

The cumulative effect of the variations in the number of births represents a difference of approximately 200 000 contributors in 50 years, a 4% difference.

Chart 35 places the projection in the actuarial valuation and the variations tested in their historical context.

Chart 34
Total fertility rate and variations used in the sensitivity tests



2.3.2 Migration

An increase in net migration has a favourable effect on the base plan's funding, whereas a decrease in net migration has an unfavourable effect.

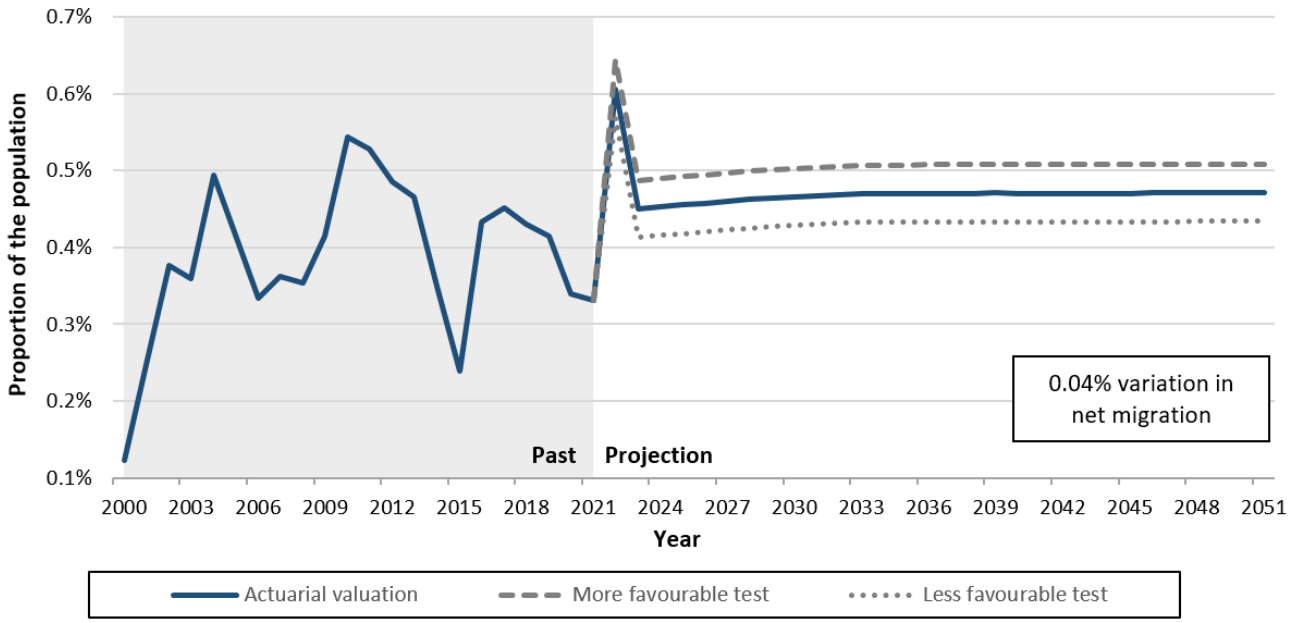
Any variation in net migration changes the number of Plan contributors and, in the long term, the number of beneficiaries. Migration is a determining factor in the projected demographic growth. The number of deaths exceeds the number of births in 2029. From then on, population growth comes from migration only.

A 0.04% variation in total migration in percentage of the population would have a 0.10% effect on the steady-state contribution rate. The tests show population variations of approximately 2000 persons in 2022 and some 250 000 persons in 50 years. The effect of these variations on the additional plan's funding is negligible.

The cumulative effect of the variations in net migration represents a difference of approximately 135 000 contributors in 50 years, an approximate 3% difference.

Chart 36 shows the historical net migration alongside the projection and sensitivity tests.

Chart 35
Total net migration in Québec and variations used in the sensitivity tests
(as a percentage of the population)



2.3.3 Mortality

An increase in life expectancy has an unfavourable effect on the Plan's funding, whereas a decrease in life expectancy has a favourable effect.

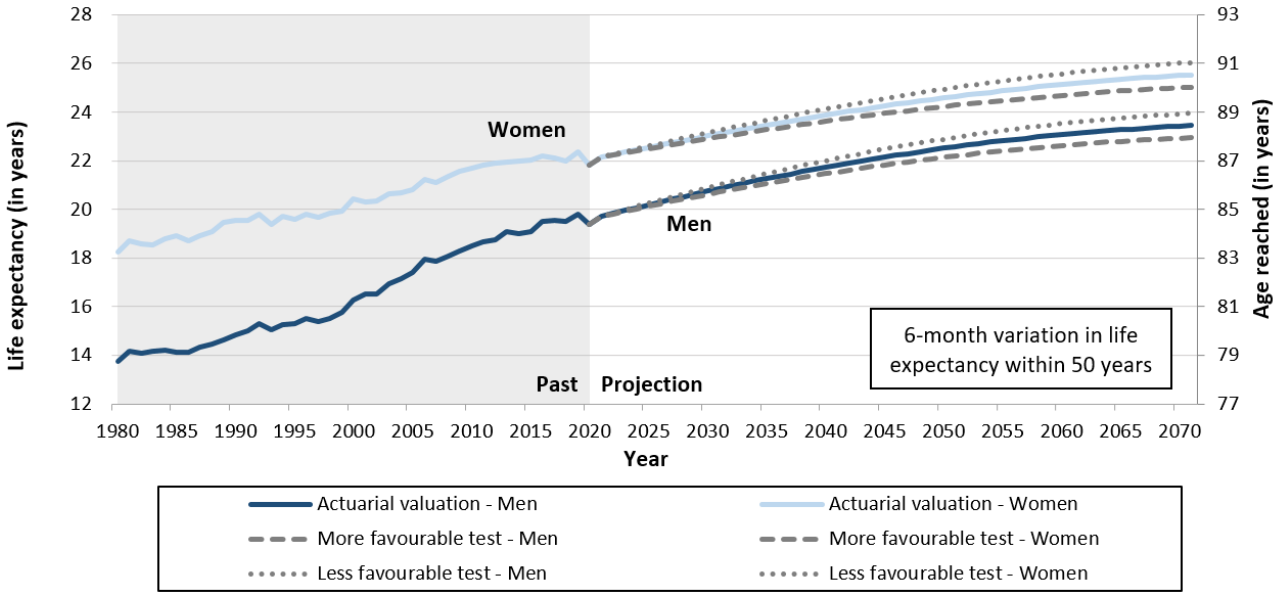
Any increase in life expectancy extends the benefit payment period and, consequently, the total amount of benefits paid is greater.

A six-month variation in life expectancy over the next 50 years would have a 0.10% effect on the steady-state contribution rate and a 0.03% effect on the reference contribution rate. The relative effect on the funding measures is approximately 1.5 times greater for the additional plan than for the base plan. The additional plan's results are more sensitive to the mortality rate than the base plan's results.

The tests carried out show that total benefits under the base plan vary by 1.7% in 50 years; those under the additional plan vary by 1.2%.

Chart 37 places these values in their historical context.

Chart 36
Life expectancy at age 65, excluding reductions in mortality after the year shown, and variations used in the sensitivity tests



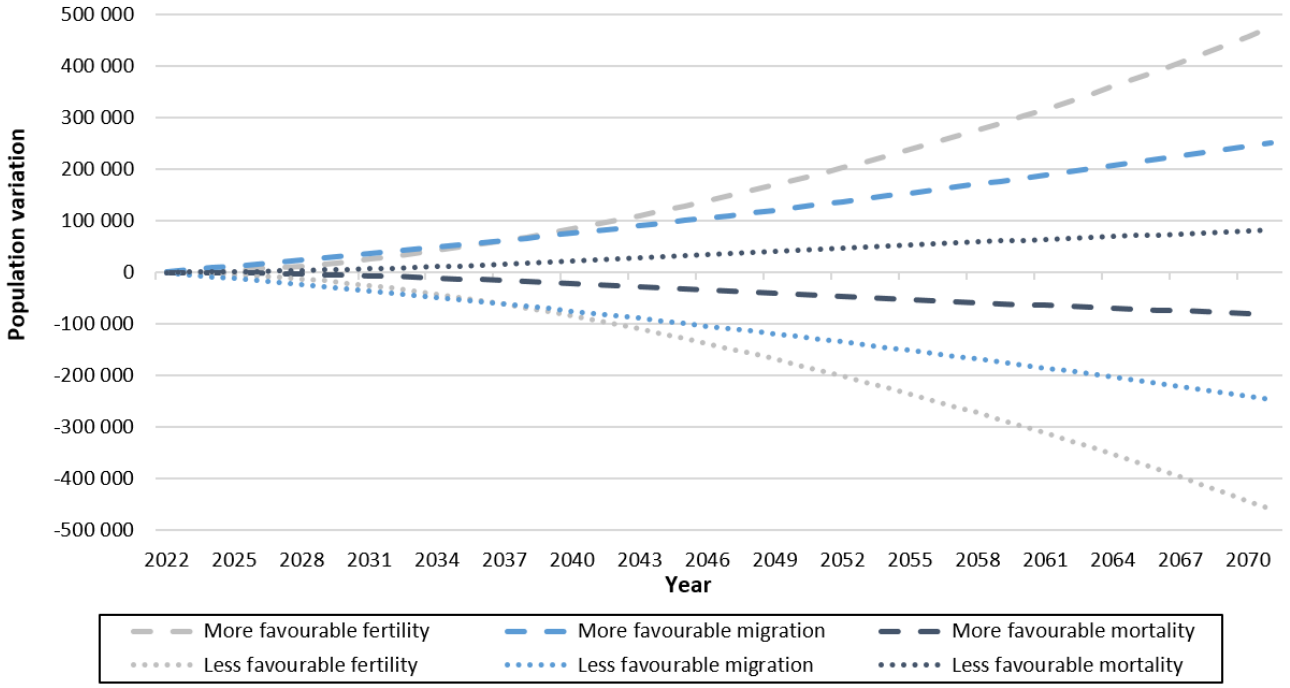
2.3.4 Impact of the demographic sensitivity tests on population projection

This section shows the impact of the demographic sensitivity tests described in sections 2.3.1 to 2.3.3 on population projection and describes the differences observed by age group. Although all three tests have the same effect on the steady-state contribution rate, their incidence on the population projection is different.

a) Projected population

Chart 38 shows the effect of the variations used in the demographic sensitivity tests on the population projection. For a given effect on the steady-state contribution rate, the sensitivity test on the fertility rate has the greatest impact on the projected population (approximately 500 000 persons in 50 years, or 5% of the population). The sensitivity tests on the fertility and migration rates that assume an increase in the projected population, have a favourable effect on the Plan's funding. With regard to the sensitivity test on mortality, this favourable effect was obtained using the test involving a reduction in life expectancy, which generates a decline in the population.

Chart 37
Impact of the demographic sensitivity tests on the projected population of Québec



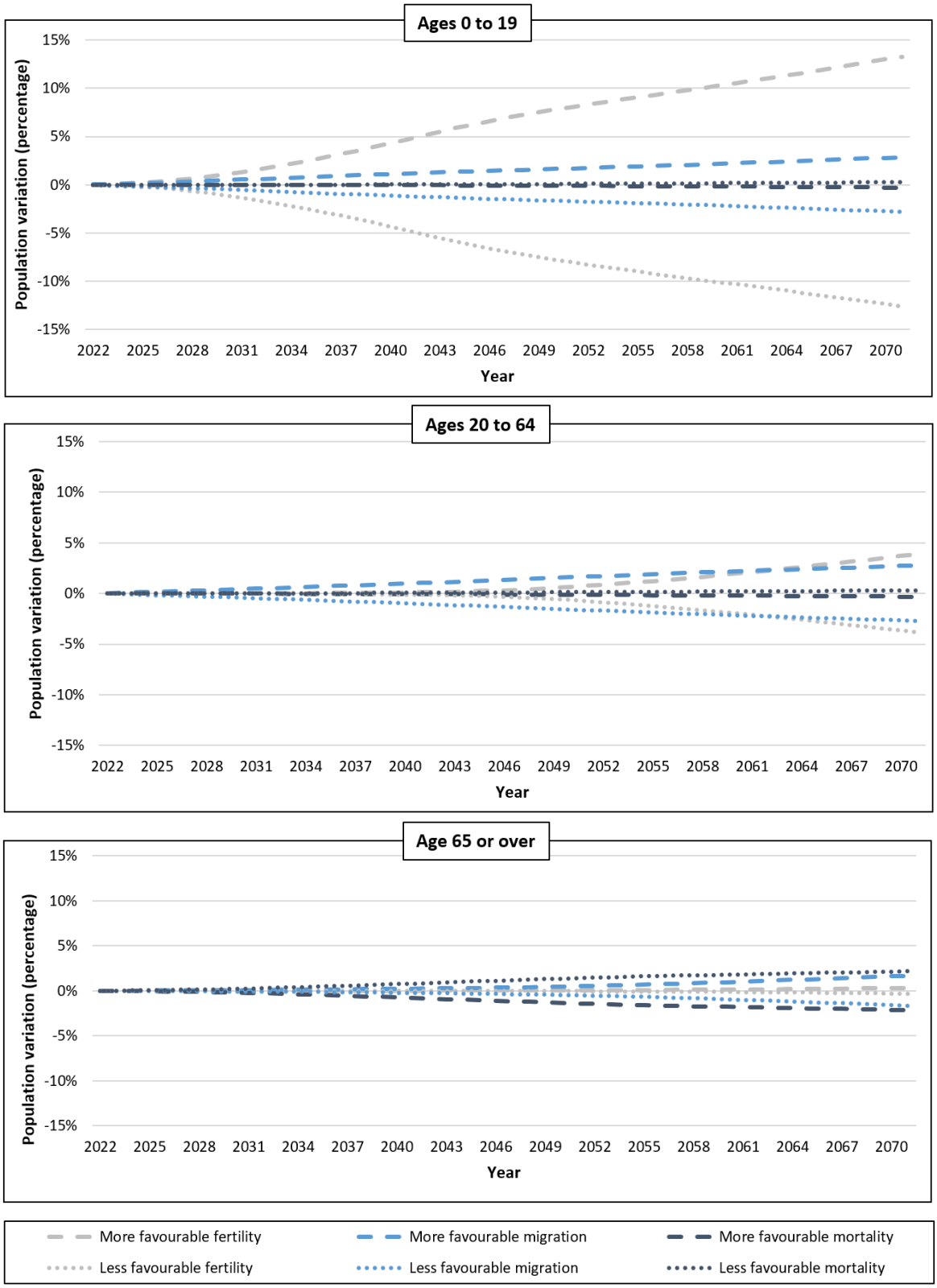
b) Differences by age group

Chart 39 shows the effect of the variations used in the demographic sensitivity tests on the projected population. The effect differs depending on the component of demographic variation and age group.

- **Fertility** is the main determinant in the projected population aged 0 to 19. It also has a major impact on the variation in the number of persons aged 20 to 64, but not as much because it takes time before Quebecers reach this age and enter the workforce.
- **Immigration** has an effect on the population for all age groups. Variations for the 20-64 age group, the largest group of contributors, have the greatest impact on funding.
- **Mortality** mainly affects variations in the population age 65 and over. The effect on funding is caused by the extension or reduction of the pension payment period.

Chart 38

Impact of demographic sensitivity tests on the projected population of Québec, by age group



2.4 Economic environment

2.4.1 Labour market – Unemployment rate

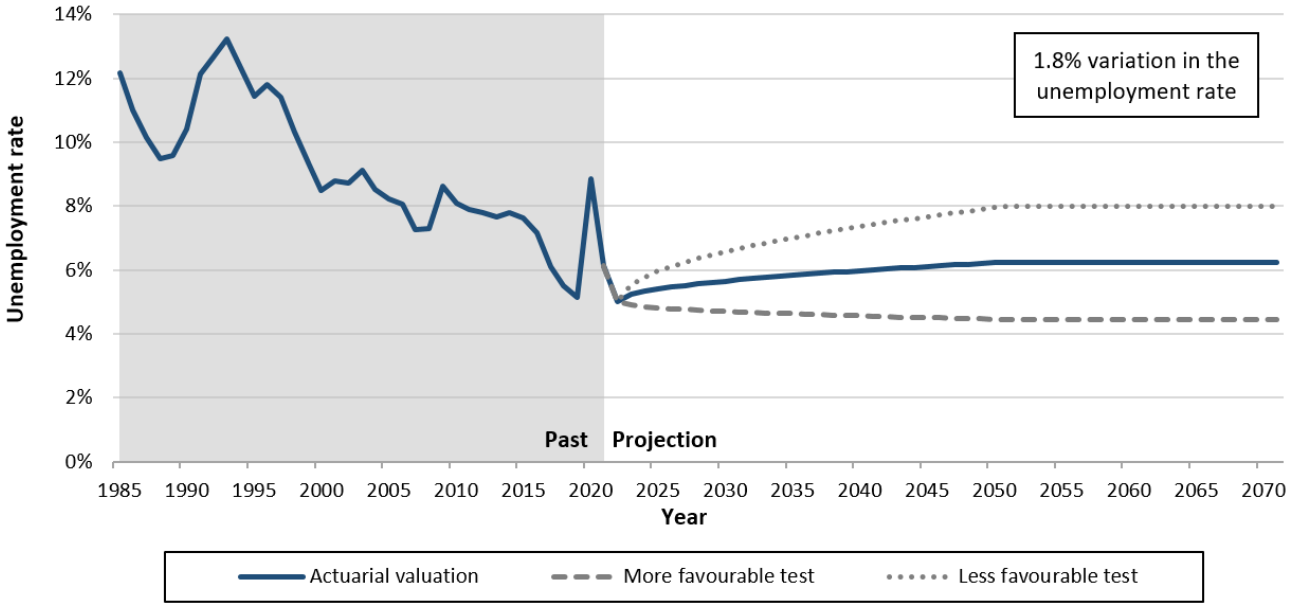
A decrease in the unemployment rate has a favourable effect on the base plan's funding, whereas an increase in the unemployment rate has an unfavourable effect.

Increased unemployment reduces the number of Plan contributors and the amount of benefits payable to such persons when they begin receiving a pension.

A 1.8% variation in the unemployment rate has a 0.10% effect on the steady-state contribution rate. This corresponds to an annual variation in the employed population of 90 000 in 50 years, and a similar variation in the number of contributors. The effect of these variations on the additional plan's funding is negligible.

Chart 40 shows the projection from the actuarial valuation, as well as the scenarios analyzed and compared with historical data.

Chart 39
Unemployment rate and variations used in the sensitivity tests



2.4.2 Inflation rate

A slight increase in inflation (where increases in average earnings and nominal rates of return rise at the same rate) **has a favourable impact on Plan funding.** Where variations in the inflation rate result from economic disturbances, the cost of indexing pensions can become dominant, and the effect on funding can be unfavourable.

An increase in inflation has a direct impact on benefits, contributions and investment income:

- Benefits are higher than in the valuation because of the higher indexation rate.
- Contributions are higher given that inflation adds to the real rate of increase in employment earnings.
- Investment income is also higher given that inflation adds to the reserve's real rate of return.

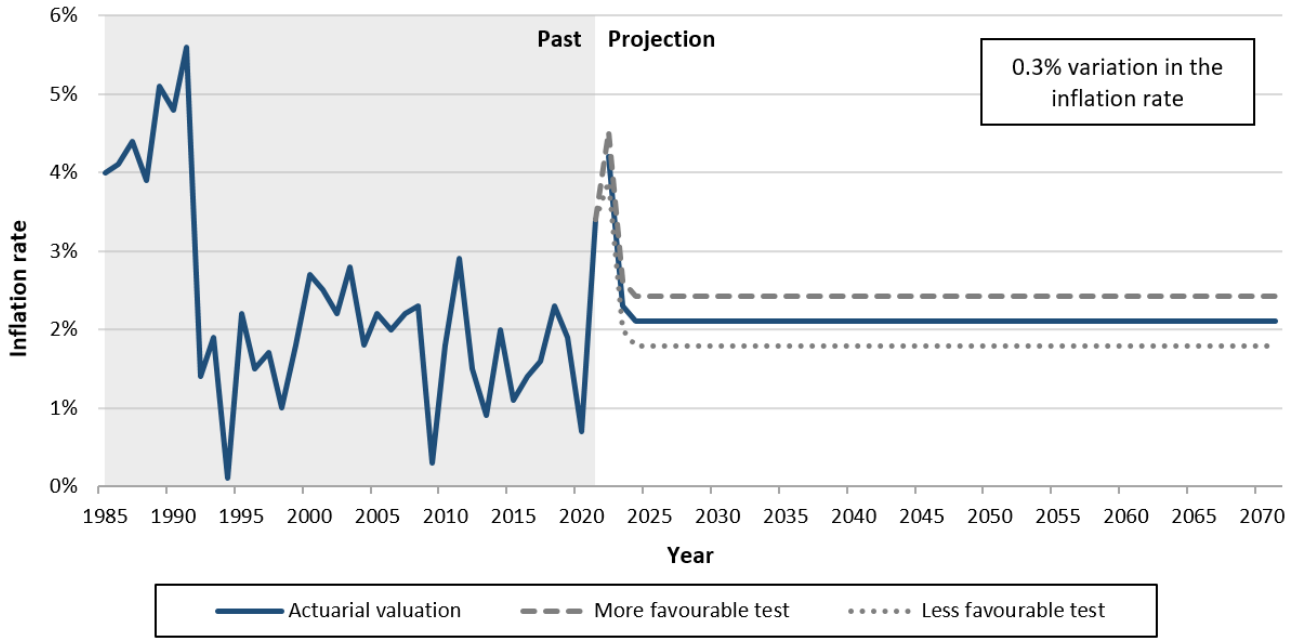
In the sensitivity tests, the combined effect of these factors is an increase in cash inflows (contributions and investment income) that is greater than the increase in cash outflows (benefits and administration costs) and has a net favourable effect for the Plan.

This reasoning is valid where variations in the inflation rate do not produce major economic shocks. In the sensitivity tests for inflation, the assumptions for the real rate of increase in employment earnings and the real rate of return on investments do not change.

A 0.3% variation in the inflation rate has a 0.10% effect on the steady-state contribution rate and a 0.02% effect on the reference contribution rate. The relative variations of the tests, for both the base plan and the additional plan, are 1%. Both plans are exposed similarly to the inflation risk factor.

Chart 41 shows Canadian inflation rates, as well as the inflation assumption and the variations used in the sensitivity tests.

Chart 40
Inflation rate and variations used in the sensitivity tests



2.4.3 Real rate of increase in average employment earnings

An increase in the real rate of increase in average employment earnings assumption is favourable for the base plan, but unfavourable for the additional plan.

A higher real rate of increase in average employment earnings has contrasting effects on plan funding:

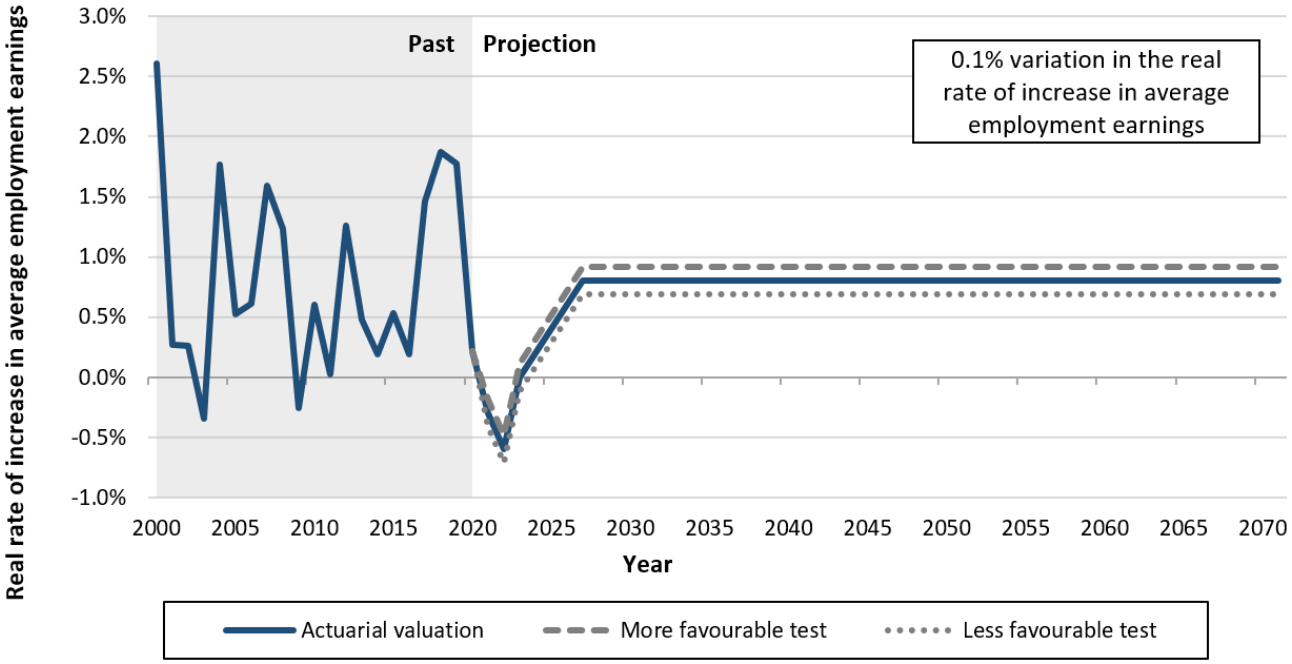
- a favourable effect due to an increase in contributions;
- an unfavourable effect due to an increase in benefits.

The net effect is different for the base plan and the additional plan. Since the base plan's funding depends largely on contributions, the favourable effect on contributions is more significant than the unfavourable effect on benefits. The opposite occurs in the case of the additional plan because it depends more on investment income as a source of funding.

The tests measure the effect on the results of a 0.1% variation in the assumption. The sensitivity tests show that a variation in employment earnings has an opposite effect on the base plan and the additional plan. If the assumption is 0.1% lower, the result is a 1% relative **increase** of the funding measure for the base plan (unfavourable situation) and a relative **decrease** of 2% for the additional plan (favourable situation).

Chart 42 shows the projection and the sensitivity tests in a historical context.

Chart 41
Real rate of increase in average employment earnings and variations used in the sensitivity tests – Base plan



2.4.4 Reserve's real rate of return

An increase in the reserve's real rate of return increases investment income and, as a result, cash inflows. This effect is favourable for Plan funding.

A 0.13% variation in the reserve's real rate of return has a 0.10% effect on the steady-state contribution rate and a 0.08% effect on the reference contribution rate.

The tests result in relative variations of 0.9% in the steady-state contribution rate and 4.3% in the reference contribution rate. Therefore, **a same variation in the real rate of return assumption causes a relative variation five times greater for the additional plan than for the base plan.**

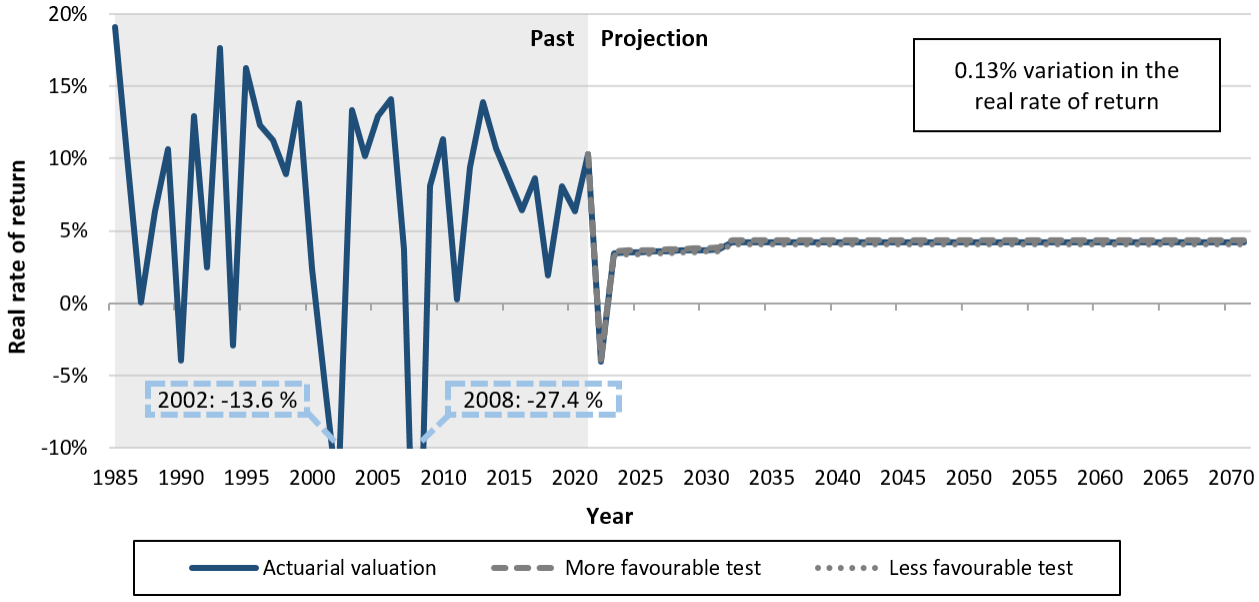
The sensitivity of the valuation results to variations in the reserve's real rate of return is linked to the importance of the reserve in its funding. Investment income makes up a larger part of cash inflows for the additional plan as the plan matures.

- In the short term, the additional plan's results are relatively insensitive to investment income because the additional plan's reserve is small compared with cash inflows from contributions.
- The portion of investment income in cash inflows in the additional plan surpasses that of the base plan in 2028. In the long term, investment income represents more than 70% of the additional plan's cash inflows, whereas it is slightly less than 40% in the case of the base plan.

In the case of the additional plan, a decrease in the rate of return after the 20th year of the projection also increases the reference value, which in turn increases the reference contribution rate.

Chart 43 shows the reserve's real rate of return for the base plan, as well as the assumption in the actuarial valuation and the variations chosen for the sensitivity tests. The sensitivity test curve and the curve representing the assumption in the actuarial valuation overlap on the chart, which shows the sensitivity of the assumption given its historical volatility.

Chart 42
Reserve's real rate of return and variations used in the sensitivity tests – Base plan[a]



a) Asset allocation changed over the period shown.

2.4.5 Effect of funding method on sensitivity to investment income

The larger the portion a pension plan's reserve represents in the plan's funding, the more variations in investment income can influence its financial situation. As a result:

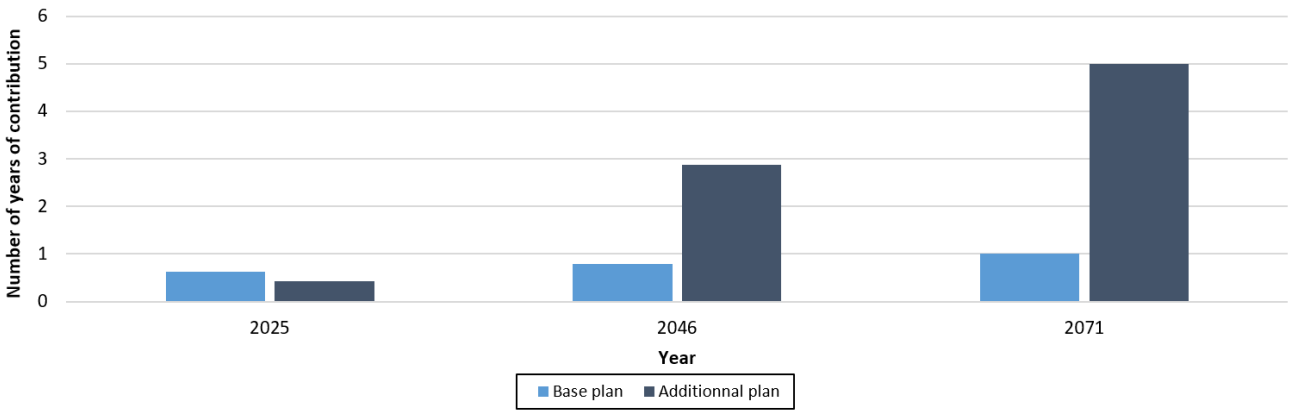
1. The additional plan is more sensitive to investment income than the base plan, because its funding relies more on financial assets.
2. The additional plan's sensitivity to investment income increases as it matures and its reserve grows.

The sensitivity tests show that the additional plan is more sensitive to investment income. Therefore, a same variation in the real rate of return assumption causes a relative variation in the funding measures five times greater for the additional plan than for the base plan. The gap can be explained by the differences between the base plan's funding and that of the additional plan.[24]

Chart 44 shows the differences in the effects caused by the same variation in the reserve at different times. A 10% variation in the reserve is equal to about 0.6 years of contributions to the base plan in 2025, and increases to 1.0 year of contributions in 2071. For the additional plan, the same variation in the reserve is equal to 0.4 years of contributions in 2025 and 5.0 years in 2071.

Thus, a variation in short-term returns has little impact on the additional plan's results, since its reserve is still relatively small. In the long term, a variation in returns will have a considerably larger impact on the additional plan's results, since its reserve will be more in proportion to contributions.

Chart 43
Projected number of years of contribution equal to a 10% variation in the reserve, 2025, 2046 and 2071 – Base plan and additional plan



[24] Appendix V shows the changes in the portion of investment income in the funding of each plan.

2.5 Plan-specific environment

2.5.1 Average age at which retirement pension payments begin

An increase in the average age at which retirement pension payments begin increases Plan disbursements, which is unfavourable in terms of funding. However, greater disbursements mean that retirees will receive a higher pension on average.

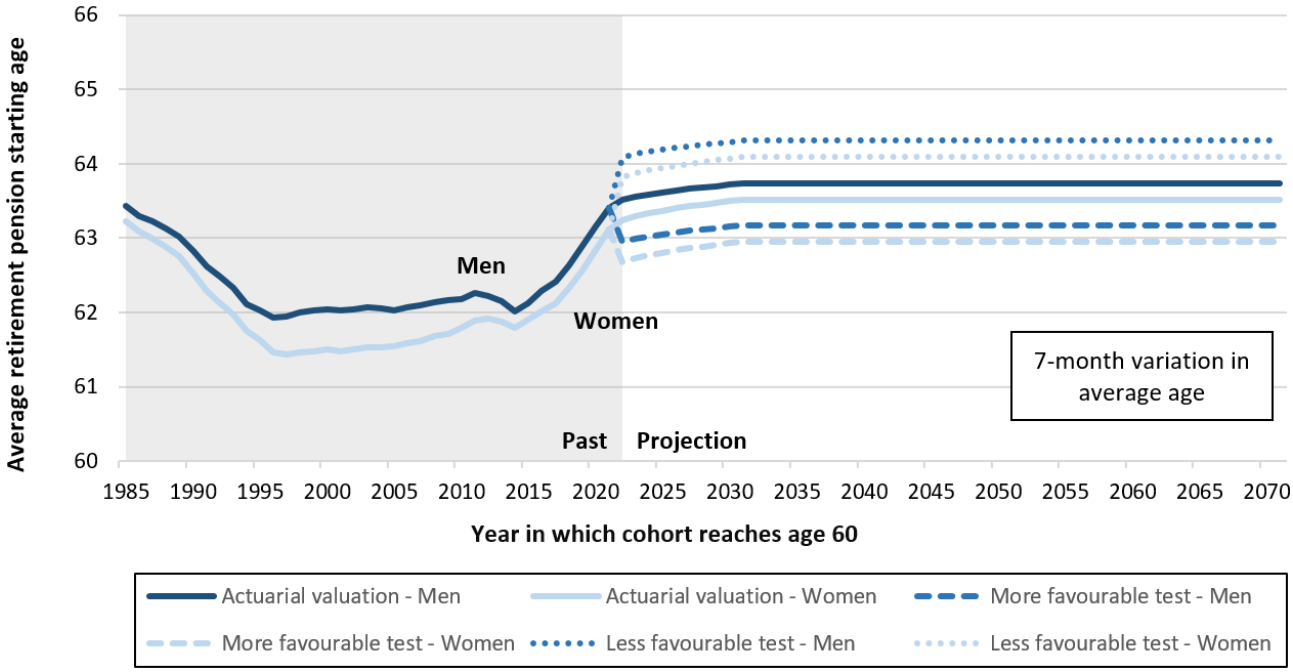
The age at which retirement pension payments begin influences retirement pension levels because of the adjustment factors for early or delayed retirement. When pensions are delayed, the average pensions paid under the Plan increase. However, they are paid out over a shorter period of time. Overall, the effect of the reduction in the average payment period is less than the effect of the increase in the average amount of the retirement pensions. As a result, the total amount paid under the Plan in pension benefits increases when pensions begin later on average.

A seven-month variation in the average age at which retirement pension payments begin has a 0.10% effect on the steady-state contribution rate and a 0.03% effect on the reference contribution rate. The seven-month difference corresponds to a variation of approximately 11% in the retirement rate of 60-year-olds.

In the less favourable scenario, disbursements are smaller in the short term, but larger after about 10 years. The cumulative effect of variations on total benefits accounts for a change of approximately 2.0% in 50 years.

Chart 45 shows changes in the average age at which retirement pension payments begin in recent decades, as well as the valuation's projection and sensitivity tests.

Chart 44
Average age at which retirement pension payments begin, by year in which the cohort reaches age 60, and variations used in the sensitivity tests



3. Stochastic analysis

3.1 Description

The methodology used for the actuarial valuation is **deterministic** and portrays a single scenario. Using an array of simulations, stochastic analysis aims to quantify the risk and probabilities associated with various events surrounding the deterministic scenario. *Stochastic* means that the modelled processes evolve randomly over time.

Whereas sensitivity analysis illustrates the effect of specific variations in the assumptions used in the actuarial valuation, **stochastic analysis provides a more comprehensive range of probabilities associated with a multitude of scenarios**. Stochastic analysis helps to quantify uncertainty by analyzing the various factors as an interrelated whole. It provides an overview of the likelihood of various scenarios and improves understanding of the risks related to Plan funding.

Stochastic analysis focuses on certain economic risk factors. An **economic scenario generator** was developed to generate 5000 plausible scenarios of the Plan's financial situation over the 50-year projection period. These scenarios are used one after the other in the actuarial valuation model. For each plan, contributions, benefits and investment income were calculated using varied scenarios to provide 5000 evolutions of the reserve over the projection period. Appendix II provides greater detail on the methodology used for the stochastic analysis. Appendix III shows the distributions for each economic factor.

3.2 Stochastic projection of the Plan's financial situation

The economic scenario generator makes it possible to simulate, in an integrated manner, the effect of fluctuating economic factors on the Plan's funding measures. The results are obtained by recalculating the steady-state and reference contribution rates every three years, which is the minimal frequency required by law. Between each new calculation, the economic factors are updated for the three previous years. For the purpose of the simulation, the automatic adjustment mechanisms were not applied, which made it possible to better understand the variability inherent in the funding measures.

Chart 46 shows the future distributions of the steady-state and reference contribution rates that result from the stochastic simulations. This process allows for the distribution of the funding measures simulated in the next 20 years. It is therefore possible to evaluate the probability that the contribution rate currently prescribed by law will be adequate at various times over the next 20 years. The main observations are the following:

Base plan

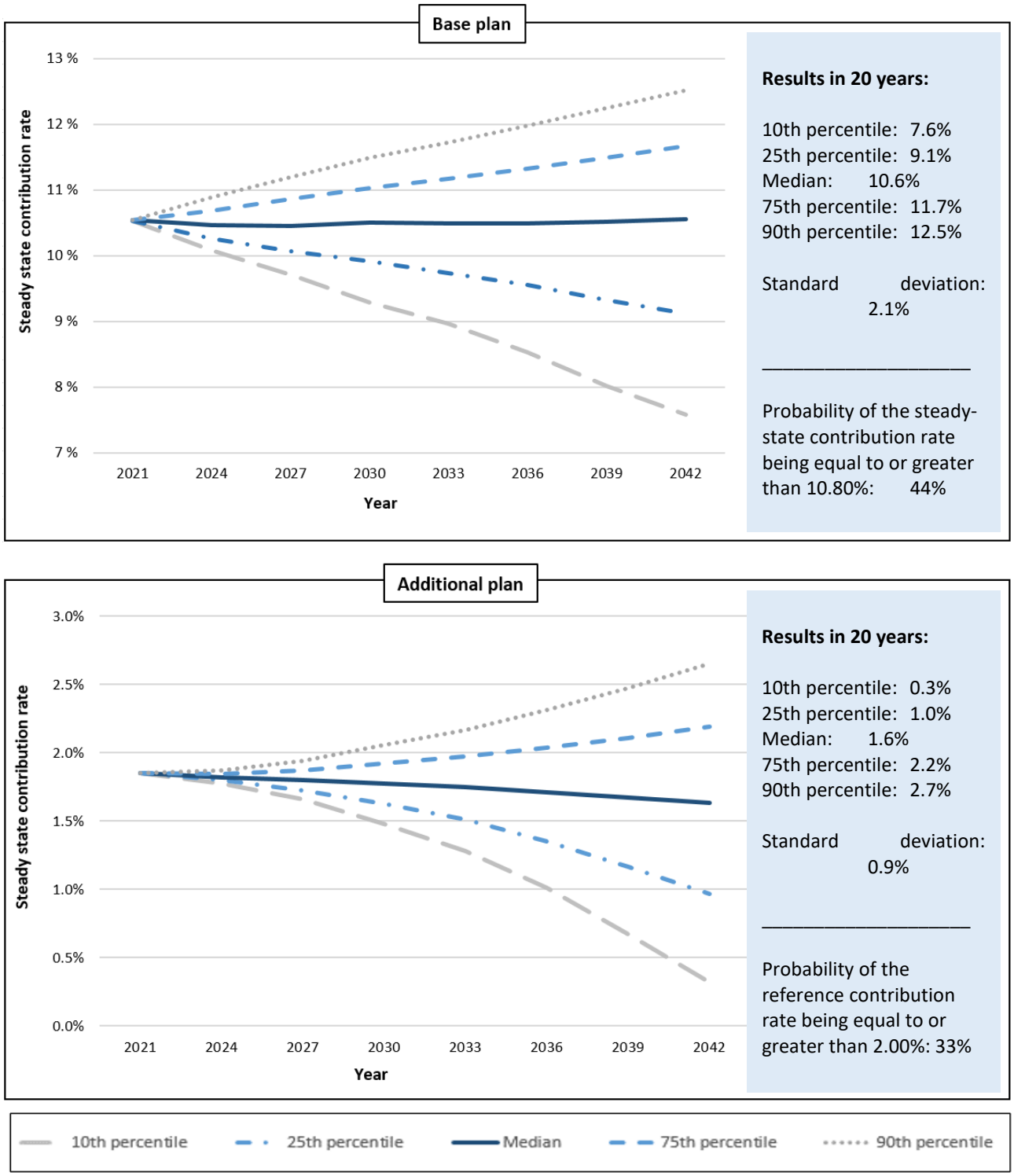
- The median of the simulated steady-state contribution rate for the next 20 years is close to the steady-state contribution rate determined in the actuarial valuation as at 31 December 2021.
- In 10 years, the probability of the steady-state contribution rate being equal to or greater than the 10.80% contribution rate prescribed by law is around 35%. The probability is around 44% in 20 years.

Additional plan

- The median of the simulated reference contribution rate for the next 20 years is slightly lower than the reference contribution rate determined in the actuarial valuation as at 31 December 2021.
- In 10 years, the probability of the reference contribution rate being equal to or greater than the 2.00% contribution rate prescribed by law is around 15%. The probability is around 33% in 20 years.

Chart 45

Stochastic projection: distribution of simulated funding measures – 2021 to 2042



Important: Some scenarios show funding measures that are particularly far from the contribution rates currently prescribed by law. In reality, if these scenarios were to occur, it is likely that the Plan's financial situation would recover before reaching such levels, either through automatic adjustment mechanisms or legislative amendments.

4. Conclusion

The sensitivity and stochastic analyses make it possible to evaluate the effect of different variations in relation to the actuarial valuation's assumptions. A plan's exposure to risk factors is closely linked to its funding method. Because the base plan and the additional plan have different types of funding, their exposure to risk is different.

- **Base plan:** For the base plan, contributions are the main source of cash inflows. As a result, the base plan is especially sensitive to factors influencing contributory payroll, particularly salary growth. It is also sensitive to the reserve's rate of return. Those rates are more volatile than other risk factors. This exposure to both changes in the contributory payroll (human capital) and the rate of return (financial capital) diversifies the base plan's exposure to risk. This diversification makes its funding more robust in the face of economic shocks.
- **Additional plan:** In the case of the additional plan, investment income is the main source of cash inflows. As a result, the additional plan is especially sensitive to the reserve's rate of return. Those rates are more volatile than other risk factors.

Risk diversification where the Plan is considered as a whole

Where the base plan and the additional plan are considered as a whole, the fact that the main sources of cash inflows are different for each plan allows for risk diversification. For example, opposite effects are observed in the results for the base plan and the additional plan for a same variation in the growth of employment earnings. These opposite effects further diversify the risks related to human capital, where the Plan is considered as a whole.

Probability of the funding measures being equal to or greater than the rates prescribed by law

Extrapolations of the sensitivity analysis results show which less favourable variations in the assumptions would cause the funding measure to reach a level equal to the contribution rate prescribed by law. The following variations over a 50-year period are examples of these results:

- **Base plan**: A 0.35% decrease in the average rate of return or a 0.3% decrease in the rate of increase of average employment earnings increases the steady-state contribution rate to 10.80%.
- **Additional plan**: A 0.24% decrease in the average rate of return or a 0.4% increase in the rate of increase of average employment earnings increases the reference contribution rate to 2.00%.

The stochastic analysis also shows that the probability of the funding measure being equal to or greater than the contribution rate prescribed by law is 44% for the base plan and 33% for the additional plan.

Appendix VII

Comparison and reconciliation with the projections in the previous actuarial valuation

1. Introduction

This appendix compares the projections in the actuarial valuation as at 31 December 2018 with the results observed for 2019 to 2021. This exercise was carried out on the population (Section 2) and the financial results (Section 3). It also reconciles the funding measures in the actuarial valuation as at 31 December 2021 with those of the actuarial valuation as at 31 December 2018 (Section 4).

Since the base plan and the additional plan have separate accounting, the financial comparison and the comparison of funding measures were done separately.

2. Comparison of the projected population in the previous valuation with the results for the past three years

The population of Québec as at 1 July 2021 is 68 000 higher than projected, mainly because of the higher number of non-permanent residents (53 000).

Overall, the differences in the other demographic factors are relatively small over the three-year period. However, major variations were observed during the period.

- Since the beginning of the COVID-19 pandemic, Québec has experienced various episodes of excess mortality and lower than expected death rates.
- Net international migration was low because of restrictions at the border. However, the decrease was more than offset by higher than expected net interprovincial migration.

Demographic movements have an impact on the Plan by modifying the number of potential contributors, as well as the number of beneficiaries. Table 53 compares the demographic projections in the previous valuation with the results observed for 2019 to 2021.

Table 53
Population changes in Québec from 1 July 2018 to 1 July 2021
(in thousands)

	Results observed (A)	Projections in the 2018 actuarial valuation (B)	Difference (C) = (A) - (B)	Variation (C) / (B)
Population as at 1 July 2018	**8402**	**8390**	**11**	**0%**
Births	250	254	-4	-1%
Net migration	93	83	10	12%
Number of non-permanent residents	69	17	53	314%
Deaths	209	208	2	1%
Population as at 1 July 2021	**8604**	**8537**	**68**	**1%**

3. Comparison between the projections in the previous valuation and the results for the past three years

3.1 Base plan

The base plan's reserve as at 31 December 2021 was 19% higher than projected, mainly because investment income was $14 billion higher.

The base plan's **cash inflows** were 26% higher than projected, and its **cash outflows** were 2% lower.

The base plan **reserve's growth** between 2019 and 2021 was estimated at $13.4 billion in the previous valuation. It actually grew by $30.1 billion. Thus, the reserve as at 31 December 2021 is already $102.8 billion. This was the projection for 2025.

Table 54 compares the base plan's projected reserve in the previous valuation with the results observed for 2019 to 2021. The various components in the table are then analyzed individually in the sections that follow.

Table 54
Variations in the reserve between 31 December 2018 and 31 December 2021 – Base plan
(in millions of dollars)

	Results observed (A)	Projections in the 2018 actuarial valuation (B)	Difference (C) = (A) - (B)	Variation (C) / (B)
Reserve as at 31 December 2018	**72 666**	**72 741**	**-75**	**0%**
Contributions	49 822	48 258	1564	3%
Investment income[a]	27 215	13 072	14 143	108%
Cash inflows for 2019, 2020 and 2021	**77 037**	**61 330**	**15 707**	**26%**
Benefits	46 700	47 658	-958	-2%
Administration costs	210	262	-52	-20%
Cash outflows for 2019, 2020 and 2021	**46 910**	**47 920**	**-1009**	**-2%**
Reserve as at 31 December 2021	**102 792**	**86 151**	**16 641**	**19%**

a) Investment income includes capital gains.

3.1.1 Initial reserve

In the previous valuation, the base plan's reserve as at 31 December 2018 was estimated to be $72.7 billion. The final result observed was $75 million less than the initial estimate (-0.1%). The contributions due before 31 December 2018 but collected after that date were lower than expected.

3.1.2 Contributions

The contributions collected for the base plan for 2019 to 2021 were $1.6 billion (3%) more than the total projected in the previous valuation.

- This was due to higher than expected employment and wage growth in 2019, which generated more contributions than anticipated.
- In 2020, the employment rate fell as a result of the pandemic, but the jobs retained were on average better paid. In the end, the total amount of contributions was similar to the projection.
- In 2021, the labour market rebounded. Although the number of jobs is still lower than pre-pandemic levels, it is higher than projected in the previous valuation. The economic recovery also generated higher average wages than projected. Thus, the contributions paid in 2021 are higher than projected in the previous valuation.

3.1.3 Investment income

From 2019 to 2021, income from the base plan's investments, net of management fees, was $27.2 billion. The previous actuarial valuation projected investment income of $13.1 billion. As a result, the investment income added to the reserve was $14.1 billion (108%) more than the projected amount.

Table 55 compares the nominal rates of return in the previous valuation with the rates observed for 2019 to 2021. During this period, the annual average rate of return, net of management fees, was 11.1%, almost twice the average rate of 5.6% used in the previous actuarial valuation.

Table 55
Nominal rates of return, net of management fees, for 2019, 2020 and 2021 – Base plan

Year	Results observed	Projections in the 2018 actuarial valuation
2019	10.6%	5.6%
2020	7.2%	5.7%
2021	15.6%	5.7%
Average rate	**11.1%**	**5.6%**

3.1.4 Benefits

In the past three years, the benefits paid under the base plan were $958 million less (-2.0%) than projected. Table 56 shows the variation by benefit type.

- The variation for the **retirement pension** is -$687 million. Between 2019 and 2021, there were 48 200 fewer beneficiaries than projected (-15%). This situation can be explained mainly by the decrease in the number of persons receiving their retirement pension at age 60. Since these persons delay the start of their pension, reductions for early retirement are smaller, and average pension amounts are higher. As a result, an increase in benefits is expected in the coming years.
- The variation for the **disability pension** is -$182 million. The number of new disability pension beneficiaries was lower than expected.
- Pension **indexation** during the period was lower than projected in the previous valuation,[25] which reduces the overall cost of benefits.

[25] The indexation rates in 2019 and 2020 were the same as projected, whereas the rate in 2021 was 1.0% lower (1.0% instead of the projected 2.0%).

Table 56
Benefits in 2019, 2020 and 2021 – Base plan
(in millions of dollars)

	Results observed (A)	Projections in the 2018 actuarial valuation (B)	Difference (C) = (A) - (B)	Variation (C) / (B)
Retirement pension and retirement benefit supplement	38 755	39 442	-687	-2%
Disability pension and additional amount for disability	2166	2348	-182	-8%
Death benefit	403	409	-6	-1%
Surviving spouse's pension	5234	5318	-85	-2%
Orphan's pension and pension for a disabled contributor's child	142	140	2	2%
Total	**46 700**	**47 658**	**-958**	**-2%**

3.1.5 Administration costs

From 2019 to 2021, the base plan's administration costs were $52 million less than expected (-20%), mainly because of their allocation between the base plan and the additional plan.

3.2 Additional plan

The additional plan's reserve as at 31 December 2021 was 13% higher than projected, mainly because investment income was $277 million higher.

The additional plan's **cash inflows** were 13% higher than projected, and its **cash outflows** were 32% higher.

The additional plan **reserve's growth** between 2019 and 2021 was estimated at $2.9 billion in the previous valuation. It actually grew by $3.3 billion. Thus, the reserve as at 31 December 2021 was $3.3 billion.

Table 57 compares the additional plan's projected reserve in the previous valuation with the results observed for 2019 to 2021. The various components in the table are then analyzed individually in the sections that follow.

Table 57
Variations in the reserve between 31 December 2018 and 31 December 2021 – Additional plan
(in millions of dollars)

	Results observed (A)	Projections in the 2018 actuarial valuation (B)	Difference (C) = (A) - (B)	Variation (C) / (B)
Reserve as at 31 December 2018	**-2**	**-2**	**0**	**0%**
Contributions	2984	2858	127	4%
Investment income[a]	447	170	277	163%
Cash inflows for 2019, 2020 and 2021	**3431**	**3027**	**404**	**13%**
Benefits	10	18	-8	-46%
Administration costs	153	105	48	46%
Cash outflows for 2019, 2020 and 2021	**163**	**123**	**40**	**32%**
Reserve as at 31 December 2021	**3267**	**2902**	**364**	**13%**

a) Investment income includes capital gains.

3.2.1 Initial reserve

The additional plan's reserve as at 31 December 2018 was -$2 million, which is the same amount as estimated in the previous valuation.

3.2.2 Contributions

For the same reasons as the base plan, the contributions collected for the additional plan for 2019 to 2021 were $127 million (4%) more than the total projected in the previous valuation.

3.2.3 Investment income

From 2019 to 2021, income from the additional plan's investments was $447 million. The previous actuarial valuation projected investment income of $170 million. As a result, the investment income added to the reserve was $277 million more than the projected amount (163%).

Table 58 compares the nominal rates of return in the previous valuation with the rates observed for 2019 to 2021. During this period, the average annual rate of return was 10.8%, whereas the average rate used in the previous valuation was 5.7%.

Table 58
Nominal rates of return for 2019, 2020 and 2021 – Additional plan

Year	Results observed	Projections in the 2018 actuarial valuation
2019	10.8%	5.6%
2020	7.7%	5.7%
2021	14.1%	5.7%
Average rate	**10.8%**	**5.7%**

3.2.4 Benefits

The $8 million difference between the projected amount and the actual result is due almost entirely to retirement pension benefits. The main reason for this difference is the delayed pension starting date.

3.2.5 Administration costs

From 2019 to 2021, the additional plan's administration costs were $48 million more than expected. The allocation of costs between the base plan and the additional plan is the main reason for this difference.

4. Reconciliation of the funding measures in the valuation as at 31 December 2021 and the previous valuation

The results of this valuation were reconciled with the results of the previous valuation. The reconciliation shows the impact on funding measures of the changes made since the last actuarial valuation (Section 4.1), the results for 2019 to 2021 (Section 4.2) and the updated projections (Section 4.3).

Funding measures

- Base plan: steady-state contribution rate
- Additional plan: reference contribution rate

A favourable (unfavourable) impact on the Plan's projected financial situation leads to a reduction (increase) in the funding measure.

4.1 Changes since the last actuarial valuation

Legislative amendments concerning benefits for disabled persons

The effects of the recent legislative amendments on the projections in the valuation as at 31 December 2018 include a 0.06% increase in the steady-state contribution rate and a 0.01% increase in the reference contribution rate.

Appendix I of this report provides a summary of the changes made. A more complete description of the changes made and their effects on the Plan's funding can be found in the October 2021 actuarial report.

Contribution rate application period

Since the contribution rates prescribed by law were higher than the funding measures, changes to the contribution rate application period generate a 0.02% decrease in the steady-state contribution rate and a 0.01% decrease in the reference contribution rate. The funding measures apply as of the third year of the projection. The year of application, 2021 in the previous valuation, is now 2024, and the higher contribution rates are applied for three additional years.

Methodological improvements

Since 2018, a number of improvements have been made to the projection model to enhance its accuracy. The model improvements resulted in a 0.01% decrease in the steady-state contribution rate and had no effect on the reference contribution rate.

4.2 Results for 2019 to 2021

The Plan's financial situation has improved since the last actuarial valuation. The reserves are higher than projected in the actuarial valuation as at 31 December 2018. This results in a 0.32% and 0.02% decrease in the steady-state and reference contribution rates, respectively.

4.3 Updated projections

The overall impact of the updated projections on the funding measures includes a 0.22% increase for the base plan and a 0.03% increase for the additional plan. The greatest changes are those made to the investment income and average employment earnings projections, as well as the projected age at which retirement pension payments begin.

The results observed in the past three years factor into the development of assumptions. The effect of a modified assumption is attributable to variations in the initial level on the one hand, and the projected path on the other. The tables in the following sections show the main changes to the assumptions that affect the funding measures.

4.3.1 Demographic assumptions

The increase in the number of non-permanent residents and the decrease in the total fertility rate are responsible for the greatest variations. The changes made to the demographic assumptions result in a 0.10% decrease in the steady-state contribution rate and have a negligible effect on the reference contribution rate.

Table 59
Effect on funding measures of changes made to the assumptions used in the actuarial valuation – Demographics

Summary of main changes		Base plan	Additional plan
Fertility	Decrease in the total fertility rate: 1.55 children per woman in the long term rather than 1.65	0.08%	0.00%
Migration	a) Increase in the number of non-permanent residents in order to maintain recently observed levels, but no further growth	-0.11%	0.00%
	b) Increase in net migration: – Lower interprovincial emigration rate – Higher international immigration rate in 2022 due to the measures in the immigration plans aimed at catching up	-0.05%	0.00%
	c) Adjustments to the age distribution	+0.03%	0.00%
Mortality	Adjustments to projected life expectancy: – Lower starting point to reflect the data observed – More rapid growth at the beginning of the projection period – Medium- to long-term levels comparable to those in the previous valuation	-0.05%	0.00%
	Total	**-0.10%**	**0.00%**

4.3.2 Economic assumptions

The decrease in the rates of return and wage increase rates are responsible for the greatest variations. The changes made to the economic assumptions result in a 0.43% increase in the steady-state contribution rate and a 0.04% decrease in the reference contribution rate.

Table 60
Effect on funding measures of changes made to the assumptions used in the actuarial valuation – Economy

Summary of main changes		Base plan	Additional plan
Labour market	Decrease in the activity rate and 0.25% increase in the unemployment rate	+0.07%	-0.01%
Inflation	Increase in the indexation rate at the beginning of the projection period	+0.07%	0.00%
Salaries	Long-term real rate of increase in average employment earnings lower than projected in the previous valuation and short-term reductions due to high inflation	+0.18%	-0.02%
Rate of return	a) Lower expectations with regard to future returns and changes made to the asset allocation assumption	+0.15%	+0.07%
	b) 0.1% higher diversification effect	-0.08%	-0.11%
	c) Higher management fees	+0.04%	+0.03%
	Total	**+0.43%**	**-0.04%**

4.3.3 Benefit assumptions

The increase in the average age at which pension payments begin is responsible for the greatest variation. The changes made to the benefit assumptions result in a 0.11% decrease in the steady-state contribution rate and a 0.07% increase in the reference contribution rate.

Table 61
Effect on funding measures of changes made to the assumptions used in the actuarial valuation – Benefits

Summary of main changes		Base plan	Additional plan
Disability benefits	Decrease in disability incidence rates to take into account recent trends, without undue importance given to the historically low levels in 2020 and 2021	-0.07%	-0.01%
Retirement	a) Later pension start dates and increase in average pensions as a result of the application of the adjustment factor	+0.20%	+0.08%
	b) Reduction in the percentage of persons who apply for a retirement pension among those eligible to apply and adjustment of the average amount of new pensions to better match the data	-0.16%	-0.02%
	c) Other components	-0.02%	0.00%
Survival	Decrease in the number of new surviving spouse's pension beneficiaries due to a decrease in the percentage of couples	-0.06%	+0.02%
	Total	**-0.11%**	**+0.07%**

4.4 Summary of the reconciliation with the previous actuarial valuation

Table 62 shows the results of the reconciliation with the previous actuarial valuation: the steady-state contribution rate has decreased from 10.61% to 10.54%, and the reference contribution rate has increased from 1.84% to 1.85%.

Table 62
Reconciliation of the funding measures with those in the previous actuarial valuation

			Base plan	Additional plan
Funding measures – Valuation as at 31 December 2018			**10.61%**	**1.84%**
1) Changes since the last actuarial valuation				
	Legislation	Modifications to benefits for disabled persons	+0.06%	+0.01%
	Contribution rate	Update to the application period	-0.02%	-0.01%
	Methodology	Various improvements	-0.01%	0.00%
		Subtotal	**+0.03%**	**0.00%**
2) Results for 2019 to 2021				
	Contributions	Average pensionable income	-0.01%	0.00%
	Benefits	Increase in pension starting age	+0.01%	0.00%
	Initial reserve	Higher investment income	-0.32%	-0.02%
		Subtotal	**-0.32%**	**-0.02%**
3) Updated projections				
Demographics	Fertility	Decrease in the total fertility rate	+0.08%	0.00%
Demographics	Migration	Increase in the number of non-permanent residents	-0.13%	0.00%
Demographics	Mortality	Lower initial life expectancy	-0.05%	0.00%
Economy	Labour market	Decrease in the activity rate and increase in the unemployment rate	+0.07%	-0.01%
Economy	Inflation	Increase in the pension indexation rate at the beginning of the projection period	+0.07%	0.00%
Economy	Salaries	Slower growth over the projection period	+0.18%	-0.02%
Economy	Rate of return	Lower expectations regarding future returns, modification of the asset allocation assumption and increase in the diversification effect	+0.11%	-0.01%
Benefits	Disability benefits	Decrease in the disability incidence rate	-0.07%	-0.01%
Benefits	Retirement	Increase in the average age at which pension payments begin and other adjustments to match the data	+0.02%	+0.06%
Benefits	Survival	Decrease in the number of new surviving spouses	-0.06%	+0.02%
		Subtotal	**+0.22%**	**+0.03%**
Funding measures – Valuation as at 31 December 2021			**10.54%**	**1.85%**

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