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The Life Cycle Cost of Canada's F-35 Program – A Fiscal Analysis

OFFICE OF THE PARLIAMENTARY BUDGET OFFICER
BUREAU DU DIRECTEUR PARLEMENTAIRE DU BUDGET

The Parliamentary Budget Officer (PBO) supports Parliament by providing economic and financial analysis for the purposes of raising the quality of parliamentary debate and promoting greater budget transparency and accountability.

This report presents a cost analysis of Canada's F-35 program, including estimates for the Development, Acquisition, Operations and Sustainment, and Disposal phases.

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Highlights

The total estimated cost of Canada's F-35 program is $73.9 billion.

Development phase costs are estimated at $0.2 billion.

Acquisition phase costs are estimated at $19.8 billion.

Operations and Sustainment phase costs are estimated at 53.8 billion.

Disposal phase costs are estimated at $0.2 billion.

Summary

On January 9, 2023, the Government of Canada announced that it had entered into an agreement with the United States Government and industry partners Lockheed Martin and Pratt & Whitney for the acquisition of 88 F-35 fighter jets at a total acquisition cost of $19 billion. Full life cycle costs, including all program costs from initial program development through to disposal of the aircraft at the end of their useful life, were reported to total approximately $70 billion.

Pursuing our commitment to providing independent analysis and transparency on major defence procurement initiatives, this report presents the PBO's own analysis of the full life cycle costs of the F-35 program, with estimates for each of the major life cycle phases: Development, Acquisition, Operations and Sustainment, and Disposal.

Summary Table 1 presents the PBO's independent estimate of the costs of Canada's F-35 program by life cycle phase along with each phase's projected start and end dates. The total cost of the F-35 program is estimated at $73.9 billion. The development phase, which is nearing completion, is estimated at $0.2 billion. The acquisition phase, now underway, is projected to cost $19.8 billion. The operations and sustainment phase is slated to begin in 2025-26 and is estimated at $53.8 billion. Finally, disposal phase activities are expected to begin with the removal from service of the first F-35s at the end of their 30-year useful life in 2055-56 and have an estimated cost of $0.2 billion.

Summary Table 1

F-35 Life Cycle Cost Estimates, by Phase ($ billions)

Phase	Cost	Phase Start	Phase End
Development	0.2	2016-17	2023-24
Acquisition	19.8	2022-23	2034-35
Operations and Sustainment	53.8	2025-26	2061-62
Disposal	0.2	2055-56	2061-62
Total	**73.9**	-	-

Source:
Office of the Parliamentary Budget Officer, Department of National Defence.

Note:
Figures may not sum to total due to rounding.

Introduction

On January 9, 2023, the Government of Canada announced that it had entered into an agreement with the United States Government and industry partners Lockheed Martin and Pratt & Whitney for the acquisition of 88 F-35 fighter jets at a total acquisition cost of $19 billion.[1] Full life cycle costs, including all program costs from initial program development through to disposal of the aircraft at the end of their useful life, were reported to total approximately $70 billion.

Pursuing our commitment to providing independent analysis and transparency on major defence procurement initiatives, this report presents the PBO's own analysis of the full life cycle costs of the F-35 program, with estimates for each of the major life cycle phases: Development, Acquisition, Operations and Sustainment, and Disposal.

Background

The F-35 is a single-seat, single-engine tactical aircraft intended as a multi-use aerial weapons system. There are 3 variants: the F-35A conventional take-off and landing variant, the F-35B short take-off and vertical landing variant, and the F-35C carrier-compatible variant. Canada is procuring the F-35A variant for the Royal Canadian Air Force; as such, all references to the F-35 in this report are in relation to the F-35A.

In 2010, the Government of Canada announced its intent to purchase 65 F-35s with an estimated purchase cost of $9 billion, with maintenance and support costs raising the total program cost to above $18 billion.[2] A subsequent PBO analysis on the proposed procurement, published in 2011, pegged the total program cost at $29.3 billion, including $9.7 billion for the acquisition of the aircraft and $19.6 billion for ongoing sustainment costs.[3]

In 2016, the Government of Canada announced its intention to launch a competition to select a design for a new fleet of 88 fighter jets to replace Canada's legacy CF-18 Hornet fleet. This process culminated in March 2022 with the Government's announcement that Lockheed Martin was the top-ranked bidder for the program.

Life Cycle Phases and Timelines

This report provides a fulsome estimate of the cost of not only procuring the full fleet of 88 F-35s but also the costs of operating them throughout their useful life and their eventual disposal. Costs are divided into four distinct life cycle phases: Development, Acquisition, Operations and Sustainment, and Disposal. A brief description of these phases and the activities associated with them follows.

Life Cycle Phases

Development: all activities leading up to the purchase or construction of a given weapon system, such as options analysis, studies, and research and development.

Acquisition: all activities associated with the purchase or construction of the system and its integration into service and full operational capability.

Operations and Sustainment: all activities relating to the usage, support, and maintenance of the system, including through-life modernization, and, as applicable, mid-life upgrades.

Disposal: activities associated with the withdrawal of the system from service at the end of its useful life.

Projected Timelines

Table 1 displays estimated start and end dates for each of the major life cycle phases of the F-35 program. With the Government of Canada announcing the finalization of an agreement to purchase 88 aircraft from the US Government and its industry partners, Canada's F-35 program is nearing the end of the Development phase of the project life cycle, and early Acquisition phase activities are underway.

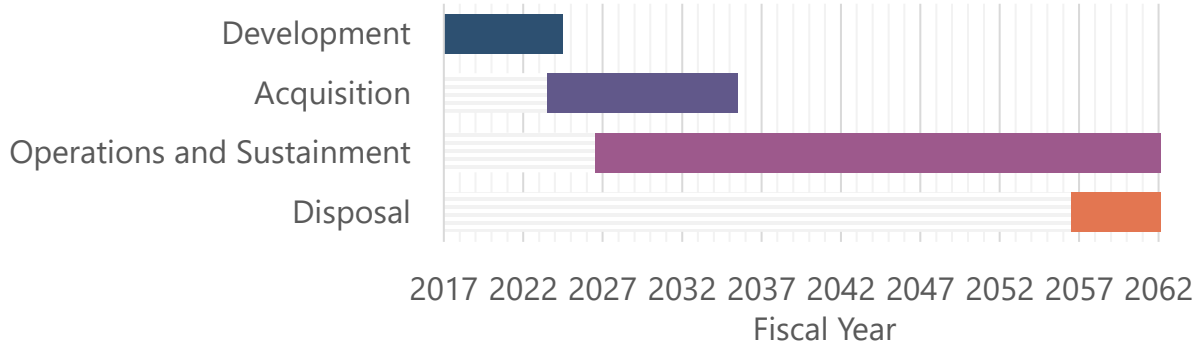
Table 1
Projected Life Cycle Phase Timelines

Phase	Phase Start	Phase End
Development	2016-17	2023-24
Acquisition	2022-23	2034-35
Operations and Sustainment	2025-26	2061-62
Disposal	2055-56	2061-62

Source:
Office of the Parliamentary Budget Officer, Department of National Defence.

Note:
All dates are estimates based on PBO modelling using inputs provided by the Department of National Defence.

Figure 1
Projected Life Cycle Phase Timelines



Textual description:
A graphical depiction of the data presented in Table 1.

Estimates

The PBO estimate of the life cycle cost of Canada's F-35 program is $73.9 billion, inclusive of each of the Development, Acquisition, Operations and Sustainment, and Disposal phases. Table 2 displays a breakdown of the costs according to each life cycle phase in nominal dollars. A description of the data and methodology used to calculate these estimates is provided in Appendix A.

Table 2

F-35 Life Cycle Cost Estimates, by Phase ($ billions)

Phase	Cost
Development	0.2
Acquisition	19.8
Operations and Sustainment	53.8
Disposal	0.2
Total	**73.9**

Source:
Office of the Parliamentary Budget Officer.

Note:
Figures may not sum to total due to rounding.

Development Phase

With the completion of the Development phase set to occur in the current fiscal year (2023-24), the estimate of approximately $0.2 billion mostly reflects known costs. These costs account for project management activities at the Department of National Defence (DND).

Acquisition Phase

The Acquisition phase is currently underway, with expenditures relating to project management and infrastructure costs beginning to be disbursed.[4]

Table 3 presents the estimated delivery profile of the F-35s. The first 4 of the planned 88 aircraft are expected to arrive in 2026, with the annual rate of aircraft delivery increasing to a maximum of 18 per year in 2029. This rate is expected to be sustained until the final 18 aircraft are delivered in 2032.

Table 3
Estimated F-35 Delivery Schedule

Year	Number of Aircraft
2026	4
2027	6
2028	6
2029	18
2030	18
2031	18
2032	18
Cumulative Total	**88**

Source:
Office of the Parliamentary Budget Officer, Department of National Defence.

The estimated cost of the Acquisition phase is $19.8 billion on a risk-adjusted basis. A breakdown of the evaluated cost elements is given in Table 4. The Unit Recurring Flyaway cost[5] for 88 aircraft totals $10.7 billion. The Weapons, Munitions and Initial Spares cost element is estimated at $2.1 billion.

The Other Acquisition Costs category, estimated at $5.9 billion, includes:

- Payments to industry partners for research and design and non-recurring depot costs; and,
- Outlays for domestic acquisition phase cost items such as infrastructure, project management, initial sustainment set-up, initial training, and ancillary tools and equipment.

A total of $1.0 billion is added as an adjustment to account for risks specific to the Acquisition phase. This figure is based on a risk analysis simulating the potential financial impacts on acquisition costs by a set of identified risk elements. The two most impactful risk categories are inflation risk and foreign exchange rate risk; these are supplemented by a set of smaller risk items identified by DND.[6]

Table 4
Acquisition Phase Cost Elements ($ billions)

Cost Element	Cost
Unit Recurring Flyaway	10.7
Weapons, Munitions, and Initial Spares	2.1
Other Acquisition Costs	5.9
Risk Adjustment	1.0
Total	**19.8**

Source:
Office of the Parliamentary Budget Officer.

Note:
Figures may not sum to total due to rounding.

Operations and Sustainment Phase

The operations and sustainment phase is slated to begin in the 2025-26 fiscal year in advance of the delivery of the first F-35 to the Royal Canadian Air Force. The estimated costs are based on an assumed 30-year life span for each individual aircraft with a yearly flying rate of approximately 167

hours each, representing a steady state yearly flying rate of roughly 14,700 hours for the fleet of 88 aircraft.[7]

Table 5 presents the PBO estimates for each cost element associated with the Operations and sustainment phase. Operations costs, which include system manpower, energy, and training munitions and expendables, are estimated at $9.2 billion. Sustainment costs, a category which combines maintenance and sustaining support costs, totals $27.5 billion. Indirect support and infrastructure sustainment costs total $14.8 billion. The Other Operations and Sustainment Costs category, which consists of projected contributions to industry partners for supply chain management activities, totals $2.4 billion.

Table 5
Operations and Sustainment Phase Cost Elements ($ billions)

Cost Element	Cost
Operations	9.2
Sustainment	27.5
Indirect Support & Infrastructure Sustainment	14.8
Other Operations and Sustainment Costs	2.4
Total	**53.8**

Source:
Office of the Parliamentary Budget Officer.

Note:
Figures may not sum to total due to rounding.

Disposal Phase

The disposal phase is projected to begin in the 2055-56 fiscal year, when the 30-year life span of the first-delivered F-35 comes to an end, and terminates in 2061-62 with the retirement and disposal of the last aircraft. The total estimate for this phase is $0.2 billion, which includes costs for the demilitarization, dismantling, and destruction of the fleet of 88 aircraft.

Excluded Costs

Prior to the conclusion of the open competition for the Future Fighter Capability Program, Canada had contributed funds towards the 2006 Joint Strike Fighter Memorandum of Understanding. With contributions during each of the 2010-11 through the 2022-23 fiscal years, these amounts totaled approximately $0.5 billion. These costs are **excluded from the analysis** in order to reflect DND's own costing assumptions and allow for a fair comparison between estimates. Contributions occurring in the 2023-24 fiscal year and later are fully included in the estimates described in this report.

Sensitivity Analysis

A sensitivity analysis to determine the financial impact of a delay in the start of the delivery schedule on the estimated acquisition phase costs of Canada's F-35 program is presented in Table 6. A 1-year delay in the start of deliveries, such that the first set of aircraft would arrive in 2027 and the last set would be delivered in 2033, would have the effect of raising Acquisition phase costs by $0.4 billion. A two-year delay increases acquisition costs by $0.7 billion, while a three-year delay would raise costs by $1.1 billion. Downstream impacts on the Operations and sustainment phase or Disposal phase are not considered.

Table 6

Cost of delay ($ billions)

Length of Delay	Increase in Cost	Total Acquisition Phase Costs
1 year	0.4	20.2
2 years	0.7	20.5
3 years	1.1	20.9

Source:
Office of the Parliamentary Budget Officer.

Note:
Figures may not sum to total due to rounding.

Appendix A: Data and Methodology

This Appendix describes the data and methodology employed in the calculation of the costs associated with each life cycle phase of the F-35 program.

Development phase

Development phase costs are based on historical data provided by DND.

Acquisition phase

The PBO estimates of Acquisition phase costs are primarily based on two sources of data: historical and projected F-35 project costs provided by DND and the US Government's Selected Acquisition Reports (SARs) for the Joint Strike Fighter (F-35) program.[8]

The 2019 F-35 SAR contains detailed projections of funding and quantities for the F-35 program through to the end of production in 2044. The unit recurring flyaway cost is calculated using average real production costs for the years in which the Canadian government is procuring the aircraft and multiplied by their associated quantity. These costs are converted to Canadian dollars and inflated to the corresponding Canadian fiscal year using projections of the USD/CAD exchange rate and consumer price index from the PBO Economic Model.[9]

The constituent cost elements within the Weapons, Ammunition, and Spares and Other Acquisition Costs categories are then classified according to whether they are assessed as being proportional to the independent estimate of the unit recurring flyaway cost and adjusted accordingly.

Operations and Sustainment phase

To calculate costs for the Operations and Sustainment phase, PBO developed a profile of total fleetwide flying hours per year according to the number of aircraft in service through to the end of the fleet's useful life in 2061-62. Estimates of cost per flying hour are obtained from the 2019 F-35 SAR and validated against newer SAR estimates published in 2022. The estimates are then averaged and converted to Canadian dollars using historical USD/CAD exchange rates. Multiplying the fleetwide flying hour profile by the estimated cost per flying hour produces an estimate of variable operations and sustainment costs per year in real terms. These real costs are then inflated accordingly using the abovementioned PBO consumer price index.

Two cost categories, Indirect Support and Infrastructure Sustainment, are jointly calculated using inputs from DND. These are first treated as varying with the number of flying hours per year and calculated in real terms. The real costs are then plotted along the Operations and sustainment phase timeline using a cost distribution calculated from DND's own projected costs for the same categories. The costs are then inflated using the PBO consumer price index.

The Other Operations and Sustainment Costs category cost estimate is based on planned outlays for supply chain management activities and reflect figures provided by DND.

Disposal phase

Disposal phase costs are based on projections provided by DND and are validated against projected F-35 disposal costs present in the SARs.

Notes

[1] Department of National Defence. (January 2023). Accessed September 2023.

[2] CBC, 2010. "Canada to Spend $9B on F-35 Fighter Jets". Accessed September 2023.

[3] Office of the Parliamentary Budget Officer, 2011. "An Estimate of the Fiscal Impact of Canada's Proposed Acquisition of the F-35 Lightning II Joint Strike Fighter". Accessed September 2023.

[4] Infrastructure expenditures reportedly include new facilities to house and service the F-35 jets as well as upgrades to the military's information networks. CTV News, December 20, 2022. "Defence Department gets OK to spend $7 billion on 16 F-35 fighter jets: CP sources". Accessed September 2023.

[5] The Unit Recurring Flyaway cost is a measure of the marginal cost of each completed, flyable aircraft. It generally excludes sunk costs such as design and testing.

[6] The $1.0 billion figure is calculated the difference between the most likely cost, defined as the 50th percentile of the cumulative cost distribution, and the point estimate of total costs unadjusted for risk.

[7] Operations and sustainment phase costs are based on a planning assumption of no attrition, meaning no aircraft are assumed to be lost over the course of the Operations and sustainment phase. This is done in order to match planning assumptions adopted by the Department of National Defence and allow for a fair comparison of life cycle cost estimates.

[8] United States Department of Defense, 2019. F-35 Lightning II Joint Strike Fighter (JSF) Program (F-35). December 2019 Selected Acquisition Report (SAR).

[9] Office of the Parliamentary Budget Officer, 2023. Economic and Fiscal Outlook - October 2023. Accessed October 2023.

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