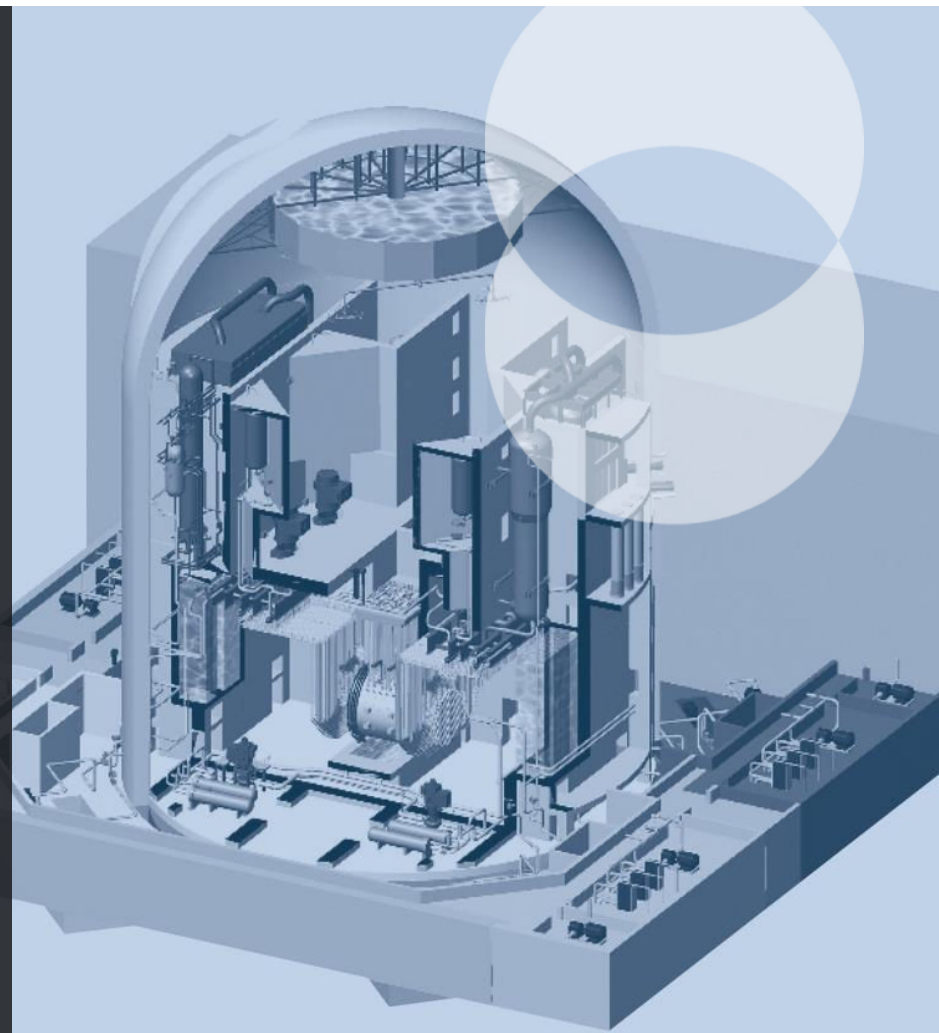


An Economic Impact Assessment of the CANDU[®] MONARK[™] Nuclear Reactor

Presented to AtkinsRéalis

Prepared by The Conference Board of Canada

June 2024



Candu **Monark**

**The Conference
Board of Canada**

Impacts from deploying four CANDU® MONARK™ reactors

- **\$90.4 billion** (2023 dollars) boost to Canadian GDP over the 88-year life of the 4-unit project – \$40.9 billion during construction, and \$49.5 billion during operations.
- Deep integration with Canadian supply chains means that for every dollar spent GDP increases by **\$0.97**. Including profit from the sale of electricity into the wholesale market increases this multiplier to **\$2.00**.
- The four reactors will add **4,000 MW** of power capacity – 22 per cent of Ontario’s new nuclear capacity needed to support the transition to a net-zero economy by 2050.¹
- **33,500 full-time equivalent jobs per year over 9 years** created during the construction of the four reactors. Over the combined design and construction phases of the first deployment **20,260 jobs per year on average** will be created. The power plant will sustain **3,500 full-time equivalent jobs per year** over its 70-plus year operating life.
- **\$29.1 billion** (2023 dollars) in additional tax revenue across municipal, provincial and federal governments over the life of the project.

Key results from deploying CANDU[®] MONARK[™]

Design, construction, and operation phases combined

	Canada-wide
GDP generated (2023\$b)	90.4
GDP Multiplier*	0.97
Employment (per year)**	6,674
Employment ratio (indirect and induce jobs per direct job creation)	1.46
Tax revenue (2023\$b)	29.1

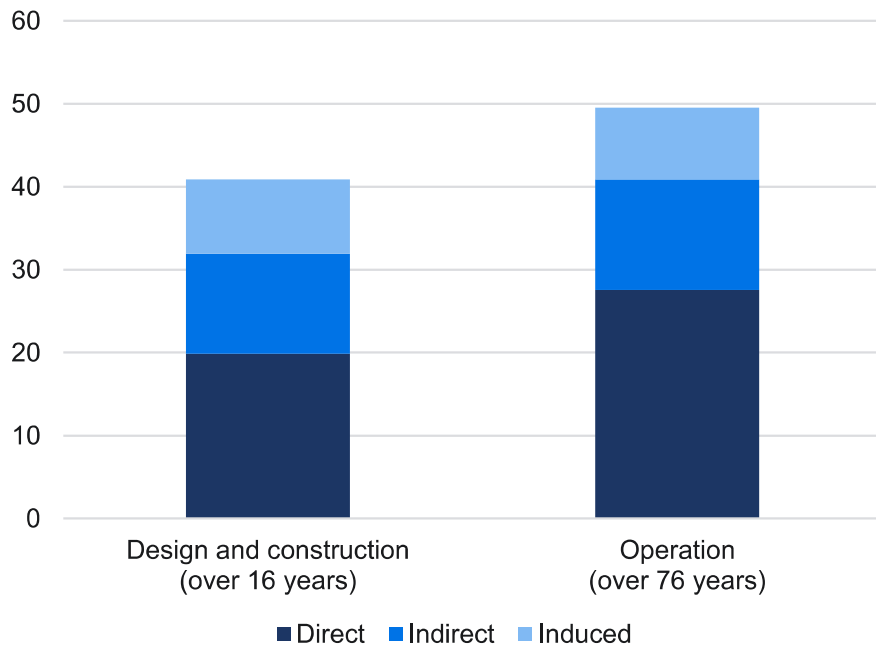
* The GDP multiplier is the ratio between the total GDP impact and total expenditure and captures the net economic impact of project expenditures. It represents the amount of GDP generated resulting from \$1 of spending; any value above zero indicates a net economic benefit. This multiplier does not include any projected return on equity (direct profit) or capital consumption allowances (CCA) from operating the reactors, including profit increases the multiplier to 2.00.

** Average jobs sustained per year over the life of the project. Average employment is higher during the design and construction phase (20,260 per year across Canada) compared with the operation phase (3,500 per year).

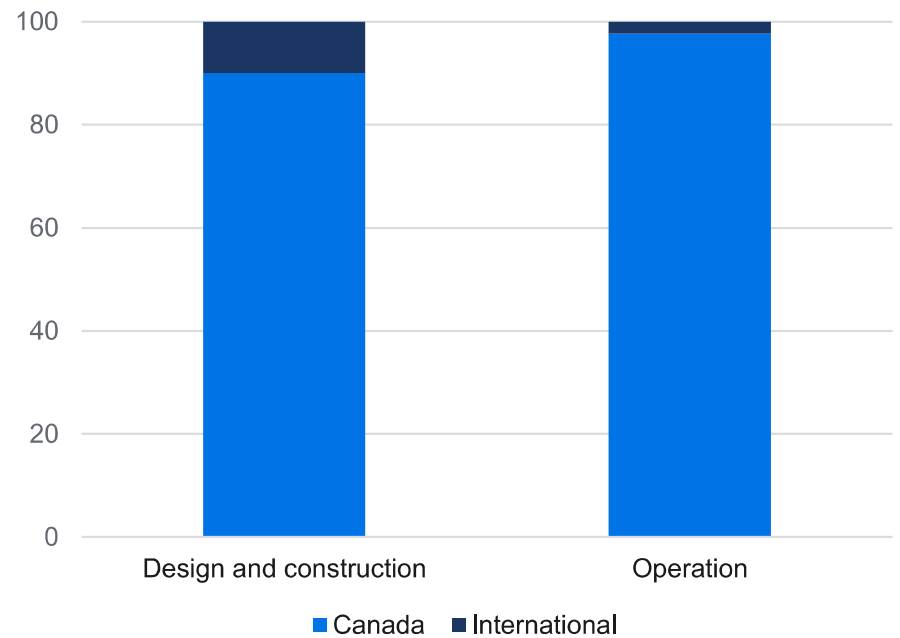
Source: The Conference Board of Canada

CANDU[®] MONARK[™] supports domestic supply chains

Overall GDP impact by phase
(2023\$ billions)

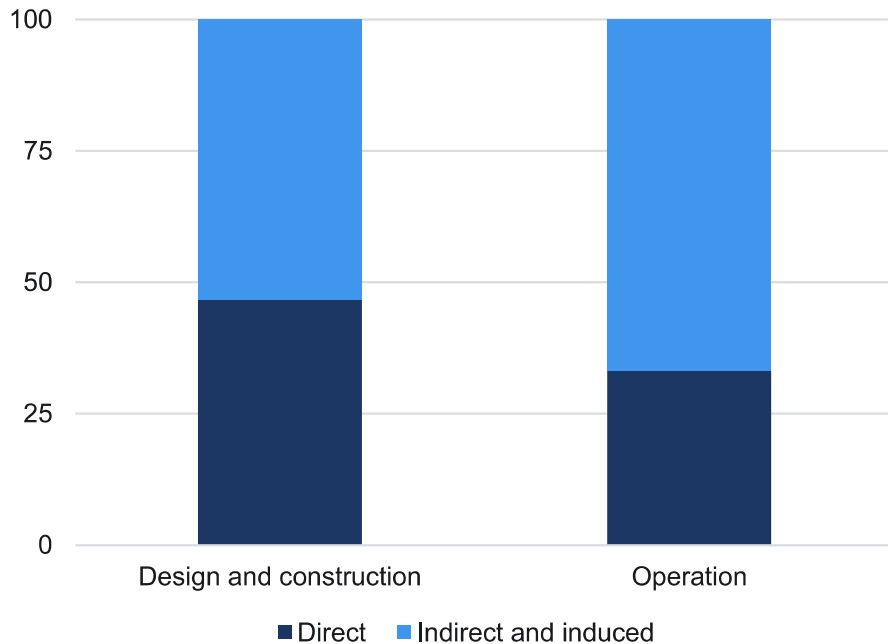


Share of domestic expenditure by phase
(per cent)

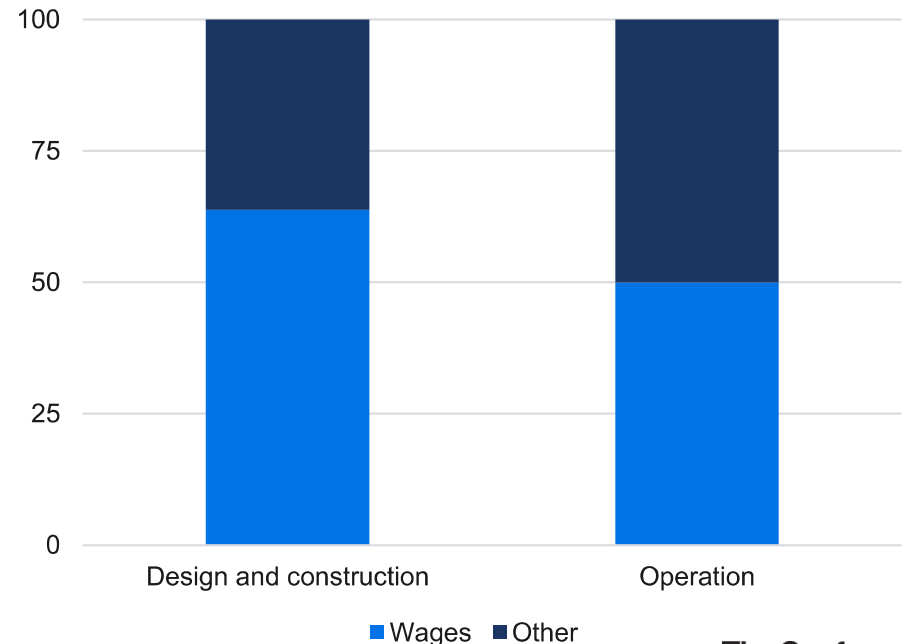


For every direct CANDU[®] MONARK[™] job, another 1.5 are created, supporting wages across Canada

Share of employment impact by channel
(per cent)



Share of GDP accruing to labour
(per cent)



Detailed results

Economic impacts of the design, construction and operation of four 1,000 MW CANDU[®] MONARK[™] reactors in Ontario

Building and operating CANDU[®] MONARK[™] reactors will boost GDP

- Impact on Canadian GDP of designing, constructing and operating a CANDU[®] MONARK[™] reactor in Ontario is expected to be **\$90.4 billion over 88-years.**
- The design and construction phase increases GDP by \$40.9 billion over 16 years, or **\$2.6 billion per year.**
- The operation phase increases GDP by \$49.5 billion over 76 years, or **\$650 million per year.**

GDP impact

(CAD 2023\$b)

	Design and Construction Phases	Operation Phase
Direct	19.9	27.6
Indirect	12.0	13.3
Induced	9.0	8.7
Total	40.9	49.5

The CANDU® MONARK™ will sustain jobs in Canada

- The design and construction phase of the CANDU® MONARK™ sustains **20,300 full-time jobs per year over 16 years**; the operation phase sustains **3,500 full-time jobs per year over 76 years**.
- During the 9-year construction window, the CANDU® MONARK™ will sustain **33,500 jobs per year**.
- The project will create downstream jobs and support local supply chains with **59 per cent of the employment from indirect and induced effects**.

Employment impact

(Full time equivalent jobs per year)

	Design and Construction Phases	Operation Phase
Direct	9,455	1,147
Indirect	5,987	1,342
Induced	4,819	974
Total	20,260	3,462

The CANDU[®] MONARK[™] project will support labour income

- **56 per cent** of the total economic gains of the CANDU[®] MONARK[™] project **will accrue to workers as employment income.**
- **49 per cent** of the wage gains will be earned by those not directly employed in the design, construction or operation of the reactor.
- Those directly employed will earn **average wages of \$91,600** during design and construction, and **\$137,900** through its 70-year operating life.
- Average wage for **all jobs** (direct, indirect and induced) will be **\$80,400** and **\$94,000** during construction and operation, respectively.

Wages impact

(CAD 2023\$b)

	Design and Construction Phases	Operation Phase
Direct	13.9	12.0
Indirect	7.6	8.3
Induced	4.6	4.4
Total	26.1	24.7

The CANDU[®] MONARK[™] project will increase tax revenues

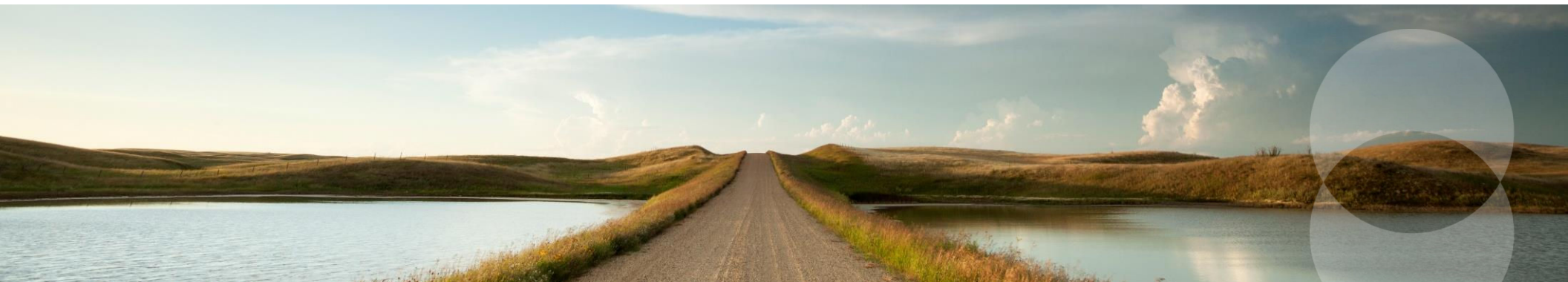
- Designing, constructing and operating a CANDU[®] MONARK[™] reactor is expected to increase tax revenues by **\$29.1 billion** across municipal, provincial and federal governments.
- The design and construction phase will increase total tax revenue by **\$809 million per year**; the operation phase will increase tax revenue by **\$212 million**.

Tax impact (CAD 2023\$b)

	Design and Construction Phases			Operation Phase		
	Municipal	Provincial	Federal	Municipal	Provincial	Federal
Direct	0.6	2.6	3.5	1.2	4.5	3.9
Indirect	0.2	1.3	1.8	0.3	1.4	2.0
Induced	0.5	1.1	1.2	0.5	1.0	1.2
Total, by government	1.4	5.0	6.5	2.1	7.0	7.1
Total	12.9			16.1		

A conservative approach to utility profits

- This analysis does not consider the GDP impact of profits generated from operating the CANDU® MONARK™.
- Including operating profits of the CANDU® MONARK™ would increase the **operational phase GDP impact from \$652 million to \$3.3 billion** per year.
- Including operating profits would increase the **overall GDP multiplier from \$0.97 to \$2.00**.
 - This assumes an electricity price of 10.1 cents per KWh (the Ontario Energy Board estimate for 2023/24).²
 - Assuming a sale price of 20 cents per KWh increases the operational GDP impact to \$6.6 billion per year and the overall GDP multiplier to 2.54 even though electricity output remains the same.
- Consistent with other Conference Board analyses of regulated power utilities, we have excluded profits generated during the operational life of the reactor. This is because regulated utilities are barred from generating profits in a manner consistent with economic impact models.



Other benefits not explicitly modelled

Low-emissions energy to meet increasing electricity demand

- Deploying CANDU® MONARK™ reactors will help meet increasing electricity demand with low-emissions generation, consistent with Canada's Clean Electricity Regulations, Independent Electricity System Operator projections for required nuclear capacity, and broader net-zero objectives.^{1,3}

Natural, unenriched uranium used as fuel

- The CANDU® MONARK™ reactor can operate with domestically available natural unenriched uranium as a fuel source creating energy independence for Canada.

Co-production of medical isotopes

- The CANDU® MONARK™ is the only commercial nuclear reactor that enables the co-production of medical isotopes like cobalt-60 for both the domestic and export markets.^{4,5} Cobalt-60 is produced at scale and for export only in Canada and Russia, and for domestic markets only in Argentina, China and India.⁶ Other medical isotopes produced in CANDU® reactors are used for medical imaging and life-saving cancer treatments.^{7,8}



Results for CANDU[®] MONARK[™] reactors deployed overseas

Leveraging Canadian supply chains

Results for CANDU MONARK reactors deployed overseas

Exporting CANDU[®] MONARK[™] overseas supports the Canadian economy

- Deploying the CANDU[®] MONARK[™] in Canada will **support Canadian domestic** supply chains.
- By leveraging these domestic supply chains, and Canadian intellectual property, each subsequent CANDU[®] MONARK[™] unit deployed overseas is expected to **increase GDP in Canada by \$4.8 billion.**

Economic impact

(per 1,000 MW CANDU[®] MONARK[™] reactor constructed and operated over 80 years)

	Canada
GDP (2023\$b)	4.8
Employment (jobs per year)	459
Wages (2023\$b)	2.9
Tax (2023\$b)	1.6

Methodology

Economic impact assessment scope

This economic impact assessment estimates the direct, indirect and induced economic and fiscal impacts for two scenarios:

- 1. Ontario-based CANDU[®] MONARK[™] deployment.** This considers the impact of the design, construction and operation of a facility consisting of four CANDU[®] MONARK[™] 1,000 MW nuclear reactors in Ontario.
- 2. Export and overseas CANDU[®] MONARK[™] deployment.** This considers the economic impact in Canada for each additional CANDU[®] MONARK[™] reactor deployed overseas that leverages Canadian supply chains where applicable.

Modelling approach

- The expected economic and fiscal impact analysis was conducted with The Conference Board of Canada's Economic Impact Assessment (EIA) model, which provides disaggregated economic effects at the industry and provincial level. Data from Statistics Canada is used to inform and construct the model.
- Cost estimates for the design, construction, and operation of the CANDU® MONARK™ were provided by AtkinsRéalis at the 2- and 3-digit cost of accounts level and translated into 28 industry codes which correspond with the EIA model structure.
- Two iterations of the EIA were run – one for the design & construction phase and one for the operation phase of the reactor. All values are in 2023 Canadian dollars unless otherwise stated. All investment and spending data were converted using the GDP price index.
- Using a conservative impact estimation approach that the Conference Board typically applies to power generation facilities, this analysis does not include any projected return on equity (i.e., no direct profit or direct revenue) or capital consumption allowances (CCA) during the operation of the four CANDU® MONARK™ reactors. Including profits would increase the estimated GDP and tax effects of the operation phase. In this analysis we account for the full economic impact of capital expenditure up front during the construction phase and therefore including CCA during operation would result in double counting.

Definitions

Our results for the construction and operation phases are separated into three distinct economic effects:

- **Direct effects:** These are the economic effects directly associated with the additional spending required for these projects. For example, during the construction phase, most of the direct effects would occur in the construction industry, while during the operational phase, many of the effects would be in the electric utilities sector.
- **Indirect effects:** The indirect, or supply-chain, effects measure the economic impact associated with the use of intermediate inputs and other support services linked to the direct spending. For example, construction activity would require inputs such as engineering services and construction materials.
- **Induced effects:** The induced effects occur when the wages that employees earn from the direct and indirect effects are spent. As such, the economic impacts associated with induced effects generally occur in consumer-oriented industries, such as retail.

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