



**EY**

Building a better  
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December 2024

# Innovation, Science and Economic Development Canada ("ISED")

**Global Innovation Clusters: Economic Analysis**

# Disclaimer

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Ernst & Young LLP (“EY”) was engaged by Innovation, Science and Economic Development Canada (“ISED”) to conduct business and specialized economic analysis for project-specific outputs and outcomes related to activities undertaken by participants in projects receiving Global Innovation Clusters (“the Program”) funding.

In preparing this document (“Report”), EY relied upon unaudited data and information from third party sources and data provided by ISED (collectively, the “Supporting Information”). EY reserves the right to revise any analyses, observations or comments referred to in this Report if additional Supporting Information becomes available to us subsequent to the release of this Report. EY has assumed the Supporting Information to be accurate, complete and appropriate for the purposes of the Report. EY did not audit or independently verify the accuracy or completeness of the Supporting Information. Accordingly, EY expresses no opinion or other forms of assurance in respect to the Supporting Information and does not accept any responsibility for errors or omissions, or any loss or damage as a result of any persons relying on this Report for any purpose other than that for which it has been prepared.

## ***Important Context Concerning Limitations of this Study***

With the Program now entering its second phase, additional projects, partners, funding, and support activities have been, or will be, announced. These projects and activities will likely have additional economic contributions which have been estimated for the purpose of forecasting in this report but may materially change as additional information becomes available.

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# 1

## Executive summary

The Global Innovation Clusters Program (“the Program”, “GIC”) is one of the initiatives pursued by Innovation, Science and Economic Development Canada (“ISED”) to build globally competitive innovation ecosystems in Canada. Ernst & Young LLP (“EY”) was engaged to conduct an economic analysis for project-specific socioeconomic outcomes attributable to Program funding and activities. As part of the analysis presented in the report, EY has completed the following tasks:

- ▶ Estimated cumulative economic contributions associated with the Program between FY 18/19 and FY 23/24;<sup>1</sup>
- ▶ Developed economic forecasts of short- and long-term contributions of the Program up to the years FY 28/29 and FY 34/35, respectively;
- ▶ Assessed the innovative capabilities of each Global Innovation Cluster (“Cluster”) relative to industry maturity, illustrating how Clusters are progressing towards market-driven value capture; and,
- ▶ Analyzed select Cluster projects and developed case studies based on ISED input to provide a thematic overview of Cluster progress, activities and contributions.

### Program overview

Since its inception in 2018, the Program has supported over 600 projects across five Clusters designed to develop and grow new innovation ecosystems in Canada.

Since 2022, the Program has witnessed the maturation of many projects, and its made-in-Canada model is catalyzing collaboration to address challenges at the heart of their respective industries. The Clusters are pan-Canadian and invest in projects that strengthen ecosystems to spur innovation activity, investment and talent development.

### KEY PROGRAM STATISTICS AS OF FY 23/24

**615**

Total projects



**380**

Projects completed



**\$2.6B**

Total project budget



**\$1B**

Cluster funding



### Key insights

Program partners are from a variety of backgrounds, including private enterprises, government agencies, non-profit organizations, and higher education and research institutions. This ecosystem of collaboration combined with Program funding and activities enables a range of socioeconomic contributions across the Canadian economy. Some notable contributions are:

- ▶ Contributions to the Canadian economy through generating economic output;
- ▶ Contributions to the Canadian labour force through job creation;
- ▶ Equipping Canadian workers with professional skills in various sectors;
- ▶ Building and supporting the growth of small- and medium-sized enterprises (“SMEs”);
- ▶ Indigenous reconciliation and employment programs in Indigenous communities; and,
- ▶ Supporting the development of innovation ecosystems across Canada.




**Note:** <sup>1</sup> FY 23/24 includes project reporting as of May 2024.

Sources: Project activity reports (“PARs”), Financial Reconciliation Data

## Executive summary

### Socioeconomic benefits at a glance

By combining government funding with industry investment, the Program bolstered ecosystems that drive economic growth in key sectors by driving revenue and follow-on investment growth across Canada. The Clusters have invested in numerous projects yielding economic contributions, with greater benefits expected as more projects mature. Below is an overview of the outputs of EY's Economic Contribution Assessment ("ECA") in gross domestic product ("GDP") and full-time equivalence ("FTE") jobs:

Total Cumulative Economic Contributions		
Time Period 	GDP 	FTEs 
Current State (FY 18/19 - FY 23/24) <sup>1</sup>	\$3.3B	34,958
Short-term Forecast <sup>2</sup> (FY 18/19 - FY 28/29)	\$8.1B	83,368
Long-term Forecast <sup>3</sup> (FY 18/19 - FY 34/35)	Up to \$13 - 16B	Up to 128,760 - 153,060

**Note:** All figures are inclusive of Program spending (including GIC and Partners), project commercialization, and follow-on investments. All contributions include direct, indirect and induced impacts, and are presented in 2024 CA\$. A range is provided for long-term forecasts due to the range of scenarios considered for projected future macroeconomic and microeconomic environments.

In addition to economic contributions, organizations have experienced and produced other socioeconomic benefits through their participation in the Program. Below is a snapshot of key impacts:

### KEY SOCIOECONOMIC IMPACTS

#### Innovation

- ▶ The AI-Powered Supply Chains Cluster ("Scale AI") enhances productivity through real-time data and artificial intelligence ("AI") analytics, focusing on integrated supply chains, improving production scalability and increasing efficiency;
- ▶ The Digital Technology Cluster ("Digital") has created a technology ecosystem that encourages collaboration among key ecosystem players, such as project partners and end-clients.

#### Social capital

- ▶ The Advanced Manufacturing Cluster ("NGen") has been working closely with Indigenous-owned and -led manufacturers, as well as creating and delivering educational programs for Indigenous students;
- ▶ Digital uses their capacity-building projects to upskill Canadians to be more tech literate through training programs on AI and data analytics, among others.

#### New business opportunities

- ▶ NGen supports smaller manufacturers to scale up production and cut down production costs via innovative technologies;
- ▶ The Protein Industries Canada Cluster ("PIC") is developing new plant-based alternatives to animal products such as eggs and fish fillets, expanding vegan food choices across North America and Europe.

#### Environmental outcomes

- ▶ Canada's Ocean Supercluster ("OSC") has been committing to sustainability and inclusion initiatives that cut carbon emissions, minimize ecological impact and remediate environmental damage;
- ▶ PIC utilizes cutting-edge technologies to reduce food production waste and develop low-carbon emission products.

**Note:** <sup>1</sup> FY 23/24 includes project reporting as of May 2024. <sup>2,3</sup> Short-term and long-term forecasts include project reporting as of May 2024 and expected project estimates based on all announced funding until FY 27/28. The announced funding data is accurate as of June 2024.

**Sources:** PARs, Financial Reconciliation Data, Statistics Canada, and EY Analysis

# 2

## Background information

### Global Innovation Clusters overview

Introduced in 2017, Global Innovation Clusters are spearheaded by five independent not-for-profit organizations that foster collaboration between the private sector and various levels of government to create globally competitive innovation ecosystems. By uniting small and large companies, these Clusters encourage collaboration with research centers, academic institutions, non-profit organizations and government agencies, creating a network of strong connections and opportunities for collective advancement.

The Clusters have the following primary focuses:

- ▶ Employing a made-in-Canada model to catalyze collaboration among diverse organizations and to tackle current Canadian industry challenges;
- ▶ Scaling up Canada's best SMEs and accelerating national economic growth;
- ▶ Providing intellectual property (“IP”) management assistance for innovation-driven industries;
- ▶ Facilitating investments across Canada in projects that bolster innovation activity, investment attraction and capacity building; and,
- ▶ Identifying and driving Canada’s developmental progress in dynamic and emerging sectors of the national economy.

Figure 1: Project locations



Each Cluster aims to achieve specific objectives relevant to their respective industries, as summarized below:

### CLUSTER OBJECTIVES

Digital Technology Cluster	Protein Industries Cluster	Advanced Manufacturing Cluster	AI-Powered Supply Chains Cluster	Ocean Cluster
Digital	PIC	NGen	Scale AI	OSC
To expedite the development and adoption of Canadian digital technologies that enhance health and wellness, safeguard the environment, bolster economic productivity and build digital skills.	To transform the agriculture and food production sector by embracing new technologies that improve ingredient processing and commercialization throughout the value chain.	To drive digital and technological transformation in advanced manufacturing, improve environmental sustainability, supply chain resiliency, and health and security.	To boost productivity across industries in Canada by integrating AI with supply chains, accelerating the growth of SMEs, and strengthening the workforce with digital and AI skills.	To leverage emerging technologies for digitizing and optimizing marine operations, and maximizing sustainable resource utilization.

### Purpose of study

Given the decade-long investment undertaken by the Government of Canada and ISED, there is a concerted effort to deepen the understanding of the socioeconomic advantages and tangible value that the Program brings to the Canadian economy. EY was engaged by ISED to conduct a specialized business and economic analysis for project-specific outputs and outcomes related to activities undertaken by participants in projects receiving Program funding.

EY has performed a comprehensive economic analysis of the overall Program, encompassing all five Clusters. The primary objective of this analysis is to evaluate the current socioeconomic benefits enabled by the Program to date and to develop a forecast of expected benefits over short- and long-term forecast periods. The study utilizes a framework for analysis derived from five socioeconomic pillars to evaluate the Program's socioeconomic contributions. These pillars are summarized below:



#### Economic growth

Investments in growth opportunities for partner organizations that generate positive economic outcomes



#### Productivity

Improvements in supply chain integration, production processes, access to inputs, ability to scale and overall efficiency



#### Innovation

New forms of IP, accelerating innovation through collaboration, commercialization of new products, processes and services



#### New business & employment opportunities

Potential for follow-on investments, opportunities to access new global markets, jobs created and maintained, and training and upskilling opportunities



#### Social capital

Development of networks, norms and trust that facilitate coordination and cooperation among partners for mutual benefit

The findings of this study may provide valuable insights to key stakeholders within ISED and industry, with respect to the following:

- ▶ Assessing the value generated for the Canadian economy through the Program's contributions to job creation, technological advancement, fostering global competitiveness and socioeconomic benefits;
- ▶ Advantages that partner organizations stand to gain by participating in the Program and undertaking specific activities;
- ▶ Improving resource allocation and the implementation of policy interventions to monitor and encourage further innovation and industry growth in Clusters;
- ▶ Gauging the Program's effectiveness in creating a robust innovation ecosystem by promoting collaboration and knowledge exchange between industry, academia and other key stakeholders.

# 3

## Approach and methodology

To evaluate the current and expected socioeconomic benefits enabled by the Program, EY developed a five-stage methodology to assess Program contributions. These stages encompass research and data collection, an economic contribution analysis, short- and long-term economic forecasts and an emergence matrix and innovation framework. Based on the analysis, EY gained a holistic understanding of the Program’s overall socioeconomic contributions to the Canadian economy as well as expectation of future growth and outcomes. Below is an overview of the structure of the methodology:



**1**

**Research and data collection**

EY collected background information to develop an understanding of the current state of each Cluster through various sources including, but not limited to, Program data, Cluster reports and Statistics Canada.

- ▶ Reviewed existing research, case studies and reports by Clusters;
- ▶ Collected official macroeconomic statistics and other public secondary data for each sector in the Program; and,
- ▶ Analyzed Program data including project activity reports and financial reconciliation data.

**2**

**Economic contribution analysis**

EY performed an economic contribution assessment of the Program from FY 18/19 to FY 23/24<sup>1</sup> using EY’s proprietary economic contribution assessment model.

- ▶ Aggregated actual project-level GIC investment and industry investment data into Program-level spending;
- ▶ Estimated total revenues from commercialization based on project commercialization rates and performance relative to industry at close-out; and,
- ▶ Captured economic contributions to GDP and employment through direct, indirect and induced channels using a tailored Input-Output (“I-O”) model framework.

The ECA results indicate total economic contributions to the Canadian economy.

Impact Channels	Definition
GIC spending	Funding provided to the projects including GIC, National Quantum Strategy (“NQS”), and the Pan-Canadian Artificial Intelligence Strategy (“PCAIS”).
Partner spending <sup>2</sup>	Co-investments made by partners <sup>1</sup> outside of the Clusters with respect to initial GIC funding.
Follow-on investments	Additional industry contributions attracted following start of project.
Commercialization revenue	Revenues generated from successful commercialization at project close-out.

Notes: <sup>1</sup> FY 23/24 includes project reporting as of May 2024.

<sup>2</sup> Partners include other businesses, academia, non-profit partners, and other sources of funding.

3



### Economic forecasts

EY developed short- and long-term economic contribution forecasts of the Program based on the following factors:

- ▶ A range of scenarios influencing the outlook for future economic contributions; including project commercialization rates, technology uptake rates and global competitiveness, among others;
- ▶ Estimating follow-on investments based on historic and expected performance; and,
- ▶ Estimating revenues from commercialization following project completion.

The forecasts showcase the long-term contributions of the Program to the Canadian economy.

4



### Innovation maturity assessment

EY created a customized framework to assess the industry and innovation maturity of each Cluster, based on innovative capabilities and industry maturity.

- ▶ Innovative capabilities assessed a technology's sophistication, scope and scale; and,
- ▶ Industry maturity assessed the pre-existing technology and market maturity.

The emergence matrix highlights the growth stages of different Clusters by comparing their innovative capabilities with industry maturity, to highlight how Clusters are positioned and what factors may drive future growth.

5



### Cluster thematic analysis

EY conducted a thematic analysis of Cluster outcomes to assess the socioeconomic contributions generated by each Cluster. Themes include, but are not limited to:

- ▶ Overview of key socioeconomic themes and developments by Cluster; and,
- ▶ Project-level case study highlighting in detail the specific socioeconomic contributions of a project and the role of the Clusters.

The thematic analysis highlights the five pillars of the Program through individual projects and success stories to supplement the economic contributions attributable to the Program.

By utilizing this framework, EY was able to holistically evaluate the total impact of the Program across the five socioeconomic pillars. A detailed breakdown of the approach and methodology used for each stage of the analysis is attached in the **Appendix**.

### Important study considerations

EY's economic contribution analysis is conducted based on primarily project-level data provided by ISED, with limited sight on firm-level data such as financial statement information and revenue projections. Using the available data, and baseline indicators from Statistics Canada, EY estimated this relationship for the purpose of the analysis. However, studies undertaken with different data availability and analytical methodologies may develop materially different economic contribution findings.

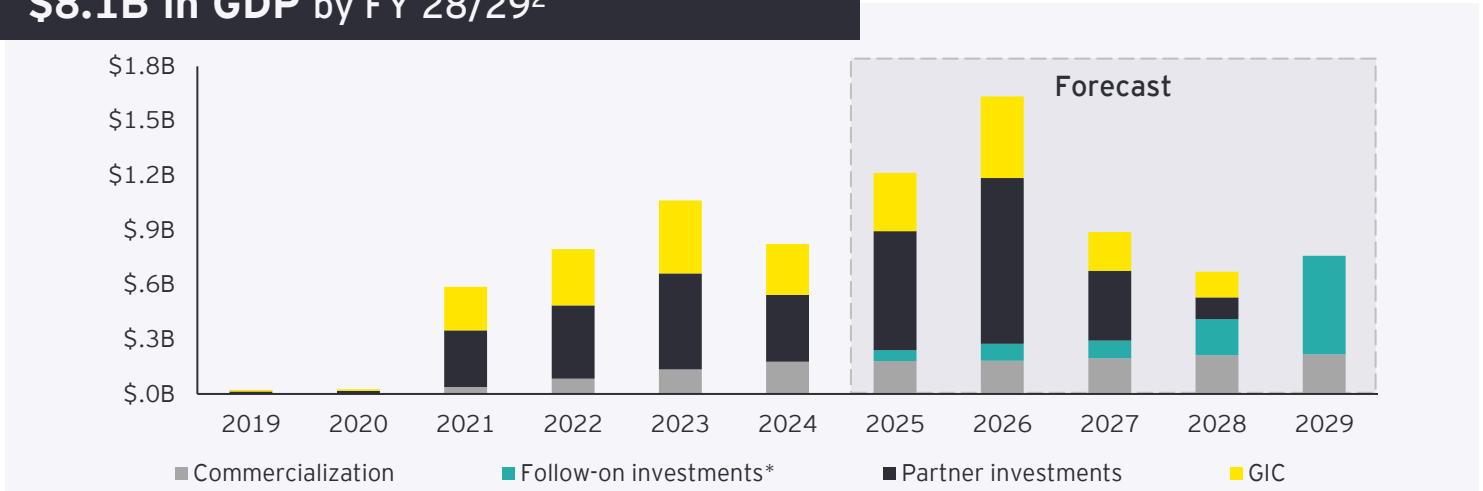
Additionally, due to underlying uncertainties regarding Cluster performance, the macroeconomic environment and broader industrial growth rates, the long-term economic forecast results are presented with a range of uncertainty, based on different scenarios analyzed. A breakdown is provided in the **Appendix**.

# 4

## Economic and innovation impacts

In addition to strengthening Canadian innovation ecosystems, the Program acts as an anchor investment by de-risking industry investments and setting the stage for follow-on investments and commercialization revenues attributable to initial Cluster funding. Based on this, EY analyzed current and expected economic benefits of the Program from FY 18/19 to FY 28/29 across spending and revenue channels using its proprietary economic contribution model and forecasting tools.<sup>1</sup>

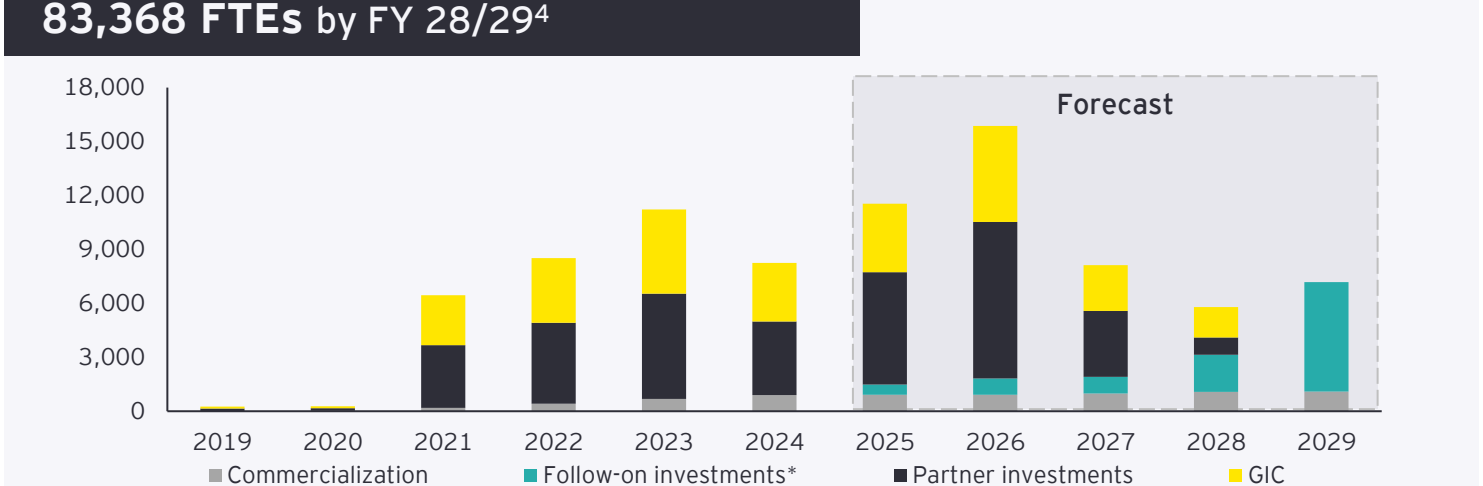
### \$8.1B in GDP by FY 28/29<sup>2</sup>



By FY 23/24, the Program (including GIC and Partner investments) and project commercialization contributed approximately \$3.3 billion in GDP. By FY 28/29, the Program, project commercialization and follow-on investments are projected to cumulatively contribute up to \$8.1 billion in GDP.<sup>3</sup>

\*In 2029 and onwards, a portion of what would have been industry investments linked to GIC spending is allocated towards follow-on investments.

### 83,368 FTEs by FY 28/29<sup>4</sup>



By FY 23/24, the Program (including GIC and Partner investments) and project commercialization contributed approximately 34,958 FTE jobs. By FY 28/29, the Program, project commercialization and follow-on investments are projected to cumulatively contribute up to 83,368 FTE jobs.

Notes: <sup>1</sup> The estimates are an overview of the total estimated contributions, including direct, indirect and induced contributions on GDP and employment in Canada.

<sup>2</sup> GDP is a measure of the value of all final goods and services produced in a region, and in this case Canada.

<sup>3</sup> Each year refers to the FY ending in the corresponding year, for example 2019 refers to FY 18/19.

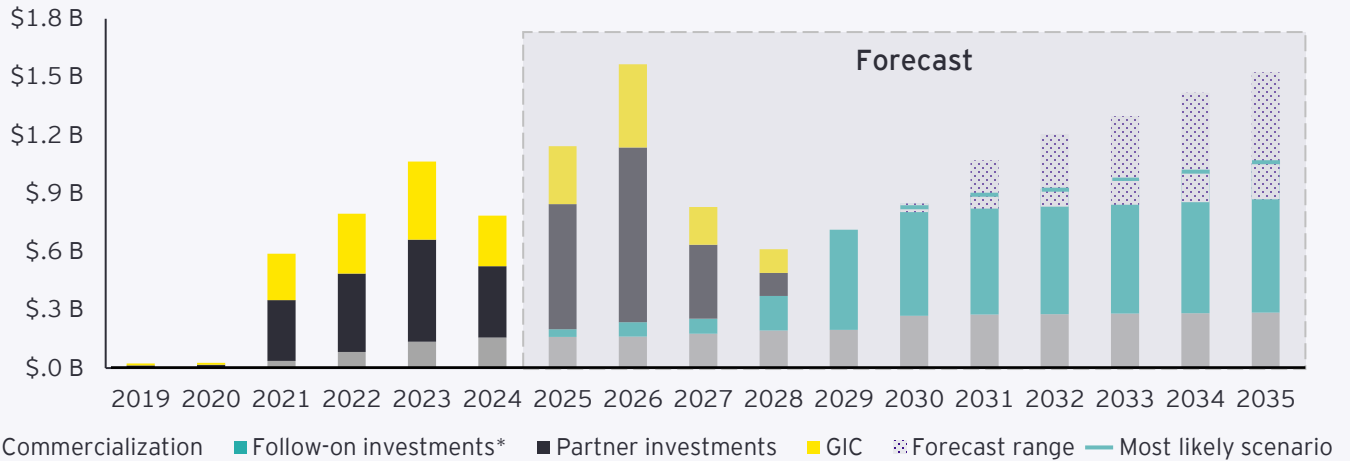
<sup>4</sup> FTE measures the total number of jobs that are converted to full-time equivalence based on the average full-time hours worked.

Sources: PARs, Financial Reconciliation Data, Statistics Canada, and EY Analysis

## Economic and innovation impacts

As projects continue to mature and commercialize, an increasing number of economic contributions is expected to be driven by commercialization of completed projects and attraction of follow-on investments. This change in the growth environment is driven by successful technology and commercial demonstrations, which encourage market-driven growth. The results are portrayed with a forecast range to reflect underlying uncertainty driven by different scenarios including project commercialization rate, the macroeconomic environment and overall competitiveness.<sup>1</sup> A detailed breakdown is provided in the **Appendix**. Below is an overview of the total cumulative results:

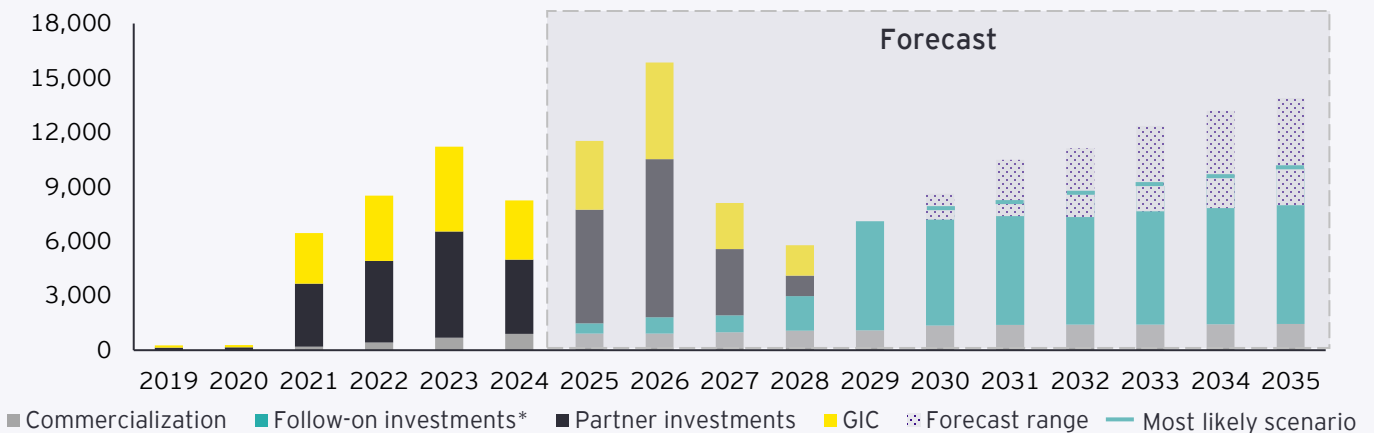
### \$13 - 16B in GDP by FY 34/35<sup>2</sup>



By FY 34/35, the Program (including GIC and Partner investments), project commercialization and follow-on investments are projected to cumulatively contribute between \$13 and \$16 billion in GDP, based on the scenario with \$14 billion expected in the most likely scenario.<sup>3</sup>

\*In 2029 and onwards, a portion of what would have been industry investments linked to GIC spending is allocated towards follow-on investments.

### 128,760 - 153,060 FTEs by FY 34/35<sup>4</sup>



By FY 34/35, the Program (including GIC and Partner investments), project commercialization and follow-on investments are projected to cumulatively contribute between 128,760 and 153,060 FTE jobs, based on the scenario with 136,531 FTE jobs expected in the most likely scenario.

Notes: <sup>1</sup> The estimates are an overview of the total estimated contributions, including direct, indirect and induced contributions on GDP and employment in Canada.

<sup>2</sup> GDP is a measure of the value of all final goods and services produced in a region, and in this case Canada.

<sup>3</sup> Each year refers to the FY ending in the corresponding year, for example 2019 refers to FY 18/19.

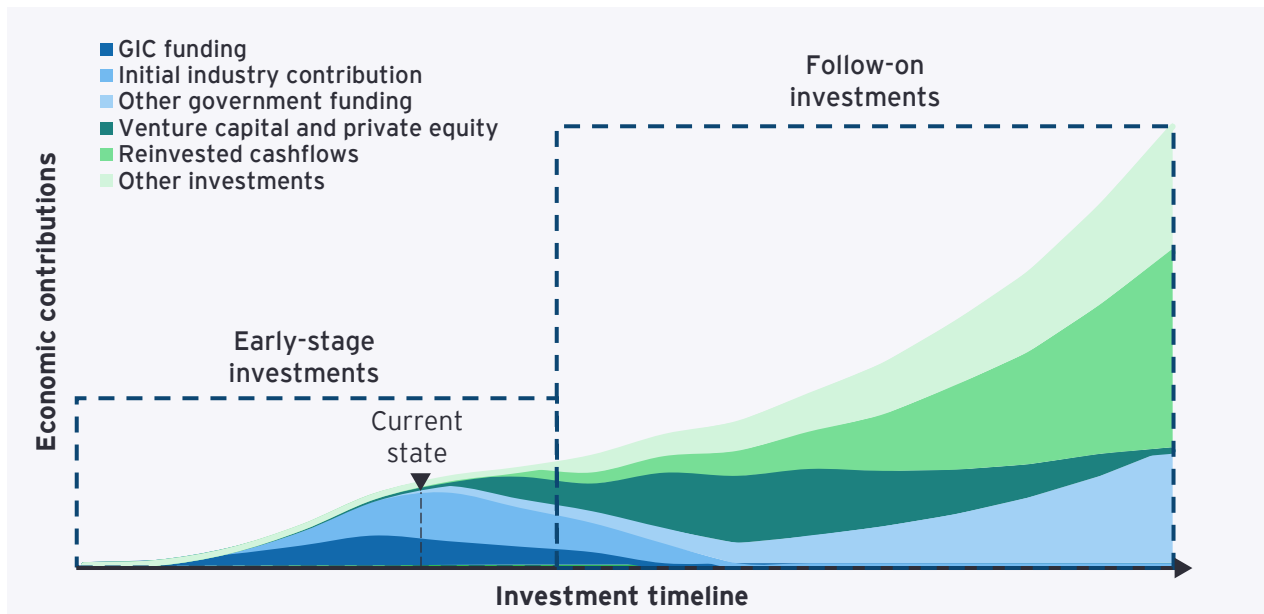
<sup>4</sup> FTE measures the total number of jobs that are converted to full-time equivalence based on the average full-time hours worked.

Sources: PARs, Financial Reconciliation Data, Statistics Canada, and EY Analysis

### Project lifecycle

With many Cluster projects and industries transitioning towards market-driven growth, follow-on investments are expected to increase over the coming years. The Program's early-stage investments have the ability to attract further investments from a variety of industry and government sources throughout the project lifecycle, as illustrated below:

Figure 2: Project lifecycle



Note: The graph provided above is an illustration of the theoretical trajectory of economic contributions which may be enabled or accelerated by the Program.

The project lifecycle graph visually represents the potential future economic contributions enabled by the Program through the attraction of further investments. As an anchor investment, the Program may serve as a catalyst for additional funding by “de-risking” projects, boosting investor confidence in projects that may otherwise not have been possible or delayed due to a lack of early-stage investments.

As projects progress through the lifecycle, the Program has the potential to create ripple effects that attract investments and stimulate economic growth. In particular, the Program boosts market-driven growth and follow-on investments:

- ▶ Market-driven growth generates reinvested cashflow. As project commercialization starts, market revenue will drive long-term growth of project impacts.
- ▶ Project maturation attracts follow-on investments. Various Cluster-funded projects have been known to receive venture capital funding as well as funding from other public and private sources.

These benefits have already been noted in projects led by Graphite Innovation and Technologies (OSC), Genecis Bioindustries (NGen), and Ideon Technologies (Digital), which collectively attract over \$40 million in follow-on investments. Additional sources of project funding may allow projects to scale and generate broader economic contributions in the future, as noted in the long-term forecast. The economic benefits from such investments include, but are not limited to:

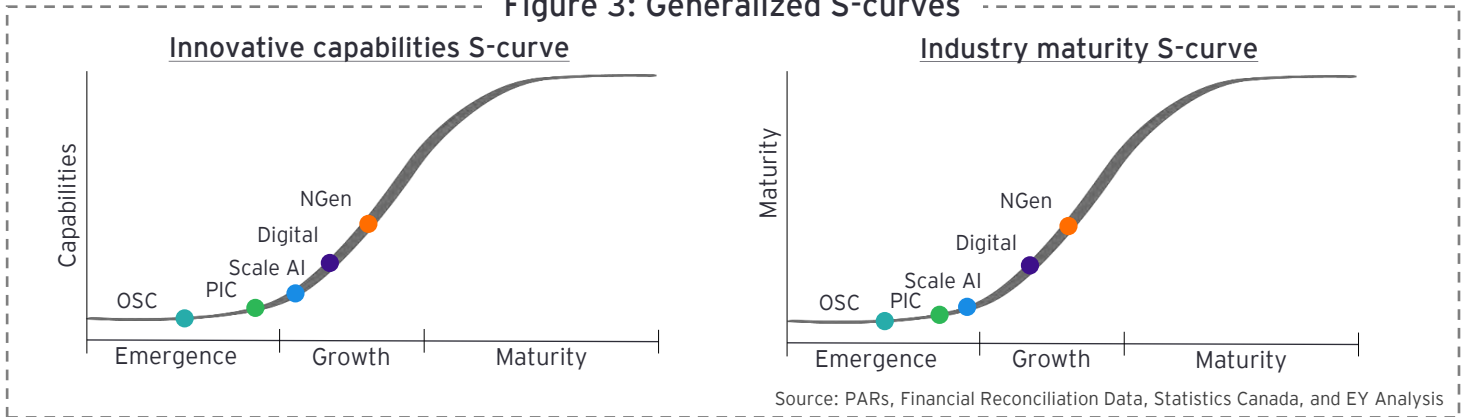
- ▶ Enhancement of productive capacity;
- ▶ Creation of high-skill jobs;
- ▶ Development of mature ecosystems; and,
- ▶ Accelerated IP creation.

Source: ISED

S-curves

The rate at which different projects attract follow-on investments can be illustrated using an S-curve. S-curves demonstrate how a Cluster’s maturity is situated uniquely with respect to its innovation capability and industry maturity. For instance, NGen displays the highest degree of innovation capability as a larger portion of its projects are currently commercialized and generating revenues. Likewise, the industry that NGen serves is more mature than those of other Clusters, enabling more accessible and scalable commercial applications. These S-curves are provided below:

Figure 3: Generalized S-curves

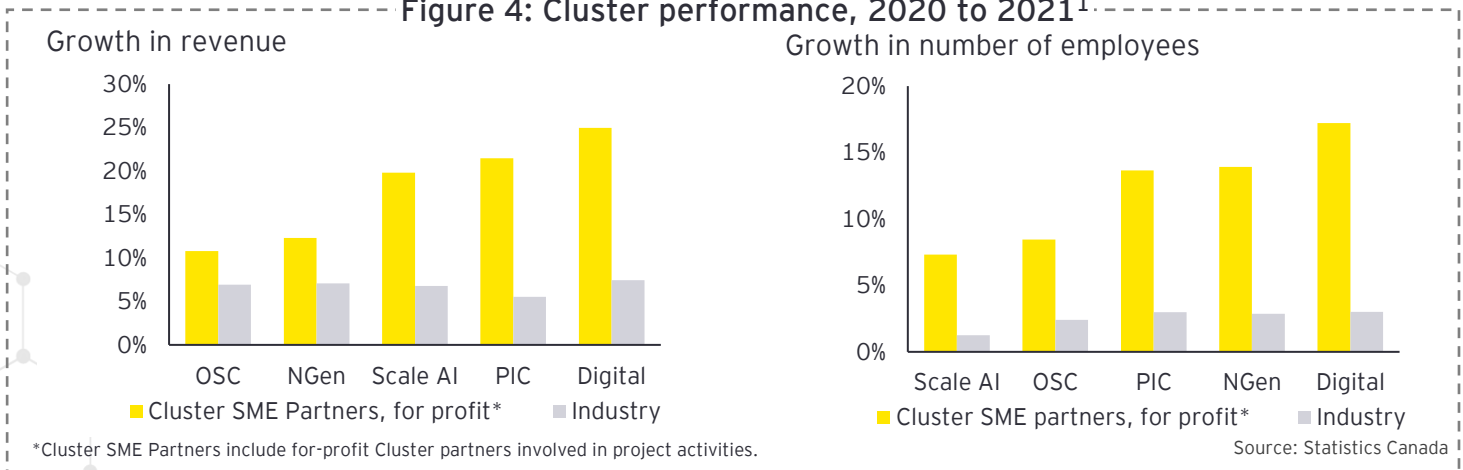


Source: PARs, Financial Reconciliation Data, Statistics Canada, and EY Analysis

Cluster performance data

While innovative capabilities and industry maturity are measured separately above, these differences can be conceptualized based on relative performance to the broader industry. Below is a summary of revenue growth and employment growth of Cluster partners relative to the broader and more mature industries that they respectively serve:

Figure 4: Cluster performance, 2020 to 2021<sup>1</sup>



\*Cluster SME Partners include for-profit Cluster partners involved in project activities.

Source: Statistics Canada

The trends highlighted above suggest that for-profit Cluster SME Partners, on average, are growing at a faster rate than their peers in terms of both revenue and employment. The gap in employment growth is much larger than in revenue as many ongoing projects have not been fully commercialized and reaped the full benefits of their investment.

EY also notes that the innovative capabilities of Clusters may exceed the broader industry and drive further technological uptake and scaling as projects continue to develop. This relationship can be visualized using an emergence matrix which interposes the innovative capabilities and industry maturity for each respective Cluster.

Note: <sup>1</sup> Cluster performance relative to baseline industries is currently only available for FY 20/21. Since then, many more projects have been completed and moved towards commercialization. Additionally, the broader macroeconomic environment has shifted. These figures are displayed only for contextual purposes.  
Sources: PARs, Financial Reconciliation Data, Statistics Canada, and EY Analysis

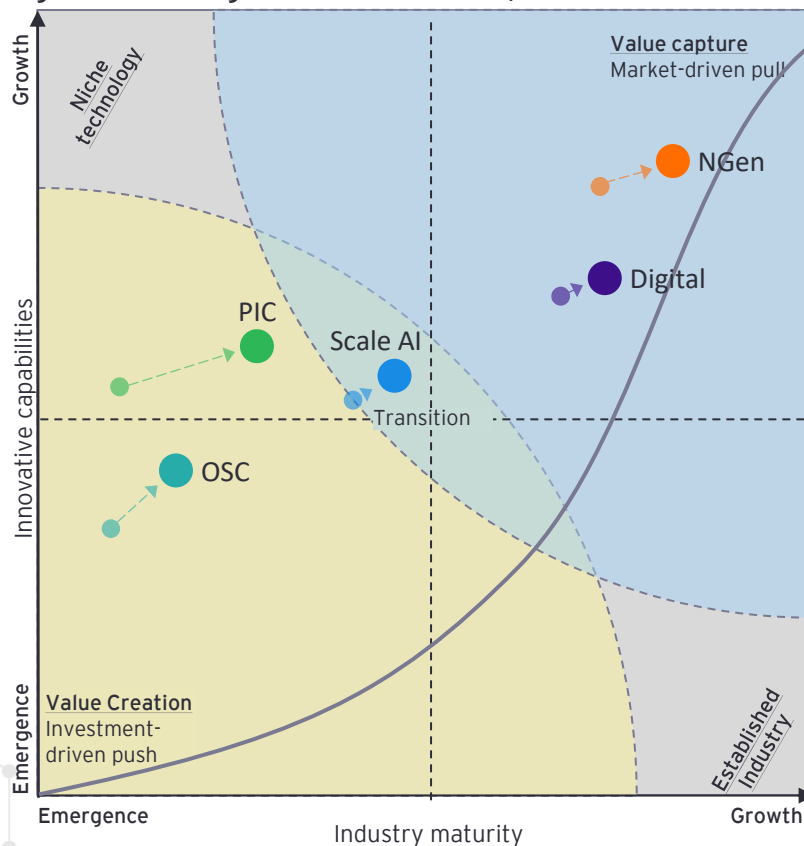
### Innovation-industry emergence matrix results

As projects have continued to mature, there have been shifts in dominant funding sources, project activities and overall readiness levels as illustrated in the forecasts and Figure 2. An acceleration in observed trends may be likely as projects reach higher levels of innovative capability and drive industry maturity, enabling further investment and market adoption. This existing shift in maturity can be observed by illustratively plotting each Cluster's position for FY 22/23 and FY 23/24.<sup>1</sup>

- ▶ NGen and Digital have a higher concentration of projects in mature industries. As a result, projects are more quickly adopted by industry to capture value now or in the near future due to market-driven growth. This is a combination of an industry that was already mature, combined with new innovations and technologies brought to market by project partners. These Clusters remain relatively stable in innovative capabilities and continue to attract additional follow-on investments.
- ▶ Scale AI remains in the transition zone, with many innovations remaining in the earlier stages of commercialization, but growth in the sector is moderated by economic headwinds in the sector. However, as the AI industry matures, follow-on investments may continue growing at a faster pace.
- ▶ PIC has witnessed further industry maturation as consumers continue to demand sustainable and plant-based foods. The industry is still emerging, but market-driven growth has started to catch up as commercialization readiness grows.
- ▶ OSC is approaching the transition zone with new technological advancements looking to build market maturity. Industry growth is still driven by investments and value creation, but long-term growth potential is demonstrated through diverse applications across many sectors.

A detailed breakdown of the emergence matrix is provided in the **Appendix**.

**Figure 5: Emergence matrix shifts, FY 22/23 to FY 23/24**



Note: <sup>1</sup> FY 23/24 includes project reporting as of May 2024.

Sources: PARs, Financial Reconciliation Data, Statistics Canada, and EY Analysis

### Cluster thematic analysis

Each Cluster has enabled various projects and outcomes that yield unique socioeconomic contributions to the broader economy. These benefits span across five socioeconomic pillars ranging from fostering innovation and economic growth to building a more equitable and competitive workforce. Below is an overview of key socioeconomic contribution themes that emerged for each Cluster, reflecting the breadth of their contributions to Canada:

Cluster name	Overview
<b>NGen</b> 	<ul style="list-style-type: none"> <li>▶ NGen boosts <b>economic growth</b> across Canada by supporting SME scaling through novel technology development and adoption, with a strong emphasis on IP protection</li> <li>▶ NGen contributes to <b>social capital</b> by creating and delivering educational programs for Indigenous students and other under-represented groups.</li> </ul>
<b>Digital</b> 	<ul style="list-style-type: none"> <li>▶ Digital prepares the Canadian workforce for <b>new business and employment opportunities</b> by building digital skills for Canadians and addressing pressing technological challenges;</li> <li>▶ Digital creates technology ecosystems conducive to collaboration among key players, such as project partners and potential end-clients, encouraging <b>productivity growth</b>.</li> </ul>
<b>PIC</b> 	<ul style="list-style-type: none"> <li>▶ PIC encourages <b>innovation</b> in the food industry by supporting the development of new plant-based protein alternatives;</li> <li>▶ PIC promotes <b>productivity growth</b> and waste reduction across the value chain in the agriculture and food production industries by using innovative technologies.</li> </ul>
<b>Scale AI</b> 	<ul style="list-style-type: none"> <li>▶ Scale AI enhances <b>productivity growth</b> by using real-time data and AI analytics to create integrated supply chains;</li> <li>▶ Scale AI enables commercial <b>innovations</b> from AI research in the health sector, adding to Canada's social capital through public health outcome improvements.</li> </ul>
<b>OSC</b> 	<ul style="list-style-type: none"> <li>▶ OSC supports <b>new business and employment opportunities</b> through its sustainability and inclusion initiatives, labour force training and Indigenous engagement;</li> <li>▶ OSC contributes to <b>economic growth</b> in the ocean sector by introducing innovative ocean technologies.</li> </ul>

# 5

## Looking ahead



Innovation is a powerful vehicle for change, which can revolutionize industries and economies under the right conditions. The Program is designed to catalyze transformational change in globally differentiating sectors of Canada's economy. Each of these Clusters is undergoing a shift towards market-driven growth, which is expected to accelerate over time.

As seen in the emergence matrix, the preconditions of more mature industries have positioned certain Clusters to experience a more rapid realization of innovation benefits and experience market-driven growth. Concurrently, other industries, which are still emerging, remain in a phase of investment-driven growth, but are approaching market applicability. Yet other Clusters straddle the transition phase, wherein early adopters show interest in new products and technologies, setting the stage for increased levels of market-driven investment and returns from commercialization. The pre-existing conditions of each sector and the function of time and investment are critical for understanding the innovation ecosystem in Canada and the role that the Clusters play in driving economic growth.

The Program's collaborative approach, emphasizing partnerships between industry, academia and government, has been well received by project partners. Efforts to scale and integrate Canadian SMEs within this network of partnerships has been critical in establishing active and vibrant innovation ecosystems. Moreover, the Program's commitment to diversity and inclusivity in Clusters has enabled underrepresented groups and Indigenous Peoples to participate in the innovation economy, promoting social and economic equity in Canada.

Collectively, the Program is seeing many of its projects successfully transition towards market-driven growth through the generation of new revenues or the attraction of follow-on investments. Productivity and efficiency gains are made at the heart of key industries, which over the coming years may ripple through the national economy. Other measures suggest accelerating levels of IP commercialization, leading to new products entering both the Canadian market and global markets.

As an increasing number of projects transition towards market-driven growth, the Program will have served a notable role in growing innovation across key sectors of Canada's economy.

# APPENDIX

## Global Innovation Clusters: Economic analysis



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**Economic contributions were assessed for spending that occurs as a result of Program-funded projects. Economic contributions were estimated in terms of GDP and FTE employment. All contributions were estimated at the direct, indirect and induced levels.**

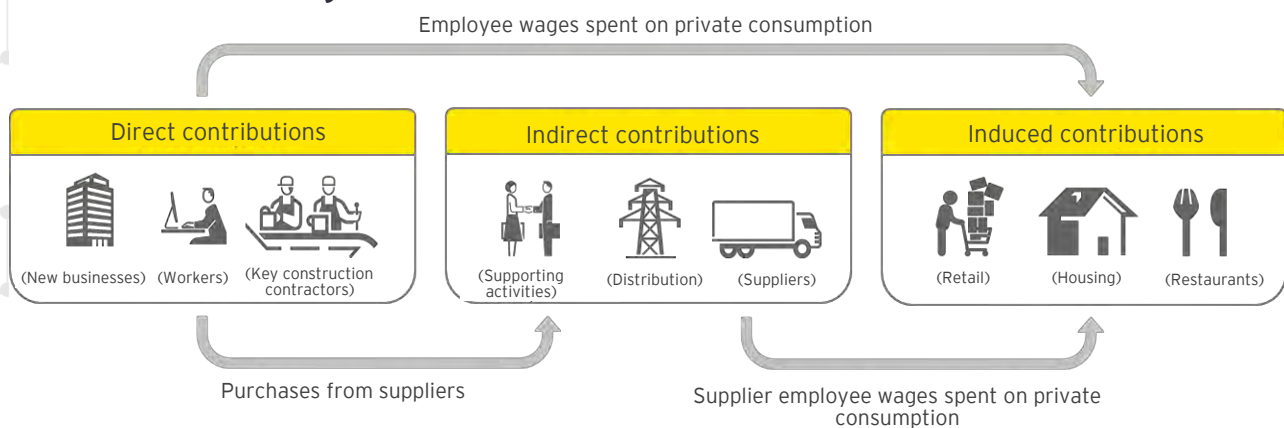
To assess the economic contributions from total project spending, including Program spending, industry spending, follow-on investments and revenues from commercialization, EY performed an economic contribution analysis. The estimation relied on project-level financial reconciliation data, PARs, inputs from Statistics Canada and EY's proprietary economic modelling tools, which are founded on the principles of the Input-Output ("I-O") model.

### Direct, indirect, and induced contributions

Economic contributions associated with activities supported by the Program were captured through three distinct channels: direct, indirect and induced contributions. These contributions individually and collectively represent how these economic activities ripple throughout the economy.

- ▶ **Direct contributions:** account for the economic activity supported directly by the operational and capital spending and revenues associated with Program-funded projects.
- ▶ **Indirect contributions:** include the economic contributions from business activities supporting the operation of direct economic activities. These include, among other things, the contributions from suppliers' spending when purchasing goods and services from other suppliers. This could encompass, for example, the costs of subcontractors hired by project-leading organizations on goods and services, such as material, equipment and labour.
- ▶ **Induced contributions:** include the economic contributions that occur when benefited employees from the stimulated direct and indirect economic activities associated with the Program spend their wages and salaries on consumer goods and services. The induced activities are assumed to be primarily in service or consumer-related industries, such as retail, transportation, accommodation, food and beverage services, and banking and finance. Consumer spending circulates in the economy and, in turn, results in additional jobs that are also considered part of the induced contributions. Induced contributions can be estimated based on any number of rounds or iterations of additional income resulting in increased spending, economic activities and further additional income.

**Figure 6: Illustration of economic contributions**



### The I-O economic framework

A static I-O model was used to assess the economic contributions of spending occurring as a result of Program-funded projects. The I-O model was selected based on its flexibility in providing a reliable method of assessing economic contributions. Fundamentally, the I-O model translates direct contributions into indirect and induced economic contributions, which collectively define the total economic contributions from economic activity supported by I-O. The contributions are expressed in terms of GDP and FTE employment.

The table below provides a description of the key indicators along which economic contributions were assessed:

Impact	Description	Indicator	Inputs used
Gross domestic product	GDP contributions generated through stimulated economic activity resulting from all project spending and revenues earned.	GDP	Estimated through the I-O model, based on total project spending
Employment	Jobs created and supported by the project as a result of GIC project spending and revenues earned.	FTE jobs and worker years	Expected number of FTE jobs created during the project, based on PARs and EY analysis.

### Spending inputs

To estimate the employment contributions, EY relied on key information provided by ISED and collected independently from secondary sources. The key data used for analysis includes, but is not limited to:

- ▶ PARs, including total project value, FTEs created and sustained, project and performance at close-out;
- ▶ Financial reconciliation information detailing the spending on an annual basis broken out by major cost categories (e.g. wages and salaries, materials and supplies, equipment and facilities);
- ▶ Statistics Canada data, including various indicators of baseline industry performance, such as revenue and employment growth, among others.

These inputs were used to estimate the direct, indirect and induced contributions to national employment.

### Estimation of national economic contributions

To estimate the total economic contributions of spending by Program-funded projects, EY's proprietary I-O model was employed, which is based on Statistics Canada's multipliers from 2019, due to alterations to the economy in 2020 as a result of the 2020 COVID-19 pandemic. These multipliers reflect how the interdependency among all industry sectors in the economy is tracked. Statistics Canada's I-O tables are used by both public and private sector organizations and other research institutes and are based on a widely accepted methodology for estimating economic contributions.

### The input-output model: assumptions and restrictions

The following section outlines the assumptions and restrictions associated with the I-O model used to perform the economic contribution analysis in this Report. The I-O model is subject to limitations both in concept and implementation. Like any economic model, the I-O model is conceptually an abstraction that attempts to be complex enough to closely capture and estimate the most significant contributions to the real-life economy caused by economic activities, yet simple enough to be analytically and intuitively meaningful.

An I-O model reflects the observed interdependency between all sectors of the economy. For Canada, Statistics Canada reports for the 236 industrial sectors in the economy: (1) how each sector relies on the other 235 sectors for inputs to their production; and (2) how each sector supplies its products and services to each of the remaining 235 sectors. While an I-O model provides a consistent and innovative way of measuring the economic effects of an economic activity, one should be aware of the assumptions and limitations imposed on the model's underlying approach. Some of these assumptions include:

- ▶ The relationship between industry inputs and outputs is linear and fixed, meaning that a change in demand for the outputs of any industry will result in a proportional change in production;
- ▶ The model assumed constant returns to scale, and cannot account for economies/diseconomies of scale or structural changes in production technologies, an assumption that does not necessarily hold in the actual economy;
- ▶ Prices are fixed in the model; thus, the model is unable to account for elasticities, or more formally, how one economic variable changes in response to another;
- ▶ I-O models are static, and therefore, do not consider the amount of time required for changes to happen. Changing the timeframe would not affect the magnitude of the estimates;
- ▶ There are no capacity constraints, and all industries are operating at full capacity. This implies that an increase in output results in an increase in demand for labour (rather than simply re deploying existing labour). It also implies that there is no displacement that may occur in existing industries as new projects complete;
- ▶ I-O models assume that the technology and resource mix (ratios for inputs and production) is the same for all firms within each industry, i.e., the 236 industry categories reported in Statistics Canada's input-output table. As such, our analysis describes industry average effects;
- ▶ The model assumes that the structure of the economy remains unchanged, and any structural changes in the economy since 2019 will, therefore, lead to changes to the multipliers, which could be implemented once Statistics Canada releases updated input-output tables. As such, the further the year of analysis is away from the year of the input-output tables used, the greater the uncertainties;
- ▶ The model does not consider the economic contributions or opportunity costs associated with using resources elsewhere. In the case of this analysis for example, funds used to purchase lab equipment may be allocated to other areas. Using these funds for alternative uses would generate their own economic contributions, which could potentially be larger or smaller. However, the model will not be able to capture this difference;
- ▶ Results from the I-O model should not be interpreted as causal impacts, that is, one should not take the economic contributions presented in this report at verbatim. It cannot be said with certainty that X dollars of capital or operational spending will produce X number of FTE jobs or have an X amount of impact on GDP.

### Economic forecasts methodology

To quantify the forecasted economic contributions of the Program up to 2035, EY utilized the following four-stage forecasting framework:

#### 1 Analytical inputs

- ▶ GIC and industry spending amounts were collected based on expected annual spending amounts by Cluster up to FY 27/28 provided by ISED. These spending amounts were assumed to be allocated to industries and projects based on historic spending patterns;
- ▶ To estimate the role of project commercialization, EY extended the current state commercialization analysis based on PARs to include projects expected to commercialize by 2035. This portion of commercialization accounts for the commercialization of new projects and continued revenue generation from existing projects;
- ▶ To supplement the commercialization forecast, EY collected a broader range of technology-level data for each Cluster including growth rates, trends, competitiveness, and other factors expected to drive overall growth. This information enables EY to tailor the forecast to the characteristics of the unique blend of key industries for each Cluster and develop scenarios to further test results;
- ▶ In addition to project commercialization, follow-on investments from other industry sources were also expected to drive economic contributions as the Program matures. To forecast industry follow-on investments and their contributions, EY collected historic follow-on investment data from Clusters where data was available in Annual Reports. EY also leveraged broader industry-level investment, innovation and research and development (“R&D”) data from Statistics Canada to identify follow-on investment relationship to broader macroeconomic conditions.<sup>1</sup>

#### Important study considerations

To ensure completeness of the forecast, where data was missing (e.g. follow-on investments for certain years or Clusters), EY estimated values based on historic spending amounts or expected values based on comparable industry/Cluster performance.

EY’s economic contribution analysis is conducted based on primarily project-level data provided by ISED, with a limited scope on firm-level financial data such as revenues and revenue projections. Using the available data, and baseline indicators from Statistics Canada, EY estimated this relationship for the purpose of the analysis. However, studies undertaken with different data availability and analytical methodologies may develop materially different economic contribution findings.

<sup>1</sup> **Data Gap:** Aggregated follow-on investments from the Clusters do not indicate expected annualized spending amounts.

### 2 Modelling

Based on the stated inputs, EY developed average growth rates for each Cluster's follow-on investments and commercialization based on its underlying technological mix. These rates were applied specifically starting in 2028 when Program funding is expected to finish, changing the investment environment to be largely industry driven. Based on these growth rates, EY utilized its proprietary forecasting tools to estimate downstream contributions of commercialized Cluster projects on the Canadian economy.

### 3 Model outputs

Based on the modelling undertaken, EY developed two sets of forecasts by contribution stream:

- ▶ **Commercialization:** including a forecast of GDP and FTEs sustained from commercialization up to the year 2035.
- ▶ **Follow-on investments:** including a forecast of GDP and FTEs sustained from follow-on investments up to the year 2035. While this amount was reported prior to the 2029 - 2035 forecast period, beginning in 2029, a portion of what would have been industry investments linked to GIC spending is allocated towards follow-on investments.

### Economic forecasts methodology

#### 4 Scenario testing

The economic forecast results were developed across high, medium and low scenarios based on a combination of inputs for the various scenario factors outlined below:

Contribution stream	Follow-on investments		Commercialization	
Growth drivers	Cluster performance - follow-on investments	Macroeconomic environment	Extend existing project footprint	Cluster industry growth rates
Scenario factors	<ul style="list-style-type: none"> <li>▶ <b>Investment attracted:</b> The amount of investment attracted may slow down depending on the technological maturity level underlying the projects.</li> <li>▶ <b>Global competitiveness:</b> The overall competitiveness of Cluster-funded projects relative to global competition.</li> </ul>	<ul style="list-style-type: none"> <li>▶ <b>Access to capital:</b> The total availability of funding from various public and private sources in Canada and globally.</li> <li>▶ <b>Supply chain challenges:</b> The extent to which geopolitical tensions may continue to complicate supply chains.</li> <li>▶ <b>Business behaviour:</b> The investment decisions made by businesses based on business confidence in the broader macroeconomic environment.</li> </ul>	<ul style="list-style-type: none"> <li>▶ <b>Project commercialization rate:</b> The rate at which projects commercialize may vary based on macroeconomic factors and may change with a drop-off in Cluster funding.</li> </ul>	<ul style="list-style-type: none"> <li>▶ <b>Technology uptake:</b> The pace of technological advancement and subsequent uptake can significantly influence industry growth altering costs, revenues and further opportunities.</li> <li>▶ <b>Regulatory environment:</b> The extent of shifts in the policy environment, including environmental standards, trade policies and AI regulations can dramatically alter industry growth rates.</li> </ul>
Confidence interval <sup>1</sup>	Large	Large	Medium	Large

**Note:** <sup>1</sup> Confidence intervals are a statistical measure of the likely range in which an unknown parameter is likely to fall. Large confidence intervals are associated with higher levels of uncertainty than medium confidence intervals.

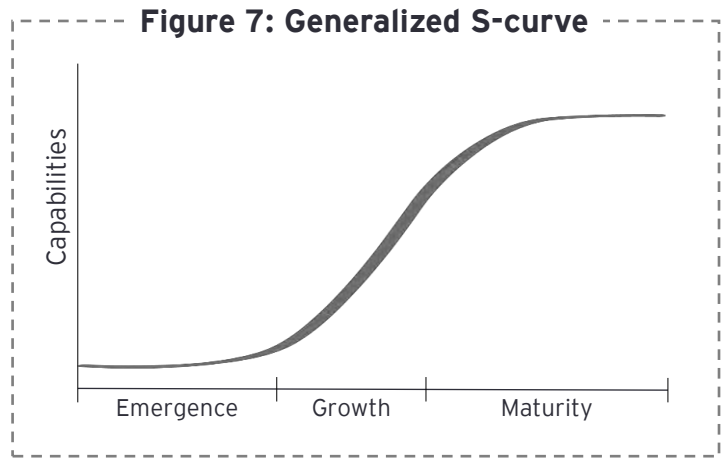
Emergence matrix & innovation framework



To illustrate the unique developmental stage of each Cluster, EY developed a customized framework based on principles of innovation and technology-based industrial emergence. This framework served as the foundation to assess Cluster development based on two principles: innovative capabilities and industry maturity. Innovative capabilities represent the sophistication, scope and scale of technology developed, while industry maturity represents the pre-existing technological conditions and market maturity of an industry.

1. Generalized S-curves

The S-curve is a useful tool for visualizing the development of each Cluster as direct comparisons between Clusters may not represent factors unique to each stage of development. For instance, Clusters in different stages of industry maturity and innovative capability may have different objectives and measures of success. A generalized S-curve provides a graphical representation of the evolution of each principle over time. The key stages of an S-curve are the following:



2. Development of indices

Both pillars of development were evaluated using customized composite indices. These indices are summarized below:

- ▶ **Industry maturity:** estimated using a variety of industry-specific indicators such as sector composition, employment, and industry, business and export performance.
- ▶ **Innovative capabilities:** estimated using Cluster-specific indicators such as ecosystem maturity, IP asset generation, commercialization potential, project spending and revenues, among others.

By plotting each index along an S-curve, the developmental stage of a Cluster can be observed.

### Emergence matrix & innovation framework



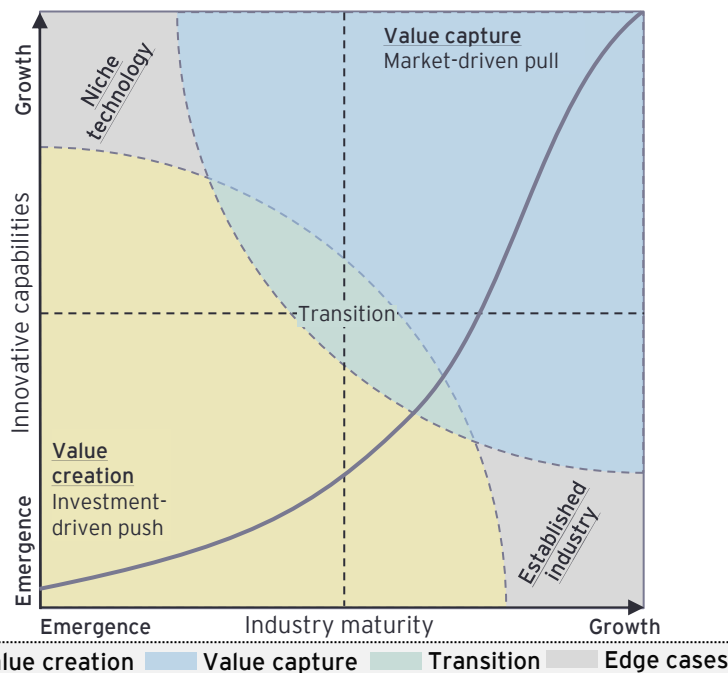
#### 3. Emergence matrix

While each S-curve demonstrates capability and maturity, innovation and industry form a dynamic relationship which reinforces one another over time. For instance, increasing innovation capabilities can push an industry to mature further as demand from markets increases. The emergence matrix illustrates each Cluster’s development relative to the maturity of its respective existing industry.

**Figure 8: Emergence matrix**

#### Key takeaways

- ▶ Industries that are less mature are expected to have lower levels of innovative capabilities as new investments seek to develop products and services that have market relevance.
- ▶ Mature industries are expected to have high levels of innovative capabilities which have led to success in capturing market interest and value.
- ▶ Edge cases exist when industry or innovation are significantly more mature or capable than the other, resulting in limited returns on investment (“ROI”).



The emergence matrix itself is denoted by six key elements:

- ▶ **Value creation:** Investments push industry maturity and innovation capabilities towards value capture, at this stage further investment, research and development are required before market adoption.
- ▶ **Value capture:** Markets pull industry and innovation towards the top and right of the emergence matrix, at this stage the industry and innovation are able to drive growth from commercial interest.
- ▶ **Transition:** The overlap between investment pushes and market pulls, characteristic of an innovation being introduced successfully to early adopters.
- ▶ **Niche technology:** A highly sophisticated level of innovation which currently has limited use-cases, as the industry lacks sufficient maturity.
- ▶ **Established industry:** A matured industry with limited opportunities for creating or capturing new value characterized by low ROI for R&D investments.
- ▶ **S-curve:** The expected level of innovation for the given level of industry maturity. The area above the S-curve suggests that innovation is exceeding the expected capability level for an industry at that maturity level.