

# **The Prince Edward Island Bioscience Cluster Economic Impact Analysis**

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February 2020

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## Acknowledgements

*This report was prepared for the Prince Edward Island BioAlliance with the financial support of the Atlantic Canada Opportunities Agency and Innovation PEI.*

## Executive Summary

The Prince Edward Island bioscience cluster is an important economic development initiative not only for the province but for all Atlantic Canada. It is an example of how a jurisdiction can leverage its post-secondary education institutions, research capacity and other assets and attributes into a highly successful cluster through collaboration. Fundamental to this success has been the ability of the cluster to attract entrepreneurs, investment and highly qualified talent from outside the province.

The table shows the summary economic impacts arising from the cluster in 2018. The combined output of the firms and institutions in the cluster was \$405 million – an increase of 95 percent since 2012<sup>1</sup>. This output (revenue/expenditures on the Island) resulted in a provincial gross domestic product (GDP) contribution of \$282 million. This includes direct, supply chain and induced economic activity (defined in Section 1.2 below). There were 2,943 jobs supported by the cluster in 2018 (full time equivalent, or FTE) or one out of every 28 workers on the Island. These workers earned \$151 million in labour income which, in turn, resulted in over \$113 million worth of consumer spending on the Island.

The well above average wage jobs and other spending led to the cluster generating an estimated \$63.6 million in tax revenue for local, provincial and federal governments. An estimated \$31.2 million of this tax revenue went to the provincial government and \$6.5 million to local government on the Island.

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### PEI Bioscience Cluster Economic Impact Summary

<u>Indicator:</u>	<u>Economic impact:</u>	<u>Context:</u>
Direct bioscience cluster output:	\$405 million	Up 95% since 2012 <sup>1</sup> .
Direct provincial GDP contribution:	\$214 million	
Total GDP contribution (includes indirect and induced effects):	\$282 million	Up 83% since 2012. Now 4.4% of the entire provincial economy.
Direct employment (FTE*):	1,968	Up 72% since 2012.
Total employment (FTE):	2,943	1 out of every 28 workers on PEI.
Direct labour income supported:	\$120 million	
Total labour income supported:	\$151 million	Up 47% since 2012. \$1 out of every \$23 of all employment income on the Island in 2019.
Taxes generated by the cluster on PEI**:	\$63.6 million	Up 94% since 2012.
<i>Provincial:</i>	<i>\$31.2 million</i>	
<i>Local:</i>	<i>\$6.5 million</i>	
Consumer spending on PEI***:	\$113 million	Up 47% since 2012.

*\*Full time equivalent employment. \*\*This does not include an estimate of corporate income taxes paid.*

*\*\*\*induced as a result of the labour income generated by the bioscience cluster.*

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<sup>1</sup> Capital expenditure impacts were not modelled in the previous report. Therefore, any comparisons between this report and the previous one exclude capital expenditure impacts.

## Executive Summary (cont.)

The bioscience cluster has many important economic attributes. It is a driver of export revenue bringing money from outside the province that in turn is spent on local goods and services. The cluster is now a top driver of economic activity on the Island generating more GDP than the tourism sector or the fishing sector. Importantly, it is fast-growing and one of the reasons why the PEI economy has out-paced the other three Atlantic Provinces in recent years.

In summary, the PEI bioscience cluster is:

- Now **one of the most important export-led sectors of the provincial economy** directly contributing \$214 million in GDP to the provincial economy in 2018. Including indirect and induced economic impacts, the total GDP contribution in 2018 rose to \$282 million.
- The **bioscience cluster now accounts for 4.4 percent of the entire provincial economy** - a larger GDP impact than tourism, or fishing or the transportation equipment manufacturing sector.
- **Bioscience-related GDP swelled by 83 percent** between 2012 and 2018 – 3.8 times faster than the overall economy.
- Much **larger than Ontario’s MaRS bioscience cluster** in relative impact. Adjusted for the size of the provincial economy and workforce, the PEI bioscience cluster has more than 10x the impact on PEI as does the MaRS District in Ontario.
- A high value industry employing highly skilled and well-paid workers. The **average employment income across all workers in the bioscience cluster is 44 percent higher** than the average for all workers on the Island. The bioscience cluster employs directly 2.5 percent of the provincial workforce and with indirect and induced impacts, 3.8 percent of the total - or one out of every 28 workers on the Island.
- A **top source of international exports** for the PEI economy. Just 13 firms in the bioscience cluster exported over \$186 million worth of products internationally in 2018, or an amount equivalent to 12 percent of the value of all international exports from the Island.
- A **driver of innovation**. A survey of PEI bioscience firms revealed that 26 of them spent more than \$19 million on research and development in 2018. This represented an investment in R&D of more than eight percent of the firms’ revenue. These firms had 70 active patent applications and 73 granted patents as of December 31, 2018.
- A **magnet for international talent**. Among the PEI bioscience firms surveyed in 2018, there were 26 founders from outside Canada. Forty-three percent of the 30 bioscience firms surveyed had at least one founder who was not born in Canada.
- **Attracting national and international investment** to PEI. The surveyed bioscience firms raised \$37 million in new private capital in 2018.
- Providing a **good return on the investment of public dollars**. The bioscience cluster on PEI generated an estimated \$57 million worth of tax revenue for local, provincial and federal governments in 2018. In addition, for every \$1.00 of government funding (from all sources) in 2018, the 30 bioscience firms surveyed by the PEI BioAlliance raised a total \$5.31 worth of total investment.

# 1. Introduction

## 1.1 Purpose of this report

The objective of the project is to estimate the economic contribution of the bioscience sector to the Prince Edward Island economy including direct, indirect, and induced economic activity. This report provides data on sector output and gross domestic product (GDP) as well as employment, employment income, taxation and consumer spending. In addition, the report includes a broader set of data to tell the story of the contribution the PEI Bioscience Cluster makes to the Island economy. It is an update to a similar economic impact assessment completed in 2014, based largely on 2012 data.

The bioscience sector has emerged as one of the Island's top economic sectors. There has been substantial growth in sector revenue, GDP contribution and exports since the original report. In addition, the sector has added hundreds of well-paid and highly skilled workers. In 2018 there were 1,700 people working directly in the cluster (private and public sector) and 2,943 when adding indirect and induced as well as the impacts of capital spending on construction. In 2020, direct employment will exceed 2,000 people.

From international exports to immigration, the PEI Bioscience Cluster has become an example of how a focused effort can drive economic growth and prosperity even in smaller markets that are outside the geographic orbit of North America's big bioscience clusters. In fact, relative to the size of the provincial economy, the PEI bioscience cluster is more than 10 times larger than the MaRS District in Ontario. The industry's stakeholders, led by the PEI BioAlliance, have deliberately internationalized the cluster and as a result it is attracting firms, talent, investment and technology from around the world.

This report also briefly discusses the value proposition for the PEI Bioscience Cluster. The 'case' for this sectors' investment on the Island has been significantly strengthened in recent years due to strategic investments in research and support infrastructure and cluster development. As measured by international exports per capita, PEI is now one of the most important exporters of bioscience-related products among the 10 provinces across Canada.

## 1.2 The economic impact model

The primary purpose of this report is to develop an economic impact model estimating the contribution of the bioscience cluster to the economy of Prince Edward Island. The economic impact model is based on Statistics Canada's Input-Output (I-O) tables that provide a detailed profile of how expenditures in specific sectors flow through the provincial and national economy as well as by international trade. The I-O tables are developed using actual spending patterns within specific industries and provinces and therefore estimates of new economic activity are based on the expenditure profile of previous activity in those industries. If there is reason to believe a certain project will dramatically deviate in its expenditure profile, the efficacy of the Input-Output tables as predictor of economic impact should be called into question. There is no reason to believe this is the case with the firms and industries reviewed in this report.

The economic impact model evaluates the direct, indirect, and induced economic impacts of both the annual operating expenditures related to the cluster and its capital expenditures, using the following parameters:

- *Direct impact* measures the value added to the economy from the industry that is attributed directly from the employees, the wages earned, and the revenues generated. In certain cases, direct impacts are not published by Statistics Canada due to privacy considerations.
- *Indirect impact* measures the value-added the bioscience sector generates within the PEI economy through the firm and organizational demand for intermediate inputs or other support services (e.g. the supply chain).
- *Induced impacts* are derived when employees in the aforementioned industries spend their earnings and owners spend their profits. These purchases lead to more employment, higher wages, and increased income and tax revenues, and can be felt across a wide range of industries.

The I-O tables trace the impact of economic activity (output shock) on the provincial and national economies (including imports and exports). In addition to the output, GDP and employment impacts, the economic impact model estimates the amount of tax revenue generated by the industry as well as consumer spending impacts.

**Table 1: The Economic Impact Model**

Direct effect -within province (where available)	Simple multipliers (direct and indirect) - within province and rest of Canada	Total multipliers (direct, indirect and induced) - within province and rest of Canada
⇒ Output	⇒ Output	⇒ Output
⇒ GDP basic price	⇒ GDP basic price	⇒ GDP basic price
⇒ Labour income	⇒ Labour income	⇒ Labour income
⇒ Jobs	⇒ Jobs	⇒ Jobs
⇒ International imports	⇒ International imports	⇒ International imports
⇒ Export shares		

There are over 200 industries for which detailed I-O data is available. Each firm and organization in the PEI Bioscience Cluster has been assigned to its most relevant industry classification (using the NAICS classification system<sup>2</sup>) and the spending of those organizations has been analyzed to determine economic impacts. Because many firms in the cluster are pre-production or research and development intensive, they are classified in the economic impact model as being in an R&D phase. This is an important distinction because the multiplier effects can be significantly different depending on how the firms are classified.

Finally, it is important to point out that no company-specific information is included in this report nor can it be inferred from the data. The report is meant to derive the overall economic impact of the bioscience sector on PEI.

<sup>2</sup> North American Industrial Classification System (NAICS).

## 2. The PEI Bioscience Cluster: Summary profile

The Prince Edward Island Bioscience Cluster now includes over 50 bioscience companies, several research institutions, is home to Emergence – Canada’s Virtual Bioscience Business Incubator, and Natural Products Canada , Canada’s Centre of Excellence for Commercialization of Natural Products.

The PEI Bioscience Cluster at a Glance (2018):

- ✓ Seven research organizations
- ✓ Over \$200 million in revenue
- ✓ \$70 million in R&D expenditures (public and private sector)
- ✓ Over \$30 million in follow on investment in 2018
- ✓ More than 50 firms including 22 in human health, 12 in contract services, seven in animal health, six in fish health, five in diagnostics and two in medical device manufacturing
- ✓ Offering a wide variety of career opportunities in areas such as scientific research (28% of all jobs), quality assurance/control (11%), production/engineering (35%) and business administration/management jobs (26%)<sup>3</sup>.
- ✓ Three post-secondary institutions turning out talent and supporting research
- ✓ Two business incubators/ accelerators supporting new startup companies and innovation

The cluster has matured over the past decade and many strengths including:

- ✓ Financing that understands the bioscience industry including private sector funders such as Build Ventures and Island Capital Partners, and public sector support through Finance PEI, Innovation PEI, NRC-IRAP, and the Atlantic Canada Opportunities Agency.
- ✓ Incubation, acceleration, and scale-up support including National Research Council, BIO FOOD TECH and Canada’s Smartest Kitchen (Holland College) to support research in food and bioscience industries; and the Emergence Bioscience Business Incubator to support startups and growth stage companies.
- ✓ Research support from institutions such as the University of Prince Edward Island and Atlantic Veterinary College, the Charlottetown R&D Centre of Agriculture and Agri-Food Canada, the National Research Council (NRC) and from private sector firms including Atlantic AgriTech Inc., the Centre for Aquaculture Technologies Canada, CNS CRO and Synapse Applied Research and Industry Services (UPEI).
- ✓ Professional services such as IP and patent development, specialized legal services, accounting and insurance services.
- ✓ Talent development including three post-secondary education institutions, BioTalent Canada and Skills PEI.
- ✓ Networking and social events and international conferences.

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<sup>3</sup> Based on a survey of firms conducted by the PEI BioAlliance.



### 3. Economic impact analysis of the PEI Bioscience Cluster

#### 3.1 Economic impact model parameters

The PEI BioAlliance provided 2018 data on firm and organization employment and ‘output’ – defined as either total revenue (for established firms and organizations) or total expenditures (for pre-commercial firms). Using input from the BioAlliance, the firms and organizations were segmented into appropriate four-digit NAICS industry groups to provide an accurate assessment of their economic impact.

Table 2 shows a list of industries used in the model. There are over 50 private sector firms and a number of research and third-party entities supporting the cluster including the PEI BioAlliance, Atlantic Veterinary College, Bio Food Tech, Agriculture & AgriFood Canada, National Research Council, UPEI-Science Faculty, Holland College-Bioscience Technology and Canada’s Smartest Kitchen. The impact of capital expenditures was also captured in the model. It was assumed that \$30 million of the \$36.8 million worth of capital expenditures went towards construction activity.

**Table 2: Industries used in the economic impact model**

*NOTE: Each of the individual firms or organizations in the cluster are assigned to a specific industry listed in this table and the multipliers associated with that industry are applied to the firm’s output/spending on PEI.*

<u>Industry code:</u>	<u>Description:</u>
BS325400	Pharmaceutical manufacturing
BS333100	Manufacturing of bioscience-related equipment
BS339100	Medical device manufacturing
BS112500	Aquaculture
BS111A00	Crop production
BS111CLO	Cannabis production
BS339900	Other miscellaneous manufacturing
BS541600	Technical consulting services
BS541600	IT services
BS541700	Research and development
BS541700	Federal research facility
BS813000	Professional organizations
GS611200	Post-secondary education

Once segmented into their proper industry group, each firm was analyzed to determine its indirect and induced employment on PEI; direct, indirect and induced gross domestic product (GDP) impact and other impacts.

### 3.2 PEI Bioscience Cluster: Economic impacts

The PEI bioscience cluster has been growing fast in both the number of firms and the direct employment supported by the cluster. Figure 1 shows the increase in the number of bioscience firms in the past few years. Between 2012 and 2018, the number increased by 67 percent.

Figure 2 shows the trend in direct bioscience-related employment including related post-secondary education intuitional employment, research and development organizations and other cluster support activity. Total employment rose by 68 percent between 2012 and 2018 and increased again in 2019 by another 10% (based on a recent survey by the PEI BioAlliance).

Table 3 below provides the summary economic impact profile of the PEI bioscience cluster. It is broken down into three broad segments including:

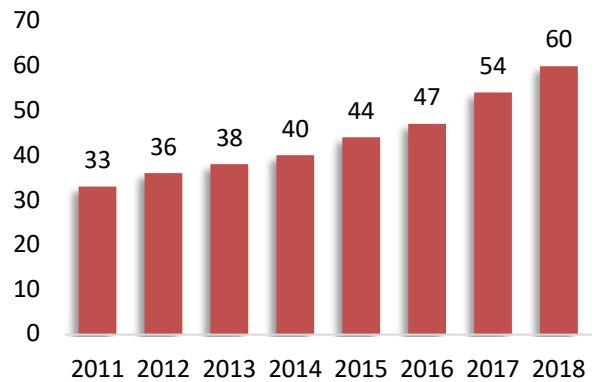
- Private sector: Includes all private sector firms in the cluster with expenditures on PEI in 2018.
- Education and training: Includes selected bioscience-related programs from Holland College, the Atlantic Veterinary College and UPEI Science.
- Cluster support: Includes research support (i.e. UPEI Research Services, NRC, AAFC (Research), BFTC, CSK, PEI BioAlliance, etc.).

The private sector generated \$288 million worth of output<sup>4</sup> in 2018 or 71 percent of total cluster economic activity. The education and training segment of the cluster accounted for \$54 million worth of activity or 13 percent of total cluster output, cluster support activities accounted for six percent and capital spending made up the rest of the economic activity accounting for nine percent of the total. Figure 3 shows the percentage breakdown of cluster output by broad segment.

Some of the output is accounted for by national and international imports and some of the firms' profits are spent off Island. As a result, the net economic activity, or provincial gross domestic product (GDP) on the Island from this output, was an estimated \$282 million in 2018. This includes the amount that firms and organizations spent on local suppliers and on capital investments as well as the impact of labour income being spent in communities across the Island.

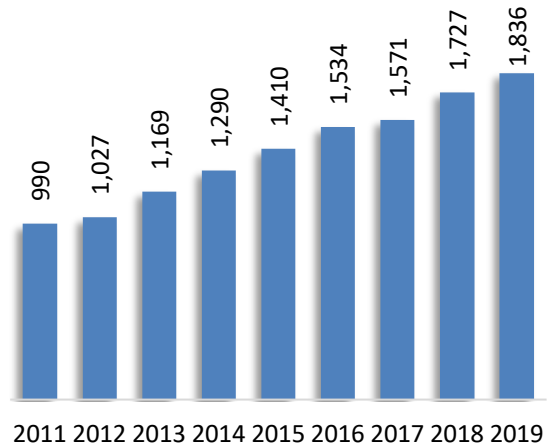
<sup>4</sup> Some of the firms are pre-revenue or generate less revenue than total expenditures as they are in startup mode. Their expenditures were captured in the model.

**Figure 1: Growth in the number of bioscience cluster firms\***



\*Some of these firms are pre-revenue. Source: PEI BioAlliance.

**Figure 2: Growth in bioscience-related employment\***

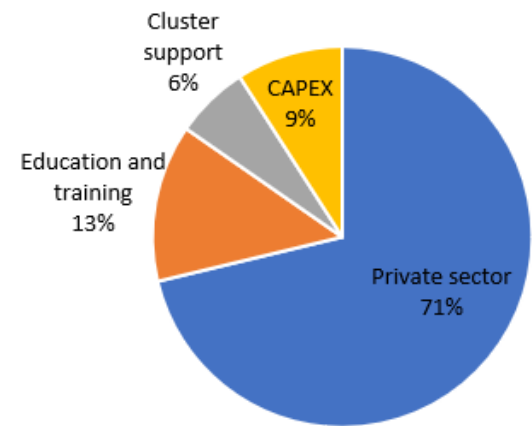


\*Direct jobs in the firms and organizations in the cluster. Indirect (supply chain) and induced employment is developed in Table 3. Source: PEI BioAlliance.

The private sector GDP was slightly lower than its output share at 63 percent of the total. This is because many of the firms are importing goods and services used to produce the products in the province they then take to market. The education providers and cluster support organizations rely on less import revenue. The education and training sector generated 19 percent of cluster GDP in 2018, the cluster support segment accounted for nine percent and capital spending for another nine percent of the total.

Because of the impact of imports, the PEI bioscience cluster also creates a considerable amount of economic benefit outside the province, elsewhere in Canada. For example, the pharmaceutical and medicine manufacturing sector generates 72 cents worth of GDP *on the Island* for every dollar of industry output. Across Canada, pharmaceutical and medicine manufacturing on PEI generates \$1.06 worth of GDP for every dollar in output. This means that every dollar spent in this sector on PEI generates *34 cents in economic benefit elsewhere in Canada* resulting in jobs and tax revenue in other provinces. These economic benefits are not quantified in this model but are worth noting. The PEI bioscience cluster has a long supply chain outside the province and other jurisdictions, led by Ontario, are also benefitting.

**Figure 3: Breakdown of the bioscience cluster by output in 2018 (% of total)**



CAPEX = Capital investment in facilities construction and equipment during 2018.

**Capital investment activity:** The economic impact model includes an analysis of how the \$36.8 million worth of capital investment during 2018 impacted the provincial economy. The model assumes that \$30 million of this spending went towards construction activity and the remaining amount towards equipment and other purchases. The differentiation is important as construction activity generates significant economic activity on the Island whereas the purchase of equipment and technology – mostly produced outside the province – generates limited economic activity from expenditures.

## Employment

One of the most important benefits of the bioscience cluster is the above average wage, high value jobs that it creates on the Island (this theme is developed further later in this report). In 2018, the cluster supported over 1,700 jobs directly in its private sector firms, related education/research activity and cluster support. With supply chain and induced effects, the total employment supported rises to nearly 2,600. In the economic impact model, the employment is shown as full-time equivalents (FTEs) as some of the workers, including students and interns, are part time or part year workers. The bioscience cluster employs directly 2.2 percent of the provincial workforce and with indirect and induced impacts, 3.4 percent of the total - or one out of every 29 workers on the Island.

**Table 3: PEI Bioscience Cluster – Economic Impact Summary (2018)**

	Private sector	Education and training	Cluster support	CAPEX	Total Cluster
<b>Output:</b>	\$288,432,000	\$54,122,000	\$25,423,000	\$36,800,000	\$404,777,000
<b>Gross Domestic Product (GDP):</b>					
Direct	\$136,877,000	\$40,923,000	\$19,430,000	\$16,740,000	\$213,970,000
Direct and indirect	154,023,000	45,482,000	21,982,000	\$20,250,000	241,737,000
Total	176,077,000	53,696,000	26,356,000	\$25,380,000	281,509,000
<b>Labour income:</b>					
Direct	\$64,960,000	\$26,266,000	\$15,651,000	\$12,990,000	\$119,867,000
Direct and indirect	75,458,000	28,760,000	17,445,000	\$15,150,000	136,813,000
Total	83,627,000	31,820,000	19,124,000	\$16,680,000	151,251,000
<b>Jobs (FTE):</b>					
Direct	1,131	396	177	264	1,968
Direct and indirect	1,483	450	220	307	2,460
Total	1,787	541	266	349	2,943
<b>Taxes induced:</b>					
All government	\$37,275,000	\$12,574,000	\$7,418,000	\$6,299,396	\$63,566,396
Federal	15,089,000	5,178,000	3,063,000	2,601,576	25,931,576
Provincial	18,488,052	6,079,978	3,571,930	3,024,478	31,164,438
Local	3,697,948	1,316,022	783,070	673,342	6,470,382
<b>Total consumer spending:</b>	\$62,597,000	\$23,818,000	\$14,315,000	\$12,485,578	\$113,215,578
Food expenditures	9,392,000	3,574,000	2,148,000	1,873,491	16,987,491
Shelter	15,763,000	5,998,000	3,605,000	3,144,290	28,510,290
Transportation	14,359,000	5,463,000	3,284,000	2,864,313	25,970,313
Health and personal care	4,475,000	1,703,000	1,023,000	892,263	8,093,263
Recreation	3,356,000	1,277,000	768,000	669,851	6,070,851

See Appendix A for more information on sources.

### Labour income

The average employment income across all workers in the bioscience cluster is 44 percent higher than the average for all workers on the Island. These above-average wage, high value jobs resulted in \$151 million worth of labour income on the Island. This labour income is, in turn, spent in a broad variety of sectors across the economy boosting construction activity, retail sales, food services and other spending activity. Importantly, many small businesses benefit as this labour income is spent each year across the province.

## Taxation

The firms and organizations in the cluster and their employees induce a significant amount of tax revenue for governments. The economic impact model estimates that combined the cluster generated \$63.6 million worth of tax revenue for all levels of government combined or an amount equivalent to 23 percent of the cluster's GDP contribution. The provincial government collected \$31.2 million or 48 percent of the total. The federal government collected \$25.9 million (41 percent) and local government collected an estimated \$6.5 million (11 percent).

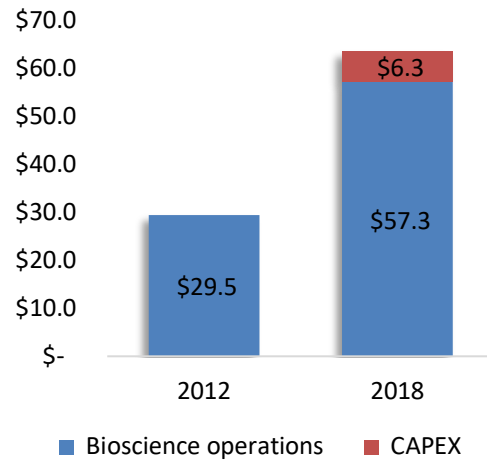
As shown in Figure 4, annual taxes generated by the cluster increased by 94 percent between 2012 and 2018 (Note: the tax impacts associated with capital expenditures were not modelled in the previous study).

## Consumer spending

A portion of the labour income generated on the Island goes to taxes, spending and other non-current consumption. However, an estimated 75 percent of the total labour income becomes consumer spending on the Island each year. This means that an estimated \$113 million worth of consumer spending on the Island was induced by the bioscience cluster in 2018. This is a nearly 50 percent increase since 2012. Table 3 shows the estimated spending by summary category including \$17 million on food, \$29 million on shelter, \$26 million on transportation, \$8 million on health and personal care and over \$6 million on recreation. These estimates assume that labour income induced by the bioscience cluster is spent in a similar pattern to the average household on the Island.

Statistics Canada tracks nearly 300 different household expenditure categories. Assuming labour income induced by the bioscience cluster is spent in a similar pattern to the average household on the Island, Table 4 shows how the bioscience cluster impacted a few specific sectors of the consumer economy in 2018. The province's dentists and eye care professionals benefitted from \$1.3 million worth of activity as a result of the cluster. Vehicle dealers and related firms generated more than \$11 million worth of revenue. Telephone and Internet service providers benefitted from over \$5 million worth of spending in 2018.

**Figure 4: Tax revenue induced by the PEI bioscience cluster (\$millions)**



Source: 2012 taxes generated data taken from a study prepared by Jupia Consultants Inc. in 2014.

**Table 4: Consumer spending induced by the bioscience cluster, selected sectors**

- Restaurants - \$3.8 million per year
- Telephone and Internet services - \$5.3 million
- Household furnishings and equipment - \$4.6 million
- Clothing and accessories - \$5.7 million
- Vehicle purchases - \$11.3 million
- Insurance premiums and services - \$8.4 million
- Dental and eye care services - \$1.3 million

\*see Appendix A for more information on sources.

## 4. The bioscience cluster and PEI's prosperity

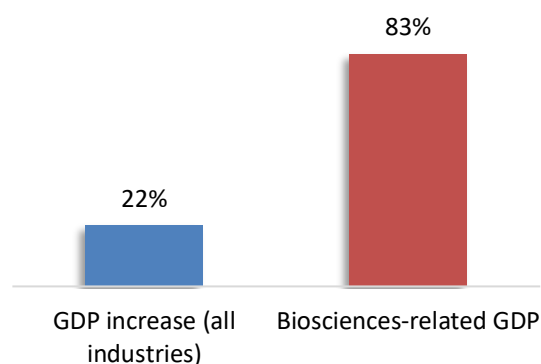
### The PEI bioscience cluster is...

#### ...now one of the most important export-led sectors of the provincial economy

The cluster directly contributed \$214 million in GDP to the provincial economy in 2018. Including indirect and induced economic impacts, the total GDP contribution in 2018 rose to \$282 million. Bioscience-related GDP swelled by 83 percent between 2012 and 2018 – 3.8 times faster than the overall economy as shown in Figure 5.

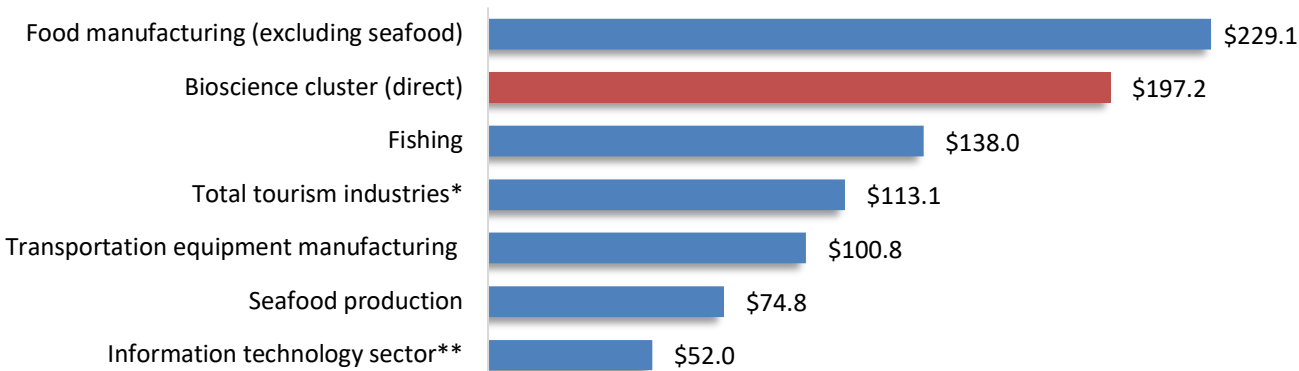
The bioscience cluster now accounts for 4.4 percent of the entire provincial economy - a larger GDP impact than tourism, fishing and the transportation equipment manufacturing sector. Figure 6 shows the current dollar GDP figure for selected sectors of the economy. For all sectors in the chart, just the direct economic activity is shown. Indirect and induced economic activity would boost all of these sectors further. Other sectors of the economy not shown in the chart are larger such as health care and retail trade, but they are not export-focused.

**Figure 5: Increase in gross domestic product between 2012 and 2018\***



\*In current dollars. Excludes CAPEX spending.  
Source: All industries GDP growth, Statistics Canada Table: 36-10-0402-01.

**Figure 6: Gross domestic product (GDP), selected export-focused industries, PEI (\$millions)**



\*The most recent comprehensive data on tourism industries GDP published by Statistics Canada is for 2014. It includes tourist only expenditures related to transportation, accommodations, food and beverage, recreation and related travel services.

\*\*This does not include the communications sector which is primarily related to local telephone, Internet and television services on the Island.

Shown in current dollars for 2016 except tourism (2014) and the bioscience cluster (2018).

Source: Statistics Canada Tables 36-10-0402-01 and 24-10-0042-01.

## The PEI bioscience cluster is...

### ... much larger than Ontario's MaRS Discovery District in relative impact.

Just how important is the bioscience cluster to the Prince Edward Island economy? For comparison its impact is much greater than other bioscience clusters relative to the size of the economy.

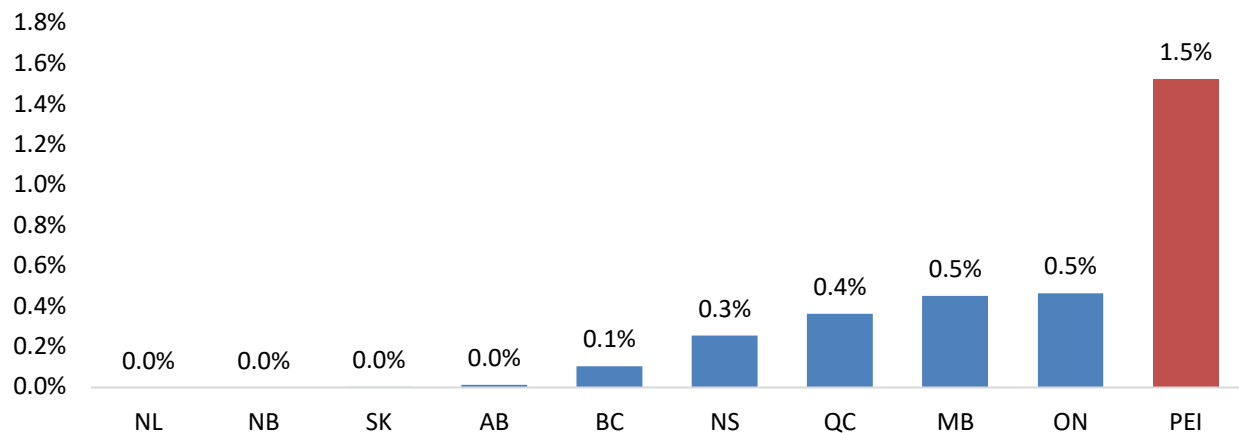
For example, the MaRS District in Ontario claims to be the largest “urban innovation hub” in North America<sup>5</sup> with more than 120 tenants including companies, research organizations and support firms. An economic impact assessment completed several years ago suggests that MARs will support 7,000 jobs and generate \$1.2 billion in provincial GDP each year between 2014 and 2024<sup>6</sup>.

These are impressive numbers, but they only represent less than 0.2 percent of provincial GDP and only 0.1 percent of total employment across Ontario. By contrast, the PEI bioscience cluster generates 4.4 percent of provincial GDP (through direct, indirect and induced effects). Just the direct GDP contribution represents over three percent of provincial GDP.

Another large North American bioscience cluster is found in Los Angeles County, California. A recent study found the cluster supported 1.6 percent of the county's total GDP and 1.2 percent of total employment (through direct, indirect and induced effects) again, relative to the size of the economy, a much lower impact than the bioscience cluster on PEI.

Another way to look at this is the impact of specific segments of the bioscience cluster on the economy. Figure 7 shows the share of provincial GDP arising from the direct activity of the pharmaceutical and medicine manufacturing sectors in each province across the country. This sector generates three times as much GDP on PEI as either Ontario, Manitoba or Quebec.

**Figure 7: Gross domestic product (GDP) from pharmaceutical and medicine manufacturing, as a percentage of total provincial GDP (2018)**



Source: Statistics Canada Table: 36-10-0402-01.

<sup>5</sup> [www.Marsdd.com/about/](http://www.Marsdd.com/about/)

<sup>6</sup> The Economic Impacts of MaRS Activities on the Ontario Economy. The Centre for Spatial Economics.

## The PEI bioscience cluster is...

### ... a high value industry employing highly skilled and well-paid workers.

The PEI bioscience cluster requires, on average, higher skilled workers than the economy overall. This results in higher average wages in the sector. As shown in Figure 8, 56 percent of all firms offer an average wage above \$70,000 per year and only 20 percent pay an average wage of less than \$50,000 per year.

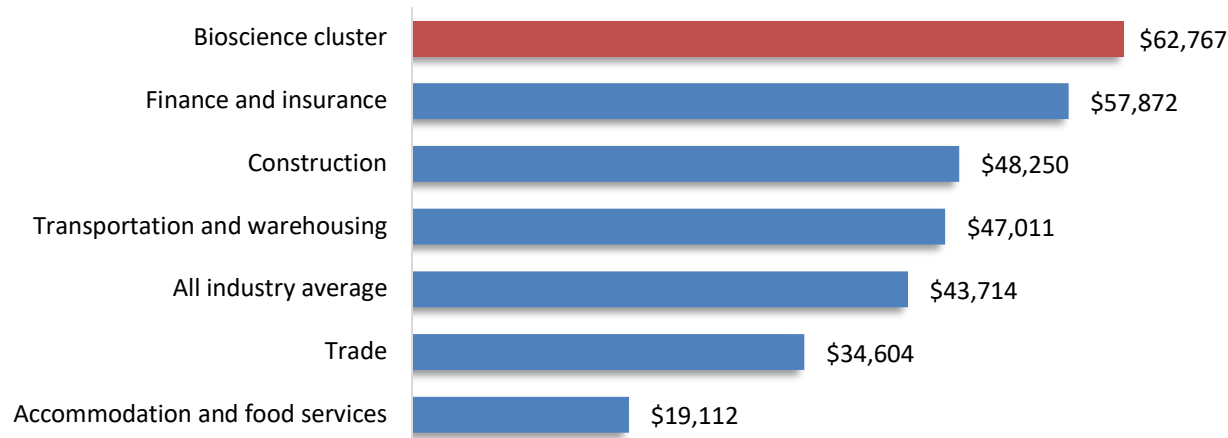
**Figure 8: Share of PEI bioscience firms by average wage level (2018)\***



Source: Survey of bioscience firms. Where payroll information not provided, the average wage for the industry was used.

As a result, the average employment income across all workers in the bioscience cluster is 44 percent higher than the average for all workers on the Island. As shown in Figure 9, the average wage for all workers is nearly \$63,000 per year which is well above the average wage in most other industries on the Island. For example, the trade sector (which includes both retail and wholesale trade) pays an average annualized wage of \$34,604 or 45 percent less than the average in the bioscience cluster.

**Figure 9: Average wage including overtime by selected sectors, PEI (2018)**

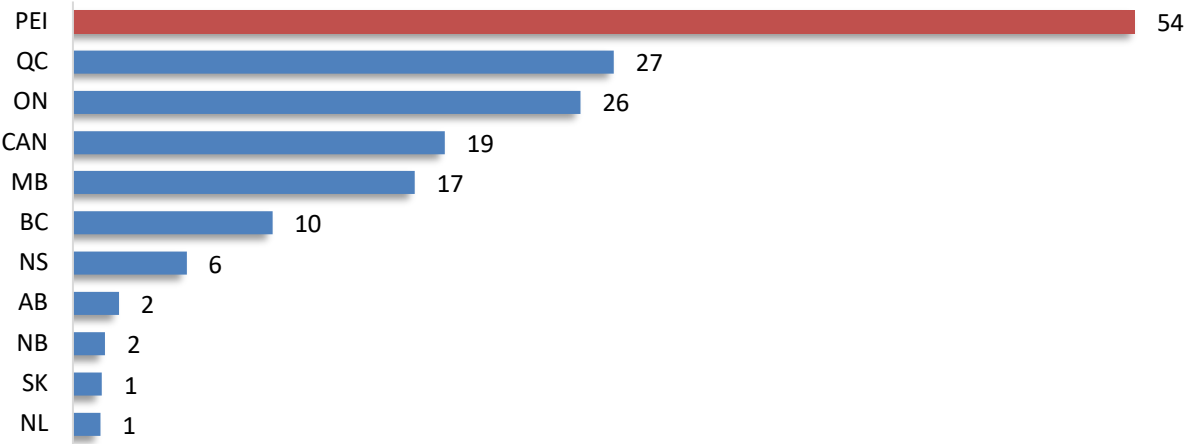


\*Average wage of firms and organizations in the bioscience cluster.  
Other sectors, source: Statistics Canada Table 14-10-0204-01.



Employment in the bioscience cluster can be found in multiple sub-sectors of the economy. Two of the main sub-sectors are pharmaceutical and medicine manufacturing and scientific research and development services. As shown in Figure 10, Prince Edward Island has the highest concentration of workers in pharmaceutical and medicine manufacturing of any province in Canada by a wide margin. Fifty-four out of every 10,000 workers on the Island work in this sector (365 in total) or twice as many adjusted for size as the next closest province, Quebec. There are nearly three times as many employed compared to the national level.

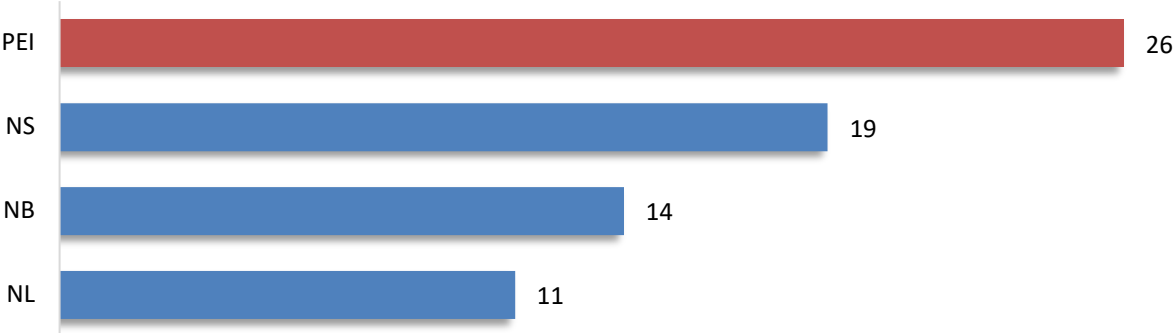
**Figure 10: Employment in the pharmaceutical and medicine manufacturing sector, per 10,000 in the overall workforce**



Source: Statistics Canada 2016 Census.

Much of Canada’s scientific research and development services sector is clustered in Ontario, Quebec and British Columbia but Prince Edward Island is moving into the top ranks for relative employment in this sector. In 2016, the Census reported that 26 out of every 10,000 workers on PEI were employed in the scientific research and development services sector (this excludes people employed in other sectors but engaged in research activity) which ranked the province 5<sup>th</sup> out of the 10 provinces for employment intensity and well above the other three Atlantic Provinces (Figure 11).

**Figure 11: Employment in the scientific research and development services sector, per 10,000 in the overall workforce**

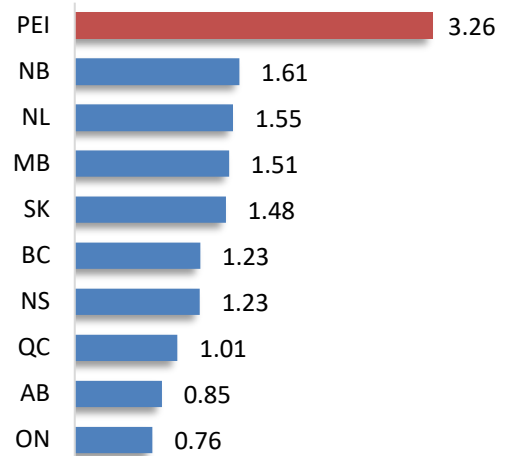


Source: Statistics Canada 2016 Census.

The same analysis can be done for employment by occupation. Figure 12 shows the Location Quotient (LQ) value for biological technologists and technicians. The LQ value compares employment intensity in specific occupational groups or industries compared to the national employment level. An LQ value greater than 1.00 means the jurisdiction has a higher concentration of employment. There are 3.5 times as many people employed as biological technologists and technicians on the Island compared to the country overall, adjusted for the size of the workforce. In fact, PEI has more employed in this occupational group than all other provinces by a wide margin, adjusted for size.

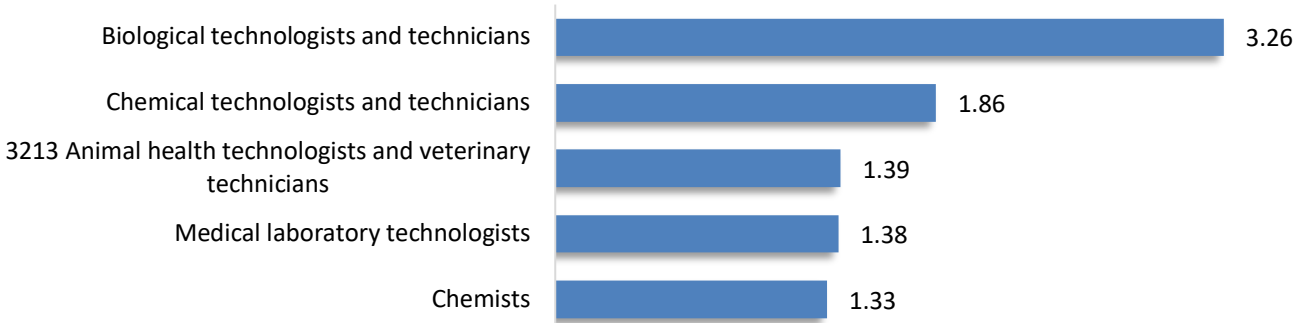
There are a number of bioscience-related occupations where PEI has a much higher concentration of workers compared to the country overall. Figure 13 shows the LQ values for five related occupations. The Island workforce has over three times as many biological technologists and technicians compared to the country overall, as a share of the workforce. There are nearly twice as many chemical technologists and technicians, 39 percent more animal health technologists and veterinary technicians, 38 percent more medical laboratory technologists and 33 percent more chemists compared to the country overall, adjusted for size.

**Figure 12: Location Quotient (LQ) for biological technologists and technicians (NOC 2221)  
Canada = 1.00**



Source: Statistics Canada 2016 Census

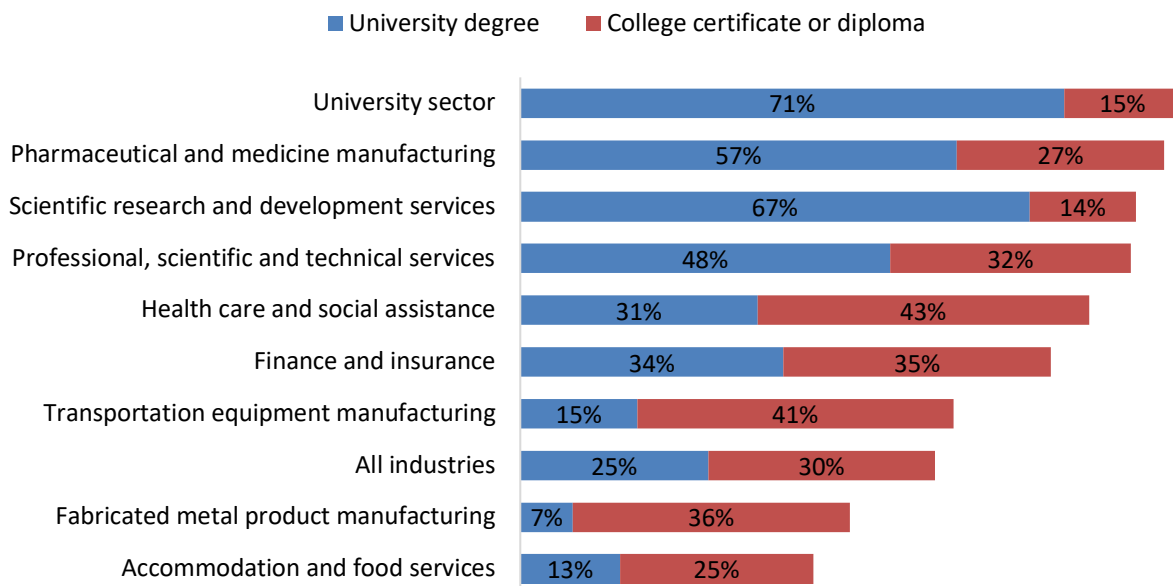
**Figure 13: Location Quotient (LQ) for selected bioscience-related occupations (Canada = 1.00)**



Source: Statistics Canada 2016 Census

Using the Census, the education profile of related sectors can be developed. As shown in Figure 14, three of the industries where the vast majority of cluster employment is concentrated (pharmaceutical and medicine manufacturing, scientific research and development services and education) have a workforce with a much higher educational attainment rate than most other sectors of the economy. Eighty-four percent of everyone working in pharmaceutical and medicine manufacturing has a university degree or college diploma which is a remarkably high share of the workforce for a manufacturing sector.

**Figure 14: Share of the workforce with a university (population aged 25-64)**



Source: Statistics Canada 2016 Census.

## The PEI bioscience cluster is...

### ...a top source of international exports for the PEI economy.

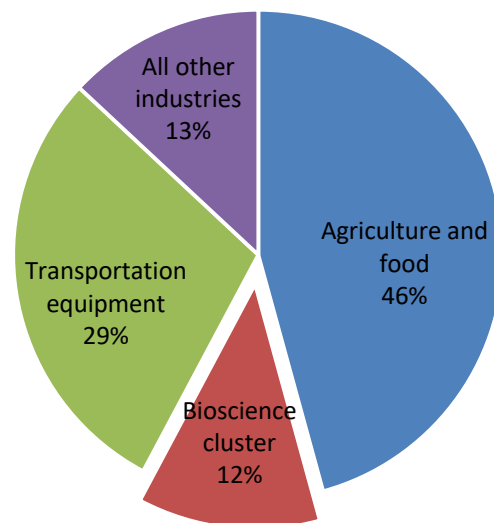
Because of its size, Prince Edward Island is a relatively large importer of goods and services. Almost all of the consumer goods and services are produced elsewhere in the world and imported into the Island for household use. To support a strong and growing economy, the Island needs to export goods and services based on the strengths, assets and attributes of the provincial economy. PEI is a relatively large exporter of potatoes, frozen food, fish and transportation equipment.

The PEI bioscience cluster has become a very important source of national and international exports. Most of the products and services being developed in the cluster are focused on global markets. The survey conducted by the PEI BioAlliance found that 13 firms in the bioscience cluster exported over \$186 million internationally in 2018, or an amount equivalent to 12 percent of the value of all international exports from the Island that year.

As shown in Figure 15, this means that bioscience is now the third most important international export 'industry' by a wide margin – accounting for almost as much export revenue as all other sectors combined (12 percent versus 13 percent for all other industries).

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**Figure 15: Breakdown of international exports by broad industry group, Prince Edward Island (2018)**

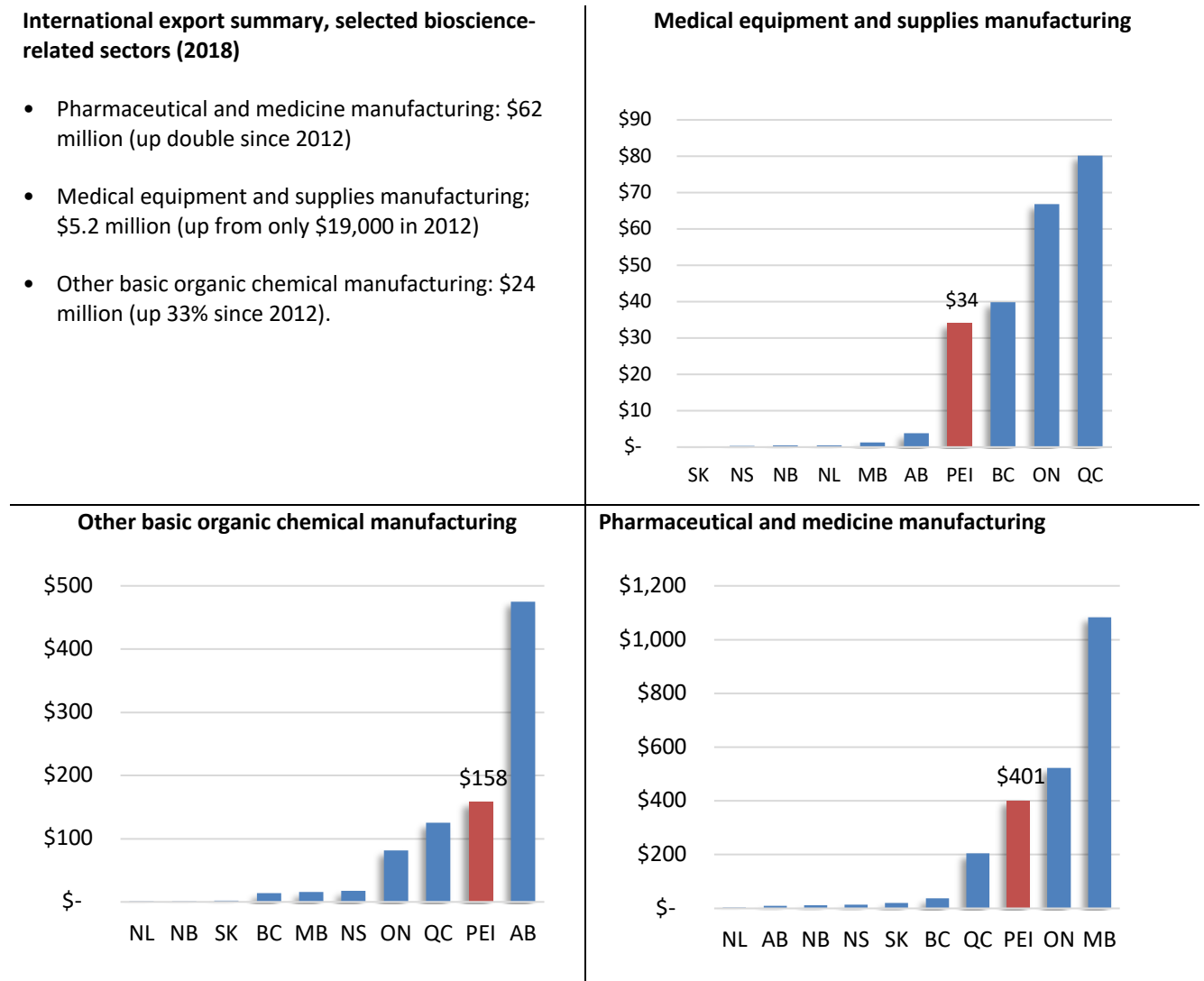


Source: All except bioscience cluster, Statistics Canada Table: 12-10-0098-01. Bioscience international exports taken from a survey of 30 bioscience firms in 2019.

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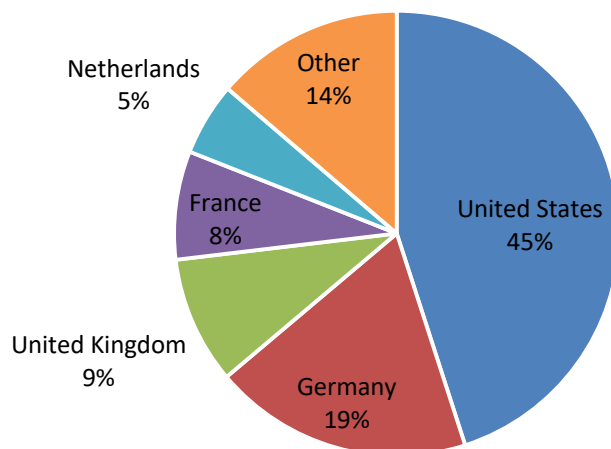
Figure 16 shows the international export revenue trends for selected sectors compared by province. The Island ranks fourth among the 10 provinces for medical equipment and supplies manufacturing per capita, second for other organic chemical manufacturing and third among the 10 provinces for pharmaceutical and medicine manufacturing exports. The figure also shows in the increase in related exports since 2012. All three of this sectors witnessed strong growth in the value of international exports between 2012 and 2018.

**Figure 16: Bioscience-related international export revenue per capita (2018), selected industries**



Where are PEI bioscience firms exporting? Using four main export sectors, pharmaceutical and medicine manufacturing, medical equipment and supplies manufacturing, other basic organic chemical manufacturing and soap and cleaning compound manufacturing combined, Figure 17 shows the breakdown of international export revenue in 2018 by country.

**Figure 17: Bioscience-related international export revenue per capita (2018), selected industries**



Source: Trade Data Online.

Finally, it is very important to note that the bioscience cluster also exports interprovincially. There is a lag in reporting time from Statistics Canada on interprovincial exports (the most recent year for data is 2016) but it does show an important source of export markets. As shown in Table 5, the pharmaceutical and medicinal products sector exported \$165 million in 2016 of which the majority went to other provinces. It is possible that some of the interprovincial exports were then exported internationally by a firm in another province.

**Table 5: Interprovincial and international exports from PEI by year (\$Millions)**

Pharmaceutical and medicinal products

	<u>2012</u>	<u>2013</u>	<u>2014</u>	<u>2015</u>	<u>2016</u>	<u>% change</u>
Interprovincial exports	\$13.7	\$68.3	\$56.6	\$126.1	\$136.4	+894%
International exports	<u>\$21.3</u>	<u>\$31.0</u>	<u>\$55.4</u>	<u>\$52.0</u>	<u>\$28.8</u>	<u>+35%</u>
Total exports	\$35.0	\$99.2	\$111.9	\$178.1	\$165.3	+372%

Source: Statistics Canada Table: 12-10-0101-01.

## The PEI bioscience cluster is...

### ...a driver of innovation.

A survey of PEI bioscience firms revealed that 26 of them spent more than \$19 million on research and development in 2018. That represented an investment in R&D of more than eight percent of revenue. These firms had 70 active patent applications and 73 granted patents as of December 31, 2018.

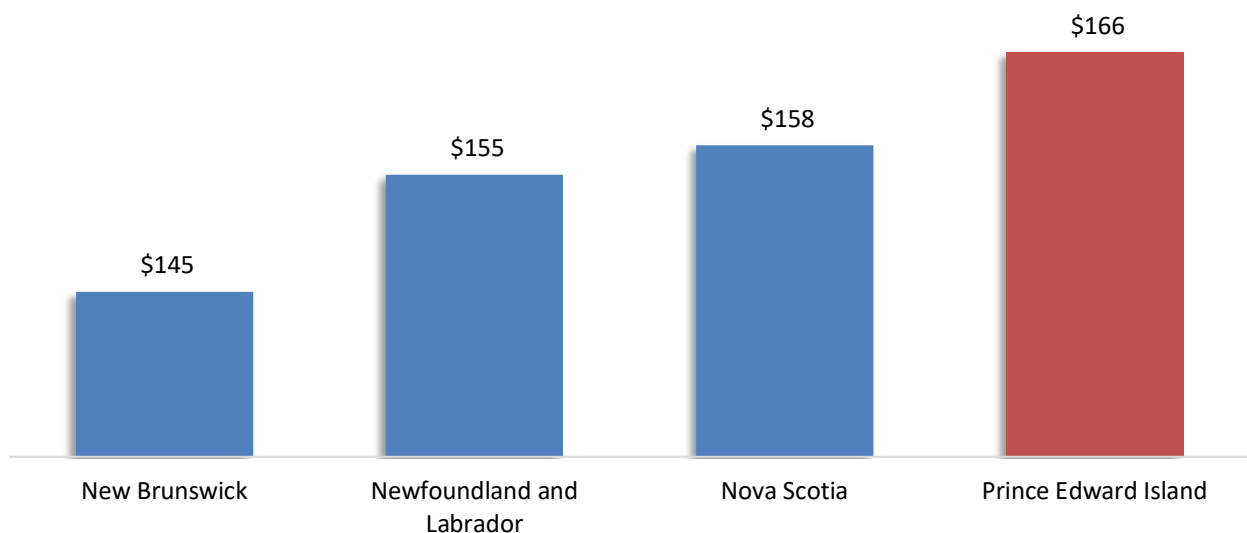
Internal firm spending on R&D is only a small share of the total amount of research activity. According to survey data gathered by the PEI BioAlliance, in 2015 the entire cluster, including academic and research organizations, spent over \$95 million on research and development.

The Statistics Canada data on research and development spending is not available on a sector-basis. Even the higher-level statistics are only available through 2016 and 2017, at the provincial level. However, this data does show the Island punching above its weight class in the area of R&D spending and personnel, and the bioscience cluster can be considered as a main driver of this activity.

In 2016, Prince Edward Island ranked ahead of Manitoba, Newfoundland and Labrador, New Brunswick, Saskatchewan and Alberta for domestic expenditures on research and development (R&D) as percentage of gross domestic product (GDP). Expenditures on R&D amounted to 1.3 percent of GDP in that year.

The private sector has boosted its share of total research and development spending on PEI from only 17.6 percent of the total in 2010 to 31.7 percent in 2016. The increase in private sector-led bioscience-related R&D is likely driving much of this increase. Another Statistics Canada table shows that total in-house research and development expenditures on the Island rose by 67 percent between 2014 and 2017 and, adjusted for population size, are higher than all three other Atlantic Provinces.

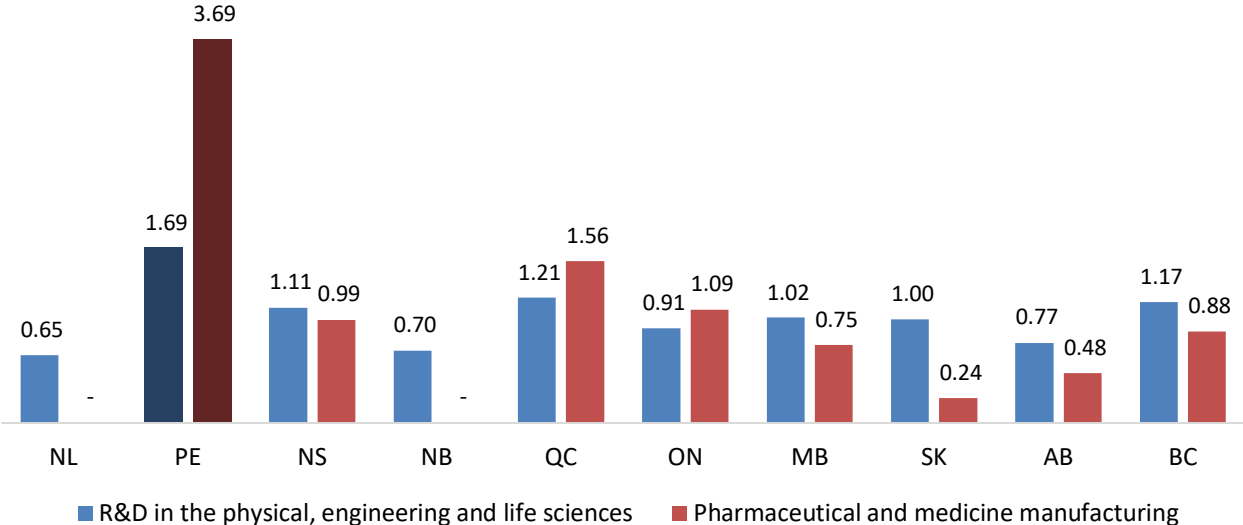
**Figure 18: Total in-house research and development expenditures per capita, 2017**



Source: Statistics Canada Table: 27-10-0341-01.

According to Statistics Canada, there are 22 firms on the Island involved in research and development in the physical, engineering and life sciences (NAICS 541710)<sup>7</sup>. While this is known to be seriously underestimated, adjusted for size, PEI still had a higher concentration of firms in this sector than any other province. The Island also has seven firms in pharmaceutical and medicine manufacturing (NAICS 325410) again, adjusted for size the highest concentration of any province in Canada (Figure 19).

**Figure 19: Concentration of firms in bioscience-related sectors (Canada = 1.00)\***



\* PEI has 3.7 times as many firms in pharmaceutical and medicine manufacturing relative to the total number of firms compared to Canada as a whole.

Source: Statistics Canada business counts, December 2018.

<sup>7</sup> Firms with employees.



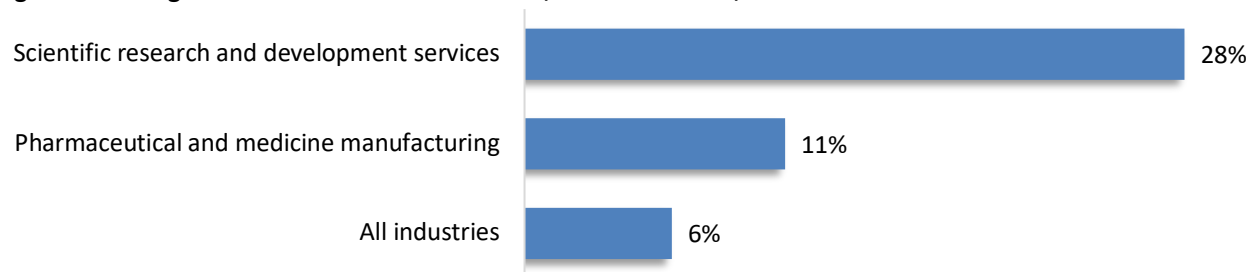
## The PEI bioscience cluster is...

### ...a magnet for international talent.

One of the most important attributes of the PEI bioscience cluster is its connectedness to the global economy and workforce. In addition to attracting global investment and fostering international exports, the cluster is attracting considerable talent from outside its borders. For example, among the PEI bioscience firms surveyed in 2018, there were 26 founders from outside Canada. Forty-three percent of the 30 bioscience firms surveyed had at least one founder who was not born in Canada. This is a remarkable share of international talent leading these bioscience companies.

Beyond company founders, the cluster is attracting a lot of immigrant talent. As shown in Figure 20, at the time of the 2016 Census, 11 percent of all workers in pharmaceutical and medicine manufacturing were immigrants, nearly double the share across the economy. In the scientific research and development services sector, 28 percent of all workers were foreign-born.

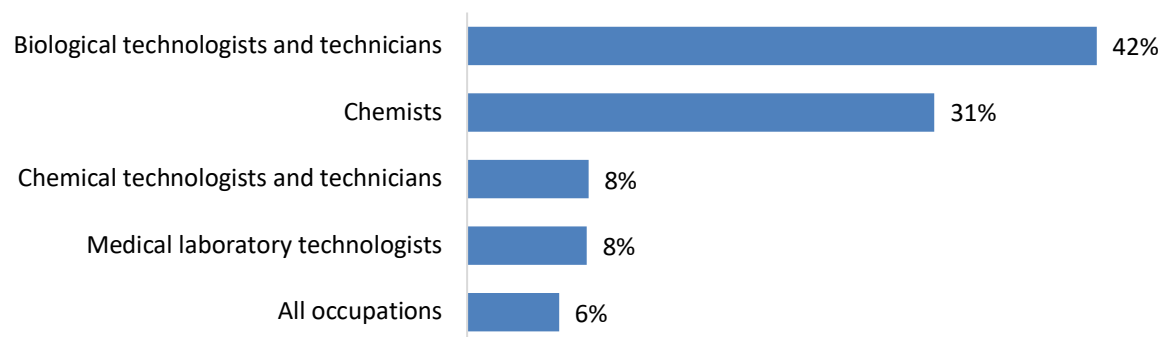
**Figure 20: Immigrants as a share of the workforce, selected sectors, PEI**



Source: Statistics Canada 2016 Census.

On an occupation basis, immigrants account for 42 percent of all biological technologists and technicians on the Island and 31 percent of all chemists (Figure 21).

**Figure 21: Immigrants as a share of the workforce, selected occupations, PEI**



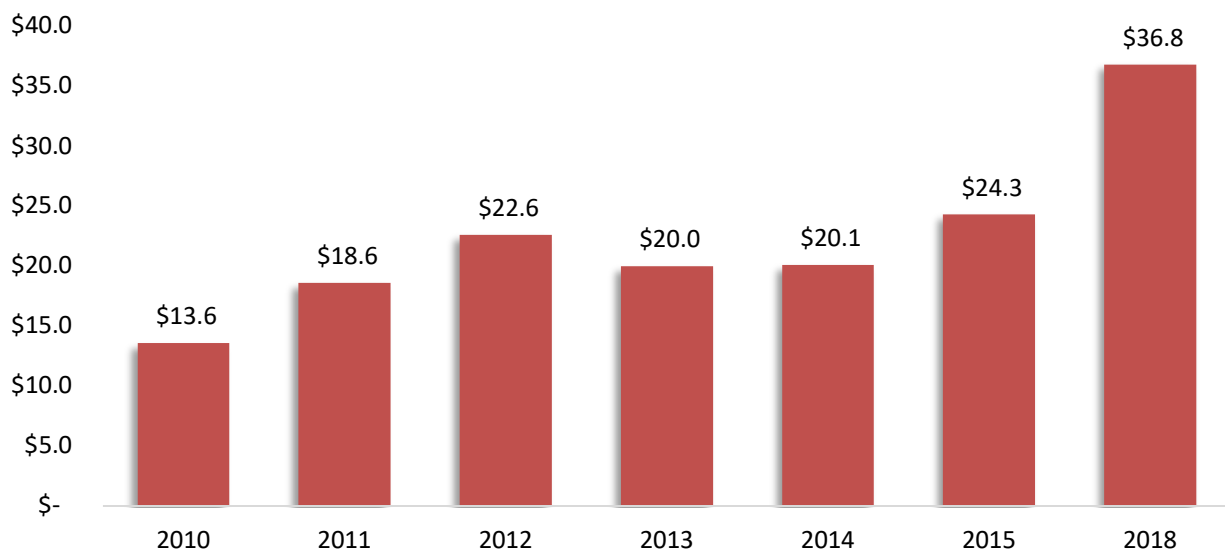
Source: Statistics Canada 2016 Census.

## The PEI bioscience cluster is...

### ...attracting national and international investment to PEI.

The PEI bioscience cluster is an important source of private and public sector investment on the Island. The private sector continues to increase its capital investment on the Island. Recently surveyed bioscience firms reporting raising \$36.8 million in new capital in 2018 up from \$24.3 million in 2015 and \$13.6 million back in 2010. The public sector has also made investments in R&D-related facilities in recent years. Governments are also strategically investing in firms that show high potential such as BioVectra which received \$37 million in federal loans for PEI and NS expansions, and Somru BioScience which received \$3.2 million from the federal government to support its research and development back in 2018.

**Figure 22: Capital investment trends, PEI bioscience firms (\$millions)**



Source: PEI BioAlliance.

## The PEI bioscience cluster is...

### ... providing a good return on the investment of public dollars.

Both the federal and provincial governments have supported the development of the PEI bioscience cluster over the last decade. These investments have led to the development of a cluster that generates substantial tax revenue to help support spending on public services and public infrastructure across the Island.

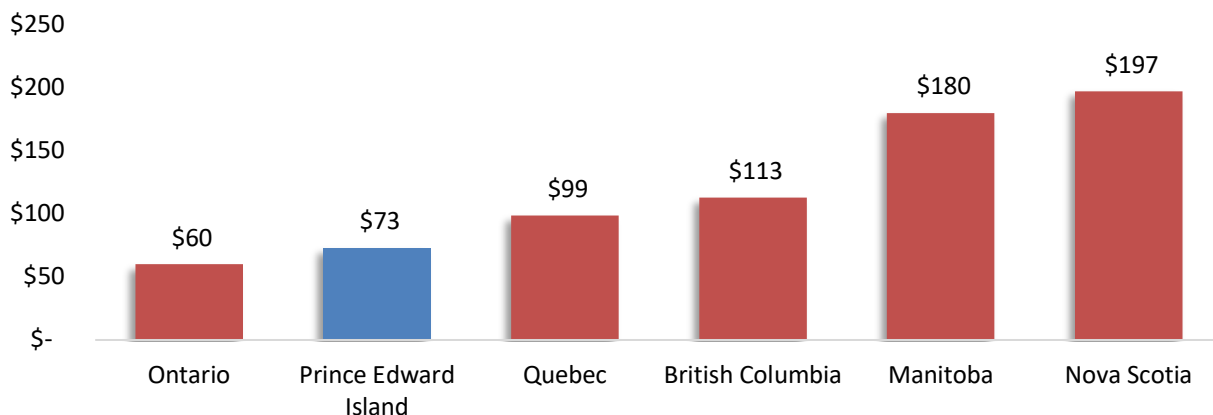
The bioscience cluster on PEI generated an estimated \$63.6 million worth of tax revenue for local, provincial and federal governments in 2018. Of this amount, an estimated \$37.6 million went to provincial and local governments.

Public investment directly into firms to help with research and development and other expenditures has been an important source of funds for the industry. This government support helps to leverage private sector funding. In a recent survey of bioscience firms by the PEI BioAlliance, companies reported generating \$37 million worth of total investment in 2018 of which \$6.9 million came for government (various federal and provincial sources). This means that for every \$1.00 of government funding (from all sources) in 2018, the 30 bioscience firms raised a total \$5.31 worth of total investment.

Statistics Canada tracks subsidies by government to industry. According to the agency, subsidies on production include “incentives paid to employers to encourage workforce development and training, or the use of other specified factors of production such as pollution abatement equipment”. Looking at this subsidy data over the most recent seven year period (2010 to 2016 is the most recent period for which published data is available), Prince Edward Island is actually at the lower end in terms of the amount of subsidies received by the pharmaceutical and medicine manufacturing industry relative to the size of industry output.

Over the 2010 to 2016 period, the pharmaceutical and medicine manufacturing industry on PEI received \$0.007 in subsidies for every \$1.00 in industrial output from that sector (or less than one cent in subsidies per dollar of output). This amounts to \$73 dollars for every \$10,000 in industry output. As shown in Figure 23, this subsidy amount was lower than all other pharmaceutical and medicine manufacturing producing provinces except Ontario.

**Figure 23: Government subsidies to the pharmaceutical and medicine manufacturing industry per \$10,000 of output (annual average 2010 to 2016)**



Source: Statistics Canada. Table 36-10-0595-01.

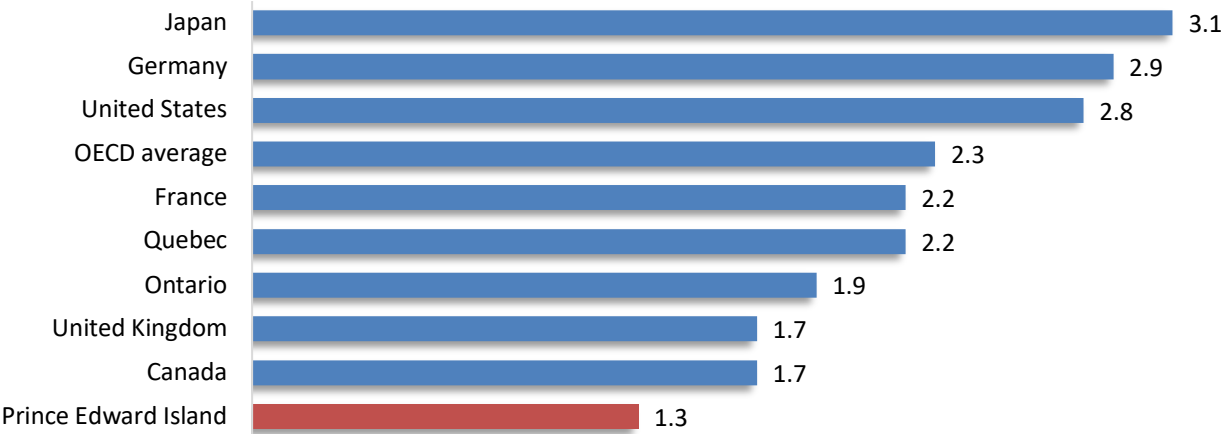
# Conclusion: Bioscience and PEI in the years to come

The bioscience cluster on PEI is an excellent example of a province combining its post-secondary education, government and other research infrastructure, coordinated by economic development intermediaries such as the PEI BioAlliance, to foster significant private sector investment through startup companies and the attraction of larger firms. This private sector activity, in turn, led to substantial export revenue for the province boosting GDP, labour income, consumer spending and tax revenues for government.

Where will the cluster go in the years ahead? There is no doubt that bioscience globally will continue to grow as the world demands advances in human and animal health and seeks to solve large and complex environmental challenges. The challenge for Prince Edward Island is that this is also a highly competitive industry with industry and governments around the world looking to attract technology innovation, talent, and investment.

The cluster needs to continue to strengthen its value proposition as it has with the development of bioscience-related incubation and acceleration services. Government needs to continue investing in early and mid-stage related research to help de-risk private sector investment just as it is in other countries. As shown in Figure 24, Canada continues to lag many of its peers in the OECD for domestic expenditures on research and development (R&D) as a percentage of GDP. The country needs to invest more, not less, and the PEI bioscience cluster is an ideal target for that investment. It has proven its ability to turn R&D into commercial products and services and the resulting economic benefits of GDP, income, jobs and taxes.

**Figure 24: Domestic expenditures on R&D as a percentage of GDP (2016)**



Source: Statistics Canada Table: 27-10-0359-01.

## Appendix A: The Economic Impact Model Sources

<u>Statistic:</u>	<u>Description:</u>
Firm-level data, employment, labour income, research spending, exports, capita investment, etc.	Supplied by the PEI BioAlliance.
Direct, indirect and induced GDP, employment and income estimates	Uses Statistics Canada Input-Output multiplier and impact estimates at the M industry level. Provincial Input-Output Multipliers, 2016. Catalogue no. 15F0046XDB. Industry Accounts Division. Statistics Canada. Sectors used in the analysis listed in Section 1 above.
Taxes induced by the cluster	<p>HST paid: Based on the ratio of HST collected to total provincial personal income in 2018 (Source: provincial budget documents and Statistic Canada).</p> <p>Personal income taxes paid Derived using several sources including Statistics Canada personal tax-related tables and its Survey of household spending (SHS) for 2017.</p> <p>Property taxes paid (from employment income) Derived using Statistics Canada CANSIM Table 203-0022 - Survey of household spending (SHS) for 2017.</p> <p>Indirect taxes Source: Statistics Canada Input-Output tables. These indirect taxes are levied on the business activity (not employment income) and include such tax areas as: business property taxes, fuel taxes, vehicle license fees, land transfer taxes, and any sales taxes arising out of the corporate activity.</p> <p>Federal and provincial corporate income taxes are not estimated in the model.</p>
Estimated consumer spending impacts	Derived using Statistics Canada Table 11-10-0222-01 - Survey of household spending (SHS) for 2017.
Average weekly wages	Bioscience cluster wages derived using firm data. General industry wages taken from Statistics Canada Table: 14-10-0204-01. Shows the annualized average weekly wage including overtime in each of the sectors.
Exports	Bioscience cluster exports for 2018 – taken from a recent survey of PEI BioAlliance members. Sector-level exports and trends taken from Statistics Canada Tables Table: 12-10-0098-01 and 12-10-0101-01 as well as Trade Data Online.